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A STUDY OF THE RELATION BETWEEN INFLATION AND EXCHANGE RATES IN THE FIJI ISLANDS: A COINTEGRATION AND VECTOR ERROR CORRECTION APPROACH

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ABSTRACT

The main purpose of this study is to examine the effects of the exchange rates, international prices, and the demand shocks on inflation in Fiji. How the domestic inflation in a pegged exchange rate system is aligned with international price shocks is an important monetarist idea, and this is tested in this study. This study employs annual data from 1975 to 2010. The multivariate cointegration tests are done after the unit root tests, and further, the Vector Error Correction (VEC) model shows that the changes in Fiji's CPI are Granger caused by the long-term trends in all other variables, and the CPI in Australia, and devaluation-year dummies are used as exogenous variables in the VEC model, and the changes in exchange rate and changes in demand shocks are the independent variables but made endogenous in the VEC model. The impulse response function also shows that due to the exchange rate depreciation, inflation has increased for many years in Fiji. The policy implication of our study is that as a monetary policy instrument, the flexibility of the exchange rate policy is indispensable for Fiji to appropriately absorb the international supply and price shocks.

JEL Classifications: E2, E2, E31, C01, C58, C32, F10
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INTRODUCTION

This paper seeks to study the impact of the exchange rate, the international prices, the demand shocks, and the devaluations done on different years, on inflation in the Fiji Islands for the years (annual data) 1975-2010 using cointegration and Vector Error Correction approach (VEC). This research paper attempts to study the effects of exchange rates on domestic consumer prices in Fiji after controlling for the effects of supply shocks represented by the foreign prices, the domestic demand shocks, and the devaluation episodes.

However, the motivation of this study is not to test the Purchasing Power Parity (PPP) theory in all its ramifications, though some implications of the PPP theory, especially the effect of exchange rates on prices may be applicable for our study of inflation in Fiji and some aspects of the PPP theory, specifically the effect of domestic prices on exchange rates may not be fully applicable to Fiji, as this country has been following a pegged exchange rate system. In the VEC model, the major research

methodology employed in this paper, the Australian consumer prices, and the devaluation-year dummy variables are used as exogenous variables. The Eviews software is used for analysis. As the focus of the study is the inflation in Fiji, some variables relevant to the PPP theory, especially the Australian prices, and the devaluation year's dummies, are not made endogenous to the system. The Australian demand variables are not even used in the study. Similar to any PPP study, the exchange rate variable is made endogenous. Our final results from the VEC model support our judgment that there is no Granger-causality from the inflation of Fiji variable to the exchange rate variable, as the exchange rate is mostly pegged exchange rate system. But how the domestic inflation, in a pegged exchange rate system will align to the international price shocks, is an important monetarist idea, which is being tested in this study. In fact, even the shocks coming from the Australian consumer prices, through the so called Balassa (1964) and Samuelson (1964) effects of higher non-tradable goods' prices from the productivity shocks in Australia, in the normal PPP framework, should cause appreciation in the Australian real exchange rates only, and by implication should depreciate the real exchange rate in Fiji. However, because the Fijian currency is also pegged to the Australian currency, this will work in the opposite direction of the real exchange rates appreciation in Fiji with increase in the nominal exchange rate value and as well as the transmission of the higher Australian consumer price shocks to the consumer prices in Fiji. This aspect is also being indirectly tested in our paper by taking the Australian consumer prices as the exogenous variable. However, unlike directly testing the Balassa (1964) and Samuelson (1964) effects which would treat the real exchange rate as an endogenous variable, we are not modeling or testing the real exchange rate of Fiji in this study.

The transmission mechanism of the effects of the exchange rates on the domestic consumer prices is described through import prices and export prices, and the domestic aggregate demand. Thus, changes in exchange rates imply changes in export and import prices, volume of exports and imports, investment decisions, and last but not least, the consumer prices. The main factors influencing the degree of pass-through are openness and size of the economy, relative elaticities of demand and supply for traded goods, macroeconomic conditions and microeconomic environment as discussed in MacFarlane (2006). The author further provides a flow chart in which the exchange rate depreciation has the direct effect through the imported inputs becoming more expensive and production costs rising and thus leading to higher consumer prices; similarly, imports of finished goods become more expensive, leading to higher consumer prices. The exchange rate depreciation also has indirect effects affecting consumer prices: the domestic demand for import substitutes rising, and the demand for substitutes and exports rising their prices, and demand for labor increases and wages increase, and finally they all lead to higher consumer prices. However, according to the 'rational expectation hypothesis' all those intermediate transmission mechanisms can be 'short-circuited' between exchange rates and domestic consumer prices. And the exchange rates changes or even the expected changes in exchange rates can directly move the domestic consumer prices before those intermediate effects on import prices and export prices.

There is another direct channel due to the operation of law of one price based on the purchasing power parity theory (PPP). It is argued that the exchange rate between two monies/ currencies is determined by the relative movements in the prices levels in

two countries. The intellectual origins of PPP began in the early 1800s, with the writing and ideas of Wheatly and Ricardo which are discussed by Cassel (1921). The Casselian approach begins with the observation that the exchange rate 'E' is the relative price of two currencies. Since the purchasing power of the home currency is 1/P and the purchasing power of the foreign currency is $1/P^*$, in equilibrium the relative value of two currencies should reflect their relative purchasing powers, $E= P/P^*$. The Casselian view suggests that the consumer price index (CPI) is typically used in the empirical implementation of the theory. However, this theory implies that the long-run real exchange rate ($q = E + P^* - P$) is constant over time which assumption may not be realistic, though mean reversion to the long-run "q" is a good possibility.

The commodity-arbitrage view of PPP, as articulated by Samuelson (1964), says that the law of one price is applicable only for all internationally tradable goods. Therefore this theory is more applicable to tradable goods only, which can be expressed in the following way:

$P = P^* E$ Where:

P = domestic currency price of imported goods

E = the exchange rate expressed as units of domestic currency per unit of foreign currency

P^* = the foreign price index.

Expressing in logarithmic form:

$\text{Log } P= \beta \log P^* + \lambda \log E$

The law of one price implies that $\beta = \lambda = 1$, that is, the changes in exchange rates completely 'pass through' to the domestic price of the traded goods.

If one accepts Samuelsson's (1964) view of the law of one price for only tradable goods, then some of his criticisms on the PPP theory through Balassa (1964) and Samuelson (1964) productivity differential between countries affecting the real exchange rate between countries, are also applicable .According to that view , the productivity mainly occurs in the tradable-good sector in the advanced countries. Therefore, the prices of tradable goods fall and those of non-tradable goods increase. To balance the current account of the balance of payments, the real exchange rate appreciates both by the consumer price increase and by the nominal exchange rate appreciation. This view of the real exchange rate appreciation is further supported by the argument that the government expenditure which largely falls on the non-tradable goods will also produce the appreciation of the real exchange rates. However, as previously mentioned, the focus of our study is not to model the real exchange rates or to model the PPP theory. How the productivity shocks in Australia, their non-tradable goods' price increases and the consumer price inflation would affect the Fiji's consumer price inflation is definitely an interesting phenomenon. This has been indirectly modeled in our analysis by taking the Australian consumer prices as exogenous to the cointegration (VEC) system.

Exchange Rate and Monetary Policy Regimes in Fiji

Fiji has been following the fixed exchange rate regime since 1975 and the Fijian dollar was linked to a basket of five currencies of its major trading partners: Australia, Japan, New Zealand, the UK and the USA. From the beginning of 2000, the British Pound was replaced by Euro. Fiji has witnessed three episodes of devaluation of its currency since 1975. In 1988 the Fijian currency was first devalued by 33 percent in order to prevent the capital outflows arisen out of two military coups in 1987. In 1998, the currency was devalued by 20 percent to withstand the pressures of the Asian financial crisis. In 2009, the devaluation of 20 percent was to cope with the global financial crisis and the subsequent world recession in 2008. The Reserve Bank of Fiji is allowing the varying the exchange rate by market forces within the band of +/- 0.07 percent of the central rate. The main exchange rate restrictions are on the capital account transactions by the residents.

Fiji's central bank, the Reserve Bank of Fiji (RBF), has two objectives: maintaining price stability and maintaining adequate level of foreign reserves. In regard to the objective of price stability, RBF seeks to keep the headline inflation low in the range between 0-3 percent. The second objective RBF seeks to maintain is an adequate level of foreign exchange reserves which shall cover at least four months of imports of goods and services.

Fiji's inflation during the first 15 years since its independence in 1970 was largely influenced by its fixed exchange rate regime as well as the country's openness, as reflected in the high ratio of imports and exports to the gross domestic product that ranges between 60 to 70 percent. Oil prices shocks in the mid-1970s accelerated inflation worldwide and Fiji was no exception. In the early 1980s, inflation declined sharply in Fiji. However, inflation rose sharply in the late 1980s, mainly because of two devaluations. Inflation was once again low in the early 1990s in concert with the rest of the world. As the central banks of Australia and New Zealand began to target for low inflation, and since Fiji's imports of consumer goods of mass consumption have been traditionally sourced from these countries, Fiji's inflation has remained low and steady.

In 1998, devaluation of Fiji's currency by 20 percent as a measure to meet the adverse impact of the Asian financial crisis resulted in a sharp rise in inflation. During the 2000 – 2010 periods, the average headline inflation was around 3.8 percent. In 2007, the inflation was about 4.3 percent. In 2008 higher import prices have raised the food prices. Inflation spiked from 5.8 percent in May 2008 to a 20-year high of 9.8 percent in September 2008, though subsequently it has fallen to 8.5 percent in October 2008. As a result of the 20 percent devaluation of Fijian dollars in April 2009, the consumer prices have reached 8 percent, increasing from 6 percent which had fallen earlier due to fall in fuel prices world over.

FIGURE 1 INFLATION TREND FOR FIJI

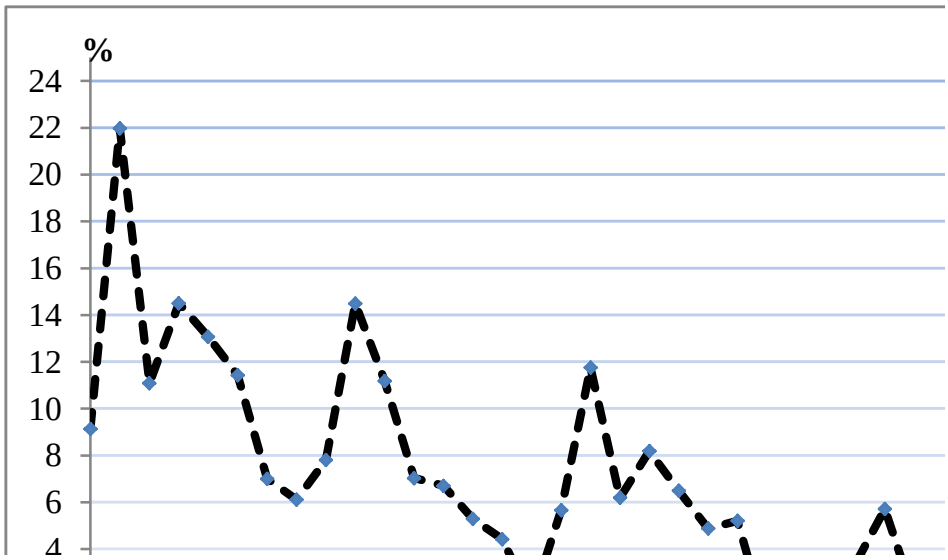


TABLE 1 INFLATION AND EXCHANGE RATES IN FIJI: 1976-2010

	Change in CPI Fiji (%)	Change in Exchange Rate (AUD/FJD)	Change in CPI Australia (%)	Change in Demand Shock (%)
1976-1980 (Avg.)	9.37	0.01	10.59	12.96
1981-1990(Avg.)	6.82	-0.02	8.13	7.47
1991-2000 (Avg.)	3.48	0.00	2.22	6.35
2001-2005 (Avg.)	2.88	-0.01	3.03	8.81
2006	2.49	-0.01	3.54	12.75
2007	4.80	-0.03	2.33	-1.63
2008	7.73	0.01	4.35	9.39
2009	3.69	-0.10	1.82	-7.50
2010	5.54	-0.09	2.85	6.45

Data Sources: The Reserve Bank of Fiji, World Development Indicators (WDI Online)

The endogenity of the quantity of money in a fixed exchange open economy has been a central proposition of the so-called "monetary approach" in the balance of payments analysis associated with the work of Johnson (1972) and Mundell (1971). It is common knowledge that in a pegged exchange rate regime with open economy, the

domestic price level will be determined greatly by the international price level. If so, what will happen when there is Balassa(1964) and Samuelson (1964) effect of the productivity increases in the tradable sector of the advanced Australian economy and non-tradable goods prices increase in Australia and even the real and nominal exchange rate of Australia appreciate to balance the current account of the Balance of Payments in Australia? Though the implication of this is as per Balassa (1964) and Samuelson (1964) effect, the non-tradable goods' prices should be lower in Fiji, the Australian non-tradable goods' price shocks transmit to higher consumer price inflation in Fiji through the pegged exchange rate of Fiji. The analysis of Australian consumer price shocks is beyond the scope of this study. We may recollect that in the literature, it is argued that the government expenditure can fall on non-tradable sector. Apart from that, the mining boom from the enormous Chinese demand for minerals resources of Australia and the consequent favorable terms of trade shocks in Australia have also resulted in a higher real exchange rate in Australia (Blundell-Wignall and Gregory (1990), Gruen and Wilkinson(1994), and Karfakis and Phipps (1999)). From all the aforementioned described non-tradable goods price shocks and higher consumer inflation in the big neighbor-economy of Australia, how will Fiji's economy be affected, especially given its pegged exchange rate?

The next section will survey the literature on the studies on Fiji regarding exchange rate pass through and the monetary transmission mechanism.

LITERATURE SURVEY

Katafono (2000) conducted an interesting study on inflation in Fiji over the period 1966-1998. The author examined the relation between various monetary aggregates, inflation and real gross domestic product (GDP) using the time series technique of Vector Auto Regression (VAR). The VAR was in first differences as many data are non-stationary. The main conclusions are that (i) the M1 definition of money is Granger-causing inflation in Fiji , but inflation is not Granger-causing M1, (ii) Broad money and inflation are not Granger-causing each other, (iii) M1 is Granger-causing nominal GDP but nominal GDP is not Granger- causing M1, (iv) nominal GDP is Granger-causing Quasi money but not vice versa, (v) nominal GDP and broad money are not Granger-causing each other, (vi) real GDP and M1 are Granger-causing each other, and (vii) real GDP and broad money are not Granger-causing each other. These findings are interesting, especially that M1 is Granger-causing inflation in Fiji. The study's further results on block exogeneity, etc, show that there is no single monetary aggregate which has clear explanatory power over inflation and real output in Fiji. The main drawback of the research methodology in Katafono (2000) is that although the study has tested for non-stationarity and found that many variables are non-stationary, it has not tested if there is cointegration between non-stationary variables. Without that knowledge, for the study has done the first differencing on the data and performed VAR with differenced variables.

Jayaraman et al (2010) have examined the relation between real gross domestic product (RGDP), a monetary aggregate (M2), and consumer prices for Fiji through cointegration and error correction models for the period 1970-2007. Though their reported cointegrating vector in that article is only for GDP as the dependent variable,

one can indirectly calculate the price as normalized to unity and can find the correct positive sign for money supply's cointegrating coefficient, which is also statistically significant as an independent variable and the price as the dependent variable. However, they subsequently point out that when the VEC model is run, they find that when the change in RGDP is taken as the dependent variable only the error correction coefficient has the right negative and significant coefficient between 0 and minus one, and has not them ,when the change in consumer price is taken as the dependent variable . In the VEC model, the change in money supply is positive and significant in explaining the change in the price level as a short run phenomenon, and the long run effect is unclear as the error correcting factor is, although negative, not statistically significant. Therefore, the implication of Jayaraman et al's (2010) results is that for Fiji the inflation cannot be explained by the exogenous money supply as what monetarists have argued. In the cointegrating vector, with the normalized LRGDP (log of the real GDP) as the dependent variable, the coefficient of the price level is significantly negative, the money supply is significantly positive, the exchange rate is significantly negative, while the lending interest rate is not significantly negative. This implies that if we normalize the price level, the exchange rate would be negative and significant. Exchange rate depreciation would lead to an increasing price level. But we should be careful in interpreting the cointegrating vector as this vector does not give the causal relations. It is interesting to note that in the VEC model, when the change in GDP is taken as the dependent variable, the change in exchange rate coefficient is positive and statistically significant for short-run relationship, and they document a negative relation in the cointegrating vector coefficient of the exchange rate. Jayaraman et al (2010) did not give any explanation about this short-run significant relationship between exchange rate appreciation and increase in GDP in their reported results of the VEC model. The authors gave the forecast error variance results of the price level in which after 5 years the money supply and exchange rates explain much of the variance in price level. However, contradicting that finding, their impulse response function shows that the response of the price to the monetary shocks is positive and significant only for the first five years. They do not give any explanation for the inconsistency between the two results of the variance decomposition and impulse response functions. Jayaraman et al (2010) reached a general conclusion that the most variability in output and inflation is explained by substantially by money shocks, and asserted that money does matter in Fiji. The authors affirmed the conclusions reached by Rao and Singh (2006) in their survey article on monetary policy that "Fiji's central bank should use the money supply as its main policy instrument instead of interest rate or the bank rate." However, we are of the view that Jayaraman et al's (2010) final conclusions and their empirical results in different tables are not necessarily very consistent with each other as they initially reported that when the change in price is taken as the dependent variable, they did not get a statistically significant negative error correcting coefficient.

Jayaraman et al (2012) analyze the exchange rate pass-through in Fiji for the period 1982-2009. For variables, the study used the log of the consumer prices in Fiji, the log of M2, the log of the exchange rate of Fijian dollars per US dollar, and the log of Treasury-bill rate. The authors find one cointegrating vector among those non-stationary variables. In the cointegrating vector, with the normalized LRGDP (log of real GDP) as the dependent variable, and when log of consumer prices is normalized as unity, the

coefficient of M2 and the exchange rates are positive and significant while that of the interest rate is negative though not significant. In the VEC form, when the change in the consumer prices is taken as a dependent variable, the coefficient of the error factor is negative and significant, as expected. Jayaraman et al (2012) conclude that exchange rate pass-through effect on consumer prices is true for Fiji. However, they have found that for the post-coup period 1987-2009 period, this pass-through effect is weakened. They argue that this weakening effect may be due to the stability in exchange rate movements, and more competitive pricing environments.

In an interesting study on Fiji for the period 1975-2005, Narayan et al (2012) examined the monetary transmission mechanism using structural VAR. The authors reached very drastic but mostly pessimistic conclusions: "We find that a monetary policy shock statistically significantly reduces output initially, but then output is able to recover to its pre-shock level. In addition, we discover that a monetary policy shock instigates inflationary pressure, leads to an appreciation of the Fijian currency and reduces the demand for money. We also analyzed the impact of a nominal effective exchange rate (NEER) shock (an appreciation) on real output and found that it leads to a statistically significant negative effect on real output. The drastic and debatable finding is that a tight monetary policy would lead to more inflation in Fiji. The authors further justify their findings: "The RBF increased official interest rates twice in 2006, from 2.25 to 4.25 percent, despite which inflation has increased from 1.8 to around 6 percent. It should be noted that in Fiji the interest rate spread is high. In 2006, the savings deposit rate was 0.84 percent while the average lending rate was around 7.89 percent. A savings deposit rate of less than 1 percent is not a sufficient incentive for consumers to save…." Though one may have sympathy with Narayan et al's (2012) findings, one may find an inconsistency in the arguments that the tight monetary policy can lead to inflation and therefore to exchange rate depreciation fear, and yet at the same time, leading to an appreciation of the exchange rate and therefore to the reduction in output! In another important article by the IMF economists, Peiris and Ding **(**2012**)** argue "… therefore, pegged exchange rate regimes should not preclude considerations to introduce some flexibility to increase the role of the exchange rate in absorbing external shocks and to provide additional freedom for monetary policy." McCallum (2006) compares the performances of Taylor-rule type interest rate rules and exchange rate based approaches to inflation targeting in an economy with varying degrees of openness. The key finding is that as the degree of openness increases, an exchange-rate based approach to inflation, targeting does much better than the standard interest-rate based approach in stabilizing output, with no adverse consequences for inflation variability. The reason for this result is that in an interest-rate based approach, the variability of the interest rate is low while that of the exchange rate is high, whereas in an exchange-rate based approach, the opposite is found.

These results suggest that in an economy with a high exchange rate pass-through to imported goods' prices and low interest rate sensitivity of aggregate expenditures, smoothing the exchange rate rather than interest rates may help control inflation and reduce output volatility. Peiris and Ding's (2012) main results and conclusions are:" the impact of monetary impulses on headline inflation is not as significant as exchange rate fluctuations. The pass-through of the exchange rate to headline inflation is 60 percent within one year, with a complete pass-through within the second year. On the other hand,

the impact on and variation of headline inflation explained by monetary impulses is relatively small whether one considers broad money, domestic credit, reserve money, or interest rates, as in the baseline model. In fact, higher interest rates are associated with greater inflation possibly indicating a reverse causation where exchange rate changes and inflation determine the level of interest rate

Another important finding by Peiris and Ding (2012) is that the real GDP is not well explained by the shocks considered except its own innovations, probably reflecting the importance of supply-side factors and policy variables such as fiscal policy that are not captured. Interestingly, global commodity prices appear to affect economic activity more than global GDP indicating a relatively weak impact of external demand compared to terms of trade, although none of these effects are statistically significant.

Sampson and Yabom (2006) examine the exchange rate pass-through effect on Papua New Guinea for the period 1989-2004. Their paper uses 1989–2004 data to investigate the dynamics of pass-through in Papua New Guinea under a floating exchange rate regime. The study estimated a simple pass-through model in which inflation is postulated to be a function of exchange rate movements, past inflation outcomes, foreign inflation and the output gap. Estimated pass-through dynamics are sensitive to how inflation and the exchange rate are measured, but pass-through is generally found to be in the 50–60 percent range and it takes between four and six quarters. The results also confirm that exchange rate movements have been the principal determinant of inflation during the sample period. When the model is estimated using data from the period before the kina was floated, the pass-through was only 25 percent and was complete after three quarters.

The major points emerging from the literature survey are the dominant roles of exchange rates, and the exogenous international prices in transmitting the inflation in to the Pacific economies. The role and the transmission mechanism of the monetary policy in the Pacific countries is still an area where scholars hold different views, so more research is needed.

METHODOLOGY

This Section discusses a few cointegration models the models and variables used in this study, the sample period and some findings.

A Comparison of Some Cointegration Methods

It is interesting to note that recently Czasonis and Quinn (2012 have chosen the panel unit root methods over cointegration methods to test for European convergence. We prefer to use the Johansen (1988) approach to cointegration and not the Engle-Granger (1987) approach because the Engle-Granger approach does not clearly indicate the order of variables which can be used as regressor and the reason why. In practice if the sample is not very large, it is possible to find one regression exhibiting cointegration while another does not. This is very obviously an undesirable feature of Engle-Granger approach. The second problem is that when there are more than two variables, there may be more than one cointegrating relationship, and the Engle-Granger approach does not test this possibility. So the Engle-Granger approach does not give us the number of cointegrating vectors. The third problem is that the Engle-Granger approach relies on a two-step

estimator. The first step is to generate the error series and the second step is to estimate a regression for this series in order to determine if the series is stationary. Hence, any error introduced in the first step is carried into the second step. All these problems are resolved with the use of Johansen approach. As our objective is to study the causal effect, the Johansen (1988) approach is the more suitable since the Engle-Granger method does not give the cause and effects. The approach of Fountis and Dickey (1989) is similar to that of Stock and Watson (1988). All approaches to cointegration use lags in testing. However, in transforming Y_t, Stock and Watson (1988) use only the variance-covariance matrix while Fountis and Dickey (1989) and Johansen (1988) use only the lag information.

The Models and Variables

The variables employed in this study can be expressed as follows:
CPIF = *f* (EXAUS, CPIA, DS, DD)
Where:
CPIF is the difference in the consumer price index, time series, and the proxy variable for inflation in Fiji. The reason this definition of the variable is used is to maintain the same order of stationarity with the other following variables in the cointegration system.
EXAUS is the exchange rate, Australian dollar/Fijian dollar. An increase in EXAUS is therefore an appreciation of Fijian dollar, and a decrease is the depreciation of Fijian dollar.
CPIA is the consumer price index in Australia, a proxy for the international supply shocks. This variable in the vector error correction cointegration (VEC) is modeled as an exogenous variable like any (I)0 variable.
DS is the proxy for the Keynesian demand shocks in Fiji, which is constructed by adding nominal GDP with imports and subtracting exports.
DD is the dummy for devaluation years in Fiji: '1' for devaluation years 1988, 1998, and 2009, and '0' for other years. This variable is treated as an exogenous variable in the VEC cointegration model.

The afore explained VEC cointegration model basically aims to study the consumer inflation in Fiji and not to test the PPP model as the Australian consumer price variable is exogenous and other relevant variables of Australia like the demand shocks of Australia are not considered in this model. Naturally, one may have doubt that if the EXAUS exchange rate as an endogenous variable is appropriate in such a scheme of modeling. This aspect has to be determined by the Granger-causality result in the VEC model: if the exchange rate is endogenous or not, and if the CPIF variable Granger-causes the EXAUS exchange rate variable. Our intuition is that as the exchange rate is mainly pegged rate at Fiji, EXAUS should Granger-cause the CPIF, the proxy variable for consumer inflation in Fiji.

We have tested for the unit roots time series properties of all the variables except the devaluation dummies. We found that all the variables follow the unit root in levels and stationarity at the first difference levels, as reported in Tables 2.and Table 3. We have used both Augmented Dickey-Fuller and Phillips-Perron tests and found that the results are robust for both methods.

TABLE 2 AUGMENTED DICKEY-FULLER (ADF) UNIT ROOT TEST

Variable	ADF Test in Levels		ADF Test in First Difference	
	Test statistics	lag	Test statistics:	lag
CPIF	2.51	0	-3.69***	0
EXAUS	-0.58	0	-4.51***	4
CPIA	-0.33	1	-3.73***	0
DS	0.37	2	-8.39***	0

*Notes: The optimal lag is chosen on the basis of the Schwarz' Information Criterion (SIC). The null hypothesis for ADF states that the series under investigation has a unit root (or is non-stationary). These results are in line with the theory that all variables in levels have unit root and inverse for variables in first difference. *, **, ***: Rejection of null hypothesis at 10%, 5% and 1% levels of significance, respectively*

TABLE 3 UNIT ROOT TEST USING PHILLIPS-PERRON TEST

Variable	Phillips-Perron test in Levels	Phillips-Perron test in First Difference
	Test statistics	Test statistics:
CPIF	-0.86	-2.88*
EXAUS	0.015	-4.17***
CPIA	-1.84	-3.62***
DS	-1.04	-2.51**

*Notes: The null hypothesis for Phillips-Perron test states that the series under investigation has a unit root (or is non-stationary). These results are in line with theory that all variables in levels have unit root and inverse for variables in first difference. *, **, ***: Rejection of null hypothesis at 10%, 5% and 1% levels of significance, respectively.*

We have then tested for the cointegration relation among these variables. To examine the long- run cointegrating relationship between CPIF, EXUS, CPIA, DS, and DD, we have used the Johansen and Juselius (1990) method. The results from using the aforementioned method are reported in Table 4. Based on both Trace Statistics and Max-Eigen Statistics, the null that there is at least not one cointegrating vector is rejected. For the alternative hypothesis, at least one cointegrating vector is accepted.

We have implemented the VEC model where there is at least one long-run Granger causality (1975 and 2000) existing between those variables. In that sense, we can test if the CPIF is an endogenous variable caused by other variables in the system. The cointegrating equation can be further refined by a suitable selection of the VEC models, and even placing some variables such as CPIA and DD as exogenous to the cointegrating system similar to the I(0) variables. Further outputs of the VEC models, namely, impulse response functions and variance decomposition analysis will help us to understand the short-run dynamics, along with the long-run cointegrating relations. To work out the variance decomposition and impulse response functions, the ordering of the variables is important. The variance decomposition is based on orthogonalized forecast error variance decomposition, which is based on Choleski factorization, with the ordering of EXAUS, DS, and CPIF, which is based on the statistical inferences determined through Granger causality in the VEC results.

TABLE 4 JOHANSEN-JUSELIUS COINTEGRATION RESULTS

Variables included in the cointegration vector: CPIF EXAUS DS CPIA DD. n=34; 1977 to 2010.

Null	Alternative	**Trace Statistics**	95% critical value	P-value
R = 0	R ≥ 1	118.71	88.80	0.0001
R ≤ 1	R ≥ 2	61.60	63.88	0.0765
R ≤ 2	R = 3	36.00	42.92	0.2061
		Maximum Eigen Statistics		
R = 0	R≥ 1	57.11	38.33	0.0001
R ≤ 1	R ≥ 2	25.60	32.11	0.2530
R ≤ 2	R = 3	19.73	25.82	0.2588

Interpretation: First null hypothesis (R=0) states no cointegration (i.e. no long run association between variables) we reject this hypothesis at 5% level since p-value is less than 0.05. Hence, above results indicates 1 cointergrating equation(s) at the 0.05 level.

Sample Time Period

The original data period is from 1975 to 2010 annual data. However, in the cointegration and vector error correction models, because of the lag effects, the number of years of adjusted sample size will be reduced. The sources of data are from the Reserve Bank of Fiji publications.

RESULTS AND INTERPRETATIONS

As mentioned in Section 3, in Tables 2 and Table 3, the unit root tests are reported and all the variables are non stationary at levels and stationary at first differences. Therefore, the cointegration test is in order. The results in Table 4 of the Johansen and Juselius (1990) method indicate that, according to both Trace Statistics and Max-Eigen Statistics, there is at least one cointegrating vector among the variables CPIA, EXAUS, DS, CPIA, and DD; DD is treated as exogenous in the next cointegration. However, as given in Table 5, in the normalized cointegrating vector with the coefficient of the CPIF as unity, the exchange rate has the right expected negative sign and is the only one with statistical significance. The DS and CPIA have the right expected positive signs but not statistically significant, and DD has the inappropriate negative sign. Therefore, we have decided to further refine the cointegrating vectors in the VEC model, as presented in Table 6. In the VEC model, we have placed CPIA, and DD as exogenous variables in the same manner we can place I(0) variables as exogenous to other I(1) variables in the cointegrating system estimation. Obviously, from a theoretical perspectives, Australian consumer price index (CPIA), and devaluation dummy years (DD) are exogenous to the inflation in Fiji, and Australian/Fijian dollar.

TABLE 5 COINTEGRATING EQUATIONS

Log likelihood -265.0508

Normalized cointegrating coefficients (standard error in parentheses)

CPIF= -19.80 EXAUS + 0.00053 DS + 0.2236 CPIA - 5.1 DD
(2.63069) (0.00050) (0.08647) (1.48612)

	D(CPIF)	D(EXAUS)	D(DS)	D(CPIA)	D(DD)
Adjustment coefficients	-0.365763	-0.011078	-76.61256	0.024288	-0.000279
standard error	(0.11697)	(0.00663)	(16.9515)	(0.09429)	(0.02908)

In Table 6 , the VEC model results are given in detail. Importantly, when the change in CPIF is taken as the dependent variable, the error correcting factor has the right negative sign and statistically significant, and the foregoing implies that the change in Fiji consumer price index, the proxy for inflation, is caused by the long term trends in the Fiji-dollar exchange rates and the domestic demand shocks. And according to Granger causality, the Fiji inflation is endogenous to the exchange rates and demand shocks. This interpretation of the Granger causality is further corroborated by the fact that when the change in exchange rate and domestic demand shock are taken as the dependent variable respectively, the error correcting factors correspondingly, have the right negative signs but are not statistically significant, so these results are not reported in the table. When the change in CPIF is treated as the dependent variable, the error correcting factor is negative and statistically significant (-0.3), and it implies that 30 percent of the long-term adjustments have taken place within a year and of course inflation has some lag effects from the exchange rates and the domestic demand shocks. Coming to the short run effects by observing the change in the independent variables of exchange rates and demand shocks, they are not statistically significant and it is difficult to infer about the short-run Granger causality.

TABLE 6 VECTOR ERROR CORRECTION ESTIMATES

Sample (adjusted): 1978-2010. Included observations: 33 after adjustments
Cointegrating Equation:

CPIF(-1) = 77.53 -25.47 EXAUS(-1) + 0.0051 DS(-1)
(11.7013) (0.00108)
[2.17654] [4.70884]
Note: Standard errors in parenthesis '( )' and t-statistics in brackets '[ ]'.

Error Correction:	**Dependent variable D(CPIF)**		
	Coefficients	**Standard Error**	**t-statistic**
CointEq1	-0.3165	0.0827	-3.83
D(CPIF(-1))	0.1158	0.1712	0.68
D(CPIF(-2))	-0.0283	0.1565	-0.18
D(EXAUS(-1))	-2.6495	2.9260	-0.91
D(EXAUS(-2))	2.3593	3.1233	0.76
D(DS(-1))	-0.0038	0.00099	-3.85
D(DS(-2))	-0.0004	0.0014	-0.25
C	-11.909	3.5620	-3.34
CPIA	0.2105	0.0534	3.94
DD	1.7275	0.8215	2.10

R-squared	0.6728	Log likelihood	-45.70
Adj. R-squared	0.5447	Akaike AIC	3.38
Sum sq. residuals	30.82	Schwarz SC	3.83
S.E. equation	1.158	Mean dependent	3.095
F-statistic	5.25	S.D. dependent	1.72
Determinant resid. covariance (DF adj.)	324.61	Akaike information criterion	15.21
Determinant resid covariance	109.90	Schwartz criterion	16.71
Log likelihood	-218.02		

In fact as already mentioned in the discussion on modeling, our objective and motivation of the study is to model the Fiji consumer prices and not to model the PPP theory in nominal or real terms. Fiji is too small a country to have the influence of its exchange rate on the Australian consumer price index.

As reported in Table 6, from the VEC model we observe that in the cointegrating equation the exchange rate has the right negative sign and statically significant. The demand shocks (DS) has the right positive sign and statistically significant. The exogenous variables CPIA, and DD have the theoretically right expected positive signs and also statically significant. So as previously discussed, we are proved to be in the right track of modeling the cointegration and VEC for studying the inflation in Fiji. Any depreciation of Fiji dollar increases domestic inflation in Fiji and any appreciation reduces the domestic Fiji inflation. Similarly, a positive Keynesian demand shock increases inflation in Fiji. When the demand for non-tradable goods increases due

to higher government demand, it leads to higher real exchange rates, more specifically here in the form of consumer prices. This aspect of the recent discussion in the literature giving one reason for higher non-tradable prices and inflation is indirectly corroborated by the positive significance of the demand shock variable in our results. Given the Fiji dollar exchange rate and the Keynesian demand shocks, any positive supply shock in the form of a higher Australian consumer price increase stimulates inflation in Fiji. Therefore, Australian non-tradable price increase, which is originated partly from the higher tradable goods productivity increases in Australia and partly from higher government expenditure in Australia, instead of strengthening the Fiji dollar as visualized in the PPP theory, leads to the higher consumer prices in Fiji. This gives a choice to the Fiji authorities in selecting the exchange rate flexibility, when the Australian mining boom and other supply shocks increases the consumer prices in Australia. The devaluation dummy years also have the right positive signs and statistically significant. In spite of any other advantages, the devaluations aggravated the inflation in Fiji.

Next we discuss the variance decomposition analysis, where the ordering of the variables is determined by the statistical inference criterion of the Granger causality from the VEC cointegration model as discussed earlier. Further interestingly and supportive to the foregoing interpretation of the long run Granger causality from the cointegrating vector and VEC models about the endogeneity of the domestic inflation (CPIF), and exogeneity of the Fiji dollar exchange rate and the domestic demand shocks, the variance decomposition analysis and its results in Table 7, show that the variance in Fiji consumer price index is profoundly influenced by the Fiji dollar rates from the third period onwards and at the end of tenth period, 64 percent of the consumer price variance is explained by the Fiji dollar rate, more than that explained by the consumer price index itself; and the domestic demand shocks also explain about 16 percent of the consumer price variance at the end of tenth period. However, the variance in Fiji dollar rate is explained by the Fijian CPI of the order of 10 percent in Period 1 and only 5 percent in Period 10. Similarly the domestic demand shock has very negligible effect on the Fiji dollar rate variance of maximum 0 to 5 percent only throughout periods 1 and 10. It is interesting also to note that the variance in domestic demand shock is explained by very little only by the Fiji consumer index. The demand shock is explained by at least 7 percent by the Fiji dollar exchange rate at the end of tenth period. Therefore, the variance decomposition analysis clearly shows that the Fiji inflation is endogenous to the Fiji dollar exchange rates and the domestic demand shocks.

The impulse response functions presented in Figure 2 indicate that due to one standard deviation shock (appreciation) in the Fijian dollar exchange rate the CPI declines for many periods. Accordingly, Fijian dollar depreciation leads to inflation in Fiji for many years. The one standard deviation shock in demand shock, though initially leads to a decline in CPIF for a short period, subsequently, with some lag effects, leads to increase in CPIF for many years. Due to one standard deviation shock in CPIF, the Australian dollar/Fijian dollar rate declines marginally for many periods. Due to one standard deviation shock in CPIF, the demand shock marginally increases for many periods. Due to one standard deviation in shock (appreciation) in Fiji dollar rate, the demand shocks marginally declines for a very short time and then increases for many periods. Put it differently, the foregoing yields a thoughtful finding that the Fijian dollar

TABLE 7 VARIANCE DECOMPOSITION

1. Variance Decomposition of Consumer Price Index for Fiji (CPIF)

Period	S.E.	CPIF	EXAUS	DS
1	1.157497	100.0000	0.000000	0.000000
2	1.819025	76.03767	15.77060	8.191732
3	2.350286	59.98986	35.09145	4.918697
4	2.895434	47.21909	49.31466	3.466243
5	3.481892	36.28507	58.26444	5.450494
6	4.043543	29.27013	62.72418	8.005689
7	4.565016	24.49408	64.27134	11.23458
8	5.003411	21.65875	64.61212	13.72913
9	5.370469	19.92496	64.39258	15.68246
10	5.672800	18.97817	64.11218	16.90965

2. Variance Decomposition of EXAUS:

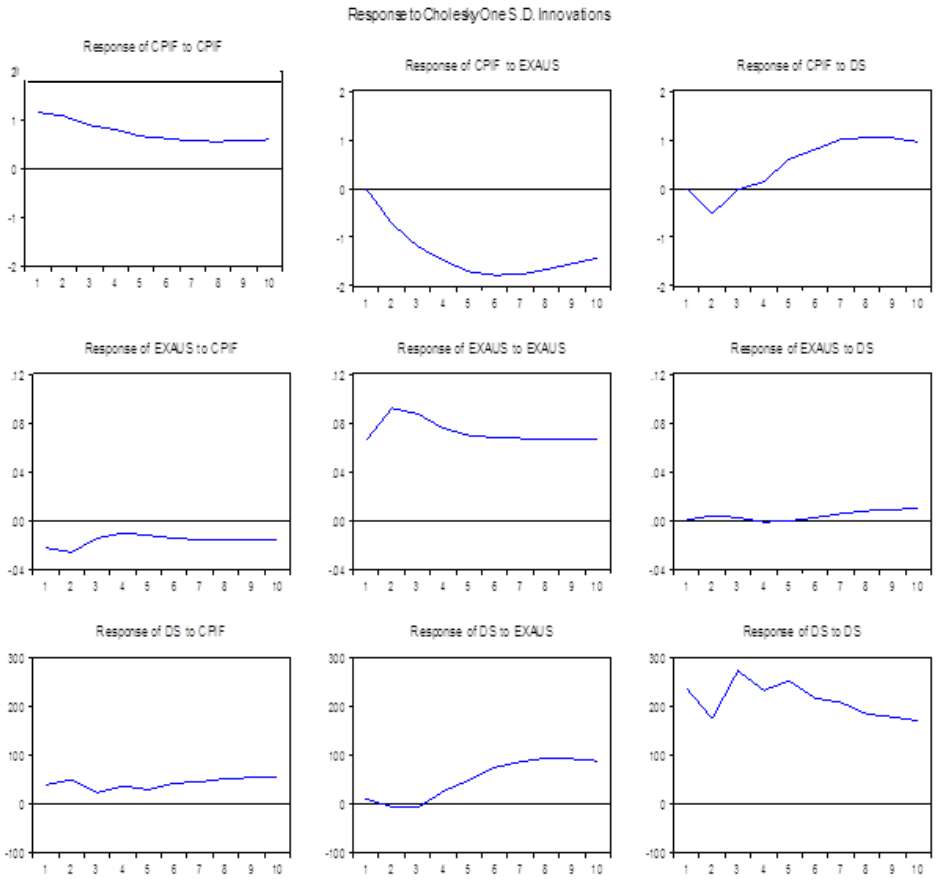
Period	S.E.	CPIF	EXAUS	DS
1	0.069509	10.70393	89.29607	0.000000
2	0.118482	8.659578	91.23289	0.107528
3	0.148177	6.517853	93.39136	0.090791
4	0.166791	5.545932	94.37526	0.078807
5	0.181255	5.170986	94.76153	0.067484
6	0.194253	5.084160	94.84499	0.070852
7	0.206308	5.106439	94.76085	0.132711
8	0.217581	5.149232	94.60834	0.242429
9	0.228342	5.195061	94.42939	0.375554
10	0.238832	5.229192	94.27145	0.499361

3. Variance Decomposition of DS

Period	S.E.	CPIF	EXAUS	DS
1	240.2082	2.547239	0.128710	97.32405
2	301.2234	4.290594	0.136553	95.57285
3	407.4776	2.647015	0.122522	97.23046
4	471.3611	2.533441	0.372317	97.09424
5	537.6616	2.228775	1.090862	96.68036
6	585.8014	2.384727	2.530185	95.08509
7	629.0110	2.561190	4.072049	93.36676
8	664.0367	2.899945	5.633804	91.46625
9	695.5234	3.216083	6.879836	89.90408
10	723.5073	3.538738	7.817183	88.64408

depreciation is contractionary in the long run for Fiji, though it can be mildly expansionary for a short time.

FIGURE 2. IMPULSE RESPONSE FUNCTIONS



CONCLUSIONS

The cointegration and the VEC models clearly indicate that the change in the Fijian consumer price index is caused by the long run trends in the Australian dollar/Fijian dollar exchange rate and the Keynesian demand shocks. Our variance decomposition analysis further corroborates the foregoing conclusion about the endogeneity of the domestic inflation, and the dominant role of the Fijian dollar exchange rate in explaining the inflation. This has a profound policy implication for the exchange rate policy of Fiji.

In the small open economy of Fiji, the exchange rate is an important determinant of inflation. The Fiji dollar depreciation has increased inflation and the appreciation has reduced inflation in Fiji. This is consistent with the earlier findings of Jayaraman et al (2010) and Peiris and Ding (2012). This substantially corroborates the argument of Peiris and Ding (2012) that the exchange rate flexibility is to be recognized as a more relevant tool of the monetary policy than interest rates or money supply. This does not support much with the argument of Jayaraman et al (2010) and Rao and Singh (2005) that the money supply is the relevant and perhaps the most important tool of monetary policy in Fiji.

Keynesian demand shocks are also important in explaining the inflation in Fiji. The wage increases, fiscal deficits, etc can come indirectly under this category though the variable of the demand shock which we calculated was only nominal GDP minus exports and plus imports. This could also imply that the Government expenditure which falls mainly in the non-tradable sector, can increase the real exchange rate and, specifically in the context of Fiji, the consumer price inflation.

Though we placed the Australian consumer price index and the dummy of devaluation years as exogenous variables in the VEC model, they have helped to refine our models, results and conclusions and in this respect ours is an important contribution to the research methodology on the ongoing research on this topic, at least for Fiji. The inflation in Fiji is also greatly determined by the foreign consumer prices of Australia. The mining boom and high real estate and property prices in Australia and other foreign supply shocks influence the inflation in Fiji. The foreign supply shocks and terms of trade shocks etc have much influence on the inflation in Fiji. As explained earlier, from the Balassa (1964) and Samuelson (1964) effects of higher productivity in the tradable sector of Australia, the higher government expenditure which falls in non-tradable in Australia, and the resultant shocks in Australian consumer prices would transmit to higher consumer prices in Fiji. This is a classic example for an open economy with a fixed exchange rate system. This also points to the necessity for a flexible exchange rate policy in Fiji. For example, if the Australian consumer price increases, and if the Fijian dollar nominal value remains constant, the inflation in Fiji would increase. When the Australian prices increase exogenously as foreign supply shock, Fiji has a policy choice of allowing the flexibility to markets to allow to appreciate its currency to prevent imported inflation. Please note that this would have automatically happened if Fiji has a freely floating exchange rate regime. This is the policy choice of the advantage of the exchange rate flexibility which Fiji can utilize to which our results in this study, and that of Peiris and Ding (2012) indicates the direction forward clearly.

The currency devaluations happened in Fiji on three occasions, in 1988, 1998, and 2009. These have positively affected the inflation. Once the inflation increases, the effect of nominal depreciation of Fijian dollar gets reduced as the real exchange rate could appreciate, defeating the objective of promoting exports and import in the competing industries.

Another interesting finding from the impulse response functions is that as a result of the Fijian dollar exchange rate appreciation, though the demand shocks initially decline for a short time and increase much for a long time with a lag effect, this has led to an important conclusion that the exchange rate depreciation is contractionary after a brief time of stimulation for Fiji economy. However, as this is not the important part of our

research considering the gamut of all research methods that we followed in this paper, this last conclusion needs more research for corroboration.

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