This article fills a gap in the empirical work on the demand for money in Fiji. We allowed for structural breaks in the cointegrating equation, within the Gregory and Hansen framework, and found that there is a cointegrating relationship between real narrow money, real income and the nominal rate of interest in three types of structural break models. However, only the model with an intercept shift for the 1987 political coup yields a meaningful cointegrating relationship. Allowing for this break, we found that the demand for money in Fiji is stable. Using our estimates the successes and failures of monetary policy are analysed.

Many empirical studies have estimated the demand for money in many countries and examined its stability. The demand for money and, more importantly, its temporal stability have important implications for the selection of the monetary policy instruments. In a classic paper, Poole (1970) has shown that when the LM curve is unstable, central banks should use the bank rate as the instrument of monetary policy; when the IS curve is unstable the appropriate monetary policy instrument is the money supply. Since a major source of instability in LM is instability in the demand for money, understanding the degree of stability of the demand for money is important.

Since the late 1980s, the demand for money in industrial economies has generally been found to be unstable, due to the liberalisation of financial markets. Therefore, central banks in the industrial economies have switched to using the bank rate as their main instrument of monetary policy. In contrast, no significant evidence has been found that the demand for money in developing economies has also become unstable (see a recent comprehensive study by Bahmani-Oskooee and Rehman 2005). Nevertheless, central banks in many developing economies, including Fiji, have switched to the bank rate as their instrument of monetary policy. Such an inappropriate
choice of monetary policy instrument could lead to increased instability. So it is important to test the stability of the demand for money using recent developments in time series techniques.

The main purpose of this article is to fill a gap in the empirical work on the stability of the demand for money in developing economies by allowing for structural breaks in the cointegrating relationship. To limit the scope of the article, we examine the stability of demand for money only in Fiji using the Gregory and Hansen (1996a) technique. Needless to say, our methodology can be easily used to analyse the stability of demand for money (or any other cointegrating relationship) in other countries.

The Gregory-Hansen equations

Gregory and Hansen (1996a) proposed residual-based tests of the null of no cointegration with structural breaks against the alternative of cointegration.\(^1\) Three models, with different assumptions about structural breaks, are proposed, namely level shift; level shift with trend; and regime shift where both the intercept and the slope coefficients change. The single break date in these models is assumed to be endogenously determined. A simple two-variable specification of the three models can be stated as follows.\(^2\)

\[
\begin{align*}
Y_t &= \mu_t + \mu_1 \varphi_{ik} + \alpha_1 X_t + \varepsilon_t, \\
Y_t &= \mu_t + \mu_2 \varphi_{ik} + \beta_1 t + \alpha_1 X_t + \varepsilon_t, \\
Y_t &= \mu_t + \mu_2 \varphi_{ik} + \beta_1 t + \alpha_2 X_t + \varphi_{ik} + \varepsilon_t
\end{align*}
\]

(1) \hspace{1cm} (2) \hspace{1cm} (3)

where \(Y\) is the dependent variable and \(X\) is the independent variable, \(t\) is a time subscript, \(\varepsilon\) is an error term, \(k\) is the break date, and \(\varphi\) is a dummy variable such that

\[
\varphi_{ik} = \begin{cases} 
0 & \text{if } t \leq k \\
1 & \text{if } t > k \end{cases}
\]

(4)

It is easy to extend these models for more than one explanatory variable.

Previous studies of the demand for money in Fiji are Luckett (1984), Joyson (1997), Jayaraman and Ward (2000), Katafono (2001), Rao and Singh (2005) and, more recently, Singh and Kumar (2006a and 2006b). The merits and weaknesses of these earlier studies were discussed in Rao and Singh (2005) and Singh and Kumar (2006a, 2006b). While Katafono found that the demand for money is unstable, Rao and Singh, Jayaraman and Ward, and Singh and Kumar found that the demand for money in Fiji is well-determined and temporally stable. In all these previous studies an important issue that was not addressed is that the cointegration relationship may have a structural break during the sample period. This issue was briefly discussed in Rao and Singh (2005). Therefore, we address the stability of the demand for money, allowing for unknown structural breaks, using the Gregory-Hansen techniques. Since Rao and Singh (2005) have obtained similar coefficients for their cointegrating equations from alternative techniques, namely the LSE-Hendry GETS and the Johansen maximum likelihood systems methods, we shall use their specification which is

\[
\ln M_t = \mu + \alpha_1 \ln Y_t - \alpha_2 r_t + \varepsilon_t, 
\]

(5)

where \(M\) is real narrow money, \(Y\) is real GDP, and \(r\) is the nominal rate of interest. The implied specifications for the three Gregory and Hansen equations with structural breaks are as follows

\[
\begin{align*}
\ln M_t &= \mu_t + \mu_1 \varphi_{ik} + \alpha_1 \ln Y_t - \alpha_2 r_t + \varepsilon_t, \\
\ln M_t &= \mu_t + \mu_2 \varphi_{ik} + \beta_1 t + \alpha_1 \ln Y_t - \alpha_2 r_t + \varepsilon_t, \\
\ln M_t &= \mu_t + \mu_2 \varphi_{ik} + \beta_1 t + \alpha_2 \ln Y_t + \alpha_1 \ln \varphi_{ik} + \alpha_2 \ln r_t + \varepsilon_t
\end{align*}
\]

(6) \hspace{1cm} (7) \hspace{1cm} (8)

These equations will be referred as GH-I, GH-II and GH-III, respectively.
The Gregory-Hansen method is essentially an extension of similar tests for unit root tests with structural breaks, for example, Zivot and Andrews (1992). However, it should be noted that unit roots and cointegration with structural breaks are conceptually different and they have different critical values. The break date is searched by estimating the cointegration equations for all possible break dates in the sample and then selecting a date where the test statistic is the minimum (that is, where the absolute value of the ADF test statistic is the maximum). With regime shifts the distribution theory to evaluate the residual-based tests is not the same as the standard MacKinnon (1991) cointegration tests used in the Engle-Granger two-step procedure. Therefore, Gregory and Hansen have tabulated the critical values by modifying the MacKinnon (1991) procedure for testing cointegration in the Engle-Granger method with unknown breaks. We follow this methodology.

**Empirical estimates of the break date**

The definitions of variables and sources of data are in the Appendix. To conserve space we do not present the results of the unit root tests on the variables. Rao and Singh (2005) have conducted unit root tests and found that real income, money, and the rate of interest are unit root variables in levels and stationary in their first differences.

We now briefly describe the broad trends in the variables of interest to provide a backdrop and to discuss more fully the policy implications of our findings. The average growth rates of real output ($\Delta \ln y$), real money supply ($\Delta \ln m$), the GDP deflator ($\Delta \ln P$), and the nominal rate of interest ($R$) are given in Table 1 for the period 1972–2002 and for two sub-periods 1972–80 and 1981–2002.

The rate of inflation in Fiji was high at 14 per cent during 1972–80 due to the high worldwide inflation rates caused by the two oil shocks in the mid and late 1970s. The inflation rate declined subsequently to an average of 4.5 per cent. During 1972–80, monetary policy was highly restrictive and the rate of growth of real money was –4.4 per cent. In contrast, monetary policy was expansionary following the oil shocks. Real money supply grew at 4.4 per cent over the period 1981–2002. Between these two periods, the rate of growth of output declined by almost two percentage points, from 3.7 to 1.7 per cent, and the nominal rate of interest increased by about one per cent. From a policy perspective it would be interesting to examine the implications of the estimates of the demand for money to understand whether the Reserve Bank of Fiji has successfully used monetary policy to achieve its objectives.

<table>
<thead>
<tr>
<th>Year</th>
<th>$\Delta \ln y$</th>
<th>$\Delta \ln m$</th>
<th>$\Delta \ln P$</th>
<th>$R$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1972–2002</td>
<td>2.30</td>
<td>1.9</td>
<td>7.23</td>
<td>6.99</td>
</tr>
<tr>
<td>1981–2002</td>
<td>1.72</td>
<td>4.4</td>
<td>4.49</td>
<td>7.26</td>
</tr>
</tbody>
</table>

**Table 1** Average rates of growth of real output, real money supply, GDP deflator, and the nominal rate of interest, 1972–2002

Source: Authors’ calculations.
The sample period is 1971 to 2002; but due to the presence of some lagged variables, the three GH models in equations (6) to (8) are estimated from 1974 to 2002. The results are given below in Table 2. These results, which are self-explanatory, imply that irrespective of which of the three models with structural breaks is used, there is a cointegrating relationship between real money, real income, and the nominal rate of interest in Fiji. The endogenously determined break date is 1987 in GH-I and GH-III, but the break date is 1976 in GH-II. Since the null is rejected by all three models, it difficult to decide which is the best.

Therefore, we have estimated the cointegrating equations for the three models with the Engle-Granger method and the first stage OLS equations are given below in Table 3.

From these estimates it can be said that GH-I is the most plausible model. In this model all estimated coefficients, except the pre 1987 intercept, are significant and their values are plausible—although the estimate of income elasticity at 0.76 seems low. However, the Wald test could not reject the null that it is unity at the 5 per cent level. The computed test statistic, with its p-value in brackets, is 1.46 (0.23).

In GH-II the estimate of income elasticity is low at 0.26 and insignificant. In GH-III, the income elasticity after the break is very high at almost 3.0 and the estimates of the two interest rate coefficients are insignificant. The results in GH-II and GH-III can be rejected as implausible because, as noted by Smith (2000) and Rao (2007), statistical techniques are merely tools to summarise facts and are not appropriate to answer questions that belong to economic theory. Therefore, we shall use the residuals from GH-I to estimate the short-run dynamic equation for the demand for money with the error correction adjustment model (ECM).

In developing an appropriate ECM model for the short run, we adopted the LSE-Hendry GETS approach in the second stage. This second stage equation is estimated with OLS in which $\Delta \ln M_t$ is regressed on its lagged values, the current and lagged values of $\Delta \ln Y_t$ and $\Delta r_t$, and the one-period lagged residuals from the cointegrating vector of Gregory-Hansen (for example, from equation GH-I). We used lags up to four periods and, using the variable deletion tests in Microfit 4.1, arrived at the following parsimonious equation

$$\Delta \ln M_t = -0.392 ECM_{t-1} + 1.092 \Delta \ln Y_t - 0.816 \Delta \ln Y_{t-1} + 0.027 \Delta^2 r_{t-1}$$

with $\bar{R}^2 = 0.532$, $SER = 0.098$, Period: 1975–2002

$X^2_{sc1} = 0.691 (0.41)$, $X^2_{ff} = 4.088 (0.04)^*$,

$X^2_{n} = 0.791 (0.67)$, $X^2_{hs} = 3.710 (0.05)^*$

### Table 2  Tests for cointegration with structural breaks, 1974–2002

<table>
<thead>
<tr>
<th>Model</th>
<th>Break date</th>
<th>GH test statistic</th>
<th>5 per cent critical value</th>
<th>Reject $H_0$ of no cointegration</th>
</tr>
</thead>
<tbody>
<tr>
<td>GH-I</td>
<td>1987</td>
<td>-5.19111</td>
<td>-4.92</td>
<td>yes</td>
</tr>
<tr>
<td>GH-II</td>
<td>1976</td>
<td>-5.95961</td>
<td>-5.29</td>
<td>yes</td>
</tr>
<tr>
<td>GH-III</td>
<td>1987</td>
<td>-6.71172</td>
<td>-5.50</td>
<td>yes</td>
</tr>
</tbody>
</table>

*Source: Authors’ calculations.*
where * and ** indicate significance at the 5 and 10 per cent levels, respectively. It may be noted from these estimates that it is possible to reduce further the number of estimated coefficients to increase the degrees of freedom. The coefficients of $\Delta \ln Y_t$ and $\Delta \ln Y_{t-1}$ are close and opposite in sign. When this restriction is tested, the Wald test computed $\chi^2(1)$ test statistic with $p$ value in the parenthesis is 0.157 (0.692) and is insignificant, and therefore the constraint could not be rejected. The following ultra parsimonious equation is based on this restriction

$$\Delta \ln M_t = -0.391 \text{ECM}_{t-1} + 0.958 \Delta^2 \ln Y_{t-1} + 0.026 \Delta^2 r_{t-1}$$

(10)

where $R^2 = 0.548, \text{SER} = 0.097, \text{Period:} \ 1975–2002$

$X^2_{sc1} = 0.749 (0.39), X^2_n = 3.951 (0.05)*,$

$X^2_{hs} = 1.039 (0.60), X^2_{ff} = 2.490 (0.12)$

The summary statistics of this equation are marginally improved. All the estimated coefficients are significant. The coefficient of the lagged error correction term is significant at the 10 per cent level with the correct negative sign, and serves as the expected negative feedback function. This implies that if there are departures from equilibrium in the previous period, the departure is reduced by about 40 per cent in the current period. The $\chi^2$ statistics indicate that there is no serial correlation ($\chi^2_{sc1}$), nonnormality ($\chi^2_n$) or heteroscedasticity ($\chi^2_{hs}$) in the residuals. However, the functional form misspecification $\chi^2_{ff}$ test is marginally

---

Table 3  Cointegrating equations, 1974–2002

<table>
<thead>
<tr>
<th></th>
<th>GH-I</th>
<th>GH-II</th>
<th>GH-III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>0.11</td>
<td>3.74</td>
<td>10.34</td>
</tr>
<tr>
<td></td>
<td>(0.07)</td>
<td>(0.98)</td>
<td>(5.71)*</td>
</tr>
<tr>
<td>Trend</td>
<td>0.024</td>
<td>0.262</td>
<td>-0.625</td>
</tr>
<tr>
<td></td>
<td>(2.91)*</td>
<td>(2.50)*</td>
<td></td>
</tr>
<tr>
<td>$\ln Y_t$</td>
<td>0.758</td>
<td>0.262</td>
<td>-0.625</td>
</tr>
<tr>
<td></td>
<td>(3.80)*</td>
<td>(0.51)</td>
<td>(2.50)*</td>
</tr>
<tr>
<td>$r_t$</td>
<td>-0.035</td>
<td>-0.029</td>
<td>-0.003</td>
</tr>
<tr>
<td></td>
<td>(4.49)*</td>
<td></td>
<td>(2.00)</td>
</tr>
<tr>
<td>Dummy 1976</td>
<td>-0.197</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2.26)*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dummy 1987</td>
<td>0.23</td>
<td></td>
<td>-22.25</td>
</tr>
<tr>
<td></td>
<td>(4.37)*</td>
<td></td>
<td>(3.68)*</td>
</tr>
<tr>
<td>Dummy 1987 x $\ln Y_t$</td>
<td></td>
<td>2.91</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3.82)*</td>
<td></td>
</tr>
<tr>
<td>Dummy 1987 x $r_t$</td>
<td></td>
<td>0.027</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.83)</td>
<td></td>
</tr>
</tbody>
</table>

Notes: Absolute t-ratios are reported below the coefficients. An asterisk indicates significance at the 5 per cent level.

Source: Authors’ calculations.
significant at the 5 per cent level but not at the one per cent level. This is not unusual for dynamic equations because it is hard to claim that the complex nature of dynamic adjustments, with limited data, can be adequately captured with linear specifications.

Having obtained the long-run equilibrium estimates and the dynamic counterpart, it is important to test for the stability of the money demand function. When we subjected the preferred parsimonious Equation 10 to CUSUM and CUSUMSQ stability tests, neither the CUSUM nor the CUSUM SQUARES showed any instability. They show that the money demand function is temporally stable (results are available from the authors).

Therefore, following Poole (1970) it can be said that money supply is the appropriate monetary policy instrument for the Reserve Bank of Fiji. If it continues to target the rate of interest, this will probably increase instability in GDP. In this respect our findings are consistent with those in Rao and Singh (2005), Singh and Kumar (2006), and Jayaraman and Ward (2000), although these works did not allow for structural breaks in their cointegration equations.

**Monetary policy in Fiji**

There is a stable demand for money in Fiji but there was an upward intercept shift in 1987, implying that there was a one-time increase in the demand for money of about 0.23 per cent. That is, the average stock of real money was 0.23 per cent higher during 1987–2002 than in the earlier period. It is hard to explain this increase because one would expect a decline in the demand for money following the worldwide financial reforms and liberalisation policies since the late 1980s. However, this one-time increase in the demand for money may have been due to the political uncertainties caused by three military coups, which could have increased the demand for precautionary balances.

Did the Reserve Bank of Fiji use monetary policy effectively to achieve its objectives? In their survey article, Rao and Singh (2006) pointed out that demand for money in Fiji has been stable. Therefore, the Reserve Bank of Fiji should use money supply as its instrument of policy to target the rate of inflation because money has no real effects. However, it shifted to the bank rate as its instrument of monetary policy after 1997. The Reserve Bank of Fiji was not alone in this respect. Many other developing economies switched to the bank rate as the monetary policy instrument although there is no convincing evidence that the demand for money has become unstable in developing economies.

It is difficult to evaluate the effectiveness of monetary policy since the shift to using the bank rate as the monetary policy instrument because there are only four observations after 1997 and the 2000 coup and this may distort the results. However, if the main objective of the monetary authorities is to maintain a low and stable inflation rate, and if inflation is always a monetary phenomenon, then the success of monetary policy depends on whether the Reserve Bank of Fiji has ensured that the rate of growth of money did not exceed the rate of growth of demand for money. In Table 4 we have computed the real excess supply of money (EXSM) using our point estimate of 0.758 as the income elasticity of the demand for money.

In the entire sample period of 1972–2002, EXMS is small and positive. Therefore, it may be said that the Reserve Bank of Fiji has maintained equilibrium in the money market. However, there is one sub-period with a high inflation rate and another with a moderate inflation rate. In the high inflation
period of 1972–80, \textit{EXMS} was negative at \(-7.2\) per cent, implying that Reserve Bank of Fiji’s policy helped to dampen high inflationary expectations caused by the worldwide inflation due to the oil price shocks in the 1970s. The success of this restrictive monetary policy can be seen in the reduction of the inflation rate in the period 1981–2002.

Was monetary policy equally effective in the post-oil crisis period during which the average rate of inflation was 4.5 per cent? It is difficult to answer this question unambiguously due to the adverse effects of the two political coups in 1987 and another in 2000, falling exports, two devaluations by 34 per cent in 1988 and another by 20 per cent in 1998, and the switch of monetary policy instruments. However, \textit{EXMS} was positive at about 3 per cent and therefore it is hard to deny that excess supply of money has contributed, in some way, to the rate of inflation of 4.5 per cent.

The expansionary policy stance by the Reserve Bank of Fiji might have been partly due to the belief that it could increase the rate of growth of output, which fell from 3.7 per cent during 1972–80 to 1.7 per cent in 1981–2002. The result seems to have been inflation and not an increase in the rate of growth of output. How much the positive \textit{EXSM} contributed to inflation during 1981–2002 depends on one’s assumptions about the relationship between \textit{EXSM} and the rate of inflation. If the core rate of inflation in Fiji is assumed to be about 2 per cent, the 3 per cent excess supply of money might have added another 2.5 per cent.\(^6\)

\section*{Conclusion}

We have used the Gregory-Hansen procedure to test the stability of the demand for money in Fiji. This is perhaps the first attempt to estimate and test the demand for money in Fiji allowing for an endogenously determined structural break in the cointegrating equation. Our results imply that a cointegrating relationship between real money, real income and the nominal rate of interest exists and that it shifted upwards by about 0.23 per cent after the 1987 coup. This outcome may have been due to increased precautionary demand for liquidity.

The major finding is a well-determined and stable long-run demand for money in Fiji. Therefore, our analysis adds support to similar findings about the demand for money by Rao and Singh (2005) and Jayaraman and Ward (2000). A major implication is that the Reserve Bank of Fiji should be using the money supply as its monetary policy instrument.

Our point estimate of the income elasticity of demand for money of 0.76 is somewhat lower than the unity found in the earlier studies.\(^7\) However, the Wald

\begin{table}[ht]
\centering
\caption{Excess money supply}
\begin{tabular}{llll}
\hline
 & \textit{EXMS} & $\Delta \ln y$ & $\Delta \ln P$ \\
1972–2002 & 0.11 & 2.30 & 7.23 \\
1972–1980 & \(-7.18\) & 3.69 & 13.91 \\
1981–2002 & 3.09 & 1.72 & 4.49 \\
\hline
\end{tabular}
\textit{Source:} Authors’ calculations.
\end{table}
test indicated that our estimate is not significantly different from unity. The estimate of the interest rate elasticity, at its mean value of 6.97, is about –0.24 and is consistent with the estimates from the previous studies. Finally, using our estimates of the demand for money we have examined the effectiveness of monetary policy in Fiji in two sub-periods. During the high inflation period of 1972–80, monetary policy was highly restrictive and helped to reduce the high inflation rate by dampening inflationary expectations. In the second sub-sample period of 1981–2002, there was an excess supply of money. Perhaps the expansionary monetary policy during this period might have added about 2.5 per cent to the inflation rate. However, it is important to note that our conclusions about the effectiveness of monetary policy are based on highly simplified assumptions and ignore the adverse effects of political coups, falling exports, and devaluations of the currency.

Notes

1 A referee has observed that the Gregory and Hansen test is only one possible test for a structural break and is only applicable when the direction of causality is one-way. While there are many structural break tests for testing for unit roots in a single variable, to the best of our knowledge there are only two cointegration tests with structural breaks among a set of unit root variables. There seems to be a general confusion between unit root and cointegration tests. The two cointegration tests are the Gregory and Hansen (1996a) test, which is used in this article and Juselius (1996) test for estimating the cointegrating equations in the Johansen method. In the Gregory-Hansen test, the single break date is determined endogenously whereas it is assumed to be known a priori in Juselius. Bai and Perron (2003) have also developed tests to find endogenous multiple break dates, but these are not cointegration tests although cointegrating equations can be estimated after the break dates are determined. Furthermore, there seems to be nothing in Gregory and Hansen (1996a) that their test is valid only after the direction of causality is established. Needless to say we shall be grateful for corrections to our statements.

2 A fourth model developed by Gregory and Hansen (1996b) is

\[ Y_t = \mu_1 + \mu_2 \phi_{1t} + \beta_1 + \beta_2 \phi_{2t} + \phi_{1t} + \alpha_1 X_{1t} + \alpha_2 X_{2t} \phi_{1t} + \epsilon_t \]

We ignore this model because of some limitations in our software.

3 Smith (2000) distinguishes between three stages in applied economic work, namely, purpose (or objective), summary of facts, and interpretation of facts. Within this three-fold classification, statistical techniques are seen as tools to develop credible summaries of the observed facts. Purpose and interpretation are left to the analyst according to their preferred economic theories. Therefore, in evaluating the relative merits of the alternative statistical estimates, it is important to ask how good is a particular result for summarising the observed facts (see also Rao 2007).

4 Rao and Kumar (2006) found that demand for money in Bangladesh declined by 0.37 per cent after 1989 due to the financial reforms.

5 Since we are using the rates of growth of the variables, the effect of a one-time upward intercept shift in the demand for money is ignored. We also ignored the small effects of changes in the rate of interest.

6 The core inflation rate might be interpreted as the rate of inflation consistent with equilibrium in the money market. In this respect it is similar to the natural rate of unemployment.

7 It makes no significant difference if an income elasticity of demand of one is used for the computations of EXMS in Table 4. An elasticity of one only implies that EXMS during the entire sample period was –0.44 per cent, in contrast to the 0.11 per cent value used in Table 4.
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**Appendix**

P = GDP deflator, which is the ratio of nominal to real GDP in 1995 prices (International Monetary Fund 2003; Reserve Bank of Fiji, various issues).

Y = GDP at factor cost in 1995 prices (International Monetary Fund 2003; Reserve Bank of Fiji, various issues).

R = Nominal interest rate. The simple average of 1–3 years savings deposit rate (Reserve Bank of Fiji, various issues).

M = Narrow money balances (M1). This includes currency in circulation, demand deposits and bills payable (Reserve Bank of Fiji, various issues; International Monetary Fund 2003).

Real GDP and real money are computed by deflating their nominal values with the GDP deflator.