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Abstract

This paper investigates whether money neutrality holds in the long run for the Maldives using the pure form of the quantity theory of money. The analysis is undertaken for the period December 2001 to December 2013 using a Vector Error Correction Model (VECM). The results indicate that the proposition of money neutrality does not strictly hold in the case of the Maldives, as only about half of the impact of the rise in money supply feeds in to prices over time. However, short-run analysis indicates that an equilibrium relationship between prices, real income and the money supply does exist.

1. Introduction

High inflation has adverse consequences on the standard of living and the overall macro economy as it erodes the purchasing power of money and generates uncertainty in the economy. As such, achieving price stability (usually defined as low and stable inflation) has become the prime objective of monetary policy for the majority of central banks around the world (King, 1999). Accordingly, understanding the extent to which inflationary pressure is generated by using the money supply as a policy tool is of prime interest.

Empirical research on the inflationary process in the Maldives is limited. Adam (2012, a) conducted the only known study on this front, and investigated the inflation dynamics with a special emphasis on exchange rate pass through. The current paper takes a step back with a much broader focus, and is intended to serve as a starting point for active research on domestic inflation and the monetary sector in general. In particular, the

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main aim of the study is to investigate whether money neutrality[1] holds in the long run for the domestic economy in the context of the pure form of the quantity theory of money, which is considered the most basic theorem of monetary economics.

The paper is organized as follows. Section 2 provides a short review of the contributions toward the money neutrality literature, while section 3 deals with the methodology adopted for the empirical analysis and data descriptions. Section 4 reports the results, and section 5 concludes.

2. Literature Review

The quantity theory of money in its basic form illustrates the long-run neutrality of money. The underlying principle of the theory is that exogenous changes in the level of money supply leads to an equivalent change in the level of the price level given that the velocity of money remains constant, leaving real output (and other real variables like unemployment) unchanged in the long run. This has implications for the effectiveness of monetary policy, as influencing the real economy will only be possible in the short run if an economy exhibits long-run neutrality.

Empirical evidence regarding long-run neutrality remains mixed depending on the context and models used. For instance, Fisher and Seater (1993) investigate long-run neutrality using U.S. and German data within an ARIMA framework. Their results show that long run neutrality appears to hold where the data series are sufficiently integrated, but reject the neutrality proposition with respect to U.S. output data. This suggests that changing the money supply to influence the real economy will be to no avail in the long run in that context, except perhaps in the case of real output in the U.S.

King and Watson (1997) also provide evidence for long run neutrality of money for the U.S. using bivariate vector autoregressive models. As originally suggested by Lucas (1972) and Sargent (1971), they note that econometrically testing the long run neutrality hypothesis requires sufficient integration of the processes. Therefore, checking for integrated series or unit roots will be the first step of the analysis in this paper.

In addition, Adam (2012, b) studied determinants of inflation in Maldives by considering both external and domestic factors. The results indicated that the dominant factor which

1 The neutrality of money suggests that an increase in the money supply leads to an increase in the price level in the long run by the same proportion.

influences domestic prices is the price level in foreign trade partner countries. It was also found that the exchange rate pass through is extremely high. This evidence is in favour of a long run relationship between money growth and inflation being present in the Maldives.

Against this backdrop, this paper takes a step back with a broader focus, and attempts to provide a starting point for research on domestic inflation and the monetary sector in the Maldives. As such, arguably the simplest theory of monetary economics is used, and a classical long run approach is taken throughout.

3. Methodology and Data Description

3.1 General Regression Framework

As the aim of the paper is to determine whether the long-run money neutrality conjecture of classical economics applies for the Maldives, the general model is based on the quantity theory of money by Fisher (1911). The quantity theory of money states that there is a relationship between the money supply (M), velocity of circulation of money (V), the general price level in the economy (P) and the volume of transactions (T).

$$MV = PT$$

If the volume of transactions is proxied by real GDP (Y) under the assumption that aggregate output would be proportional to the amount of economic transactions during a given period, the identity can be re-written as:

$$MV = PY$$

This is rearranged to get the same identity as an equation of price.

$$P = \frac{MV}{Y}$$

To arrive at a linear equation for estimation, the natural logarithms of the variables are taken.

$$lnP = lnV + lnM - lnY$$

A crucial assumption made throughout the analysis is that the velocity of money is constant, which is the baseline assumption used in the "pure" classical version of the quantity theory. However, this is unlikely to hold strictly in practice as velocity can be influenced by a number of factors. For example, as the degree of financial innovation (introduction and spread of electronic payment methods, access to ATM's, etc.) increases in an economy, the velocity of money can be expected to decline. Zhai, Geng and Zhang (2013) note that monetization, a high proportion of non-performing loans, a weak credit base or a high savings rate can also contribute to a decline in velocity. Data analysis suggests that the velocity of broad money (M2) in the Maldives has come down significantly over time. However, to stick to the naïve quantity theory model, the velocity is still assumed constant. As such, it will be captured in the constant term (α) in the regression analysis. This has occasionally been supported in the literature (for example, see Gould and Nelson (1974)), and so the assumption is used throughout the analysis despite the divergence with reality.

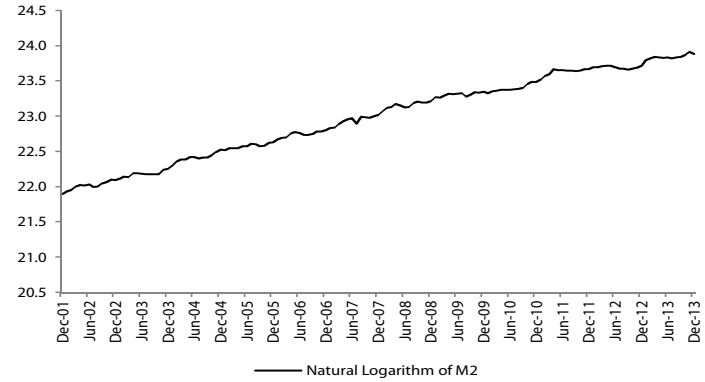
Adding a stochastic error term which captures all other variations in the data thus gives the following general regression model:

$$lnP_t = \alpha + \beta_1 lnM_t + \beta_2 lnY_t + \varepsilon_t$$

3.2 Data Description

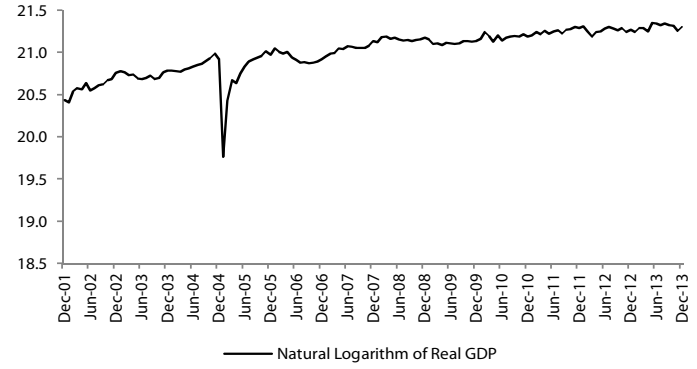
The data used in the study covers the period from December 2001 to December 2013 at monthly frequency, and thus comprises of 145 observations. The variables considered are: lnM2 – the natural logarithm of the monetary aggregate M2, *lnRGDP* – the natural logarithm of real GDP and *lnCPI* – the natural logarithm of the consumer price index. The natural logarithm is used here to arrive at the linear quantity theory equation and for general ease of interpretation. An additional dummy variable (*tsunami*) equal to 1 for the month January 2005 (and equal to 0 otherwise) and its 3 lags were also used to account for structural changes which occurred as a result of the December 2004 tsunami. The evolution of these variables over time is depicted in figures 1 to 3, and descriptive statistics are provided in Table 1.

Figure 1: Natural Logarithm of Money Supply (M2), Dec 2001–Dec 2013



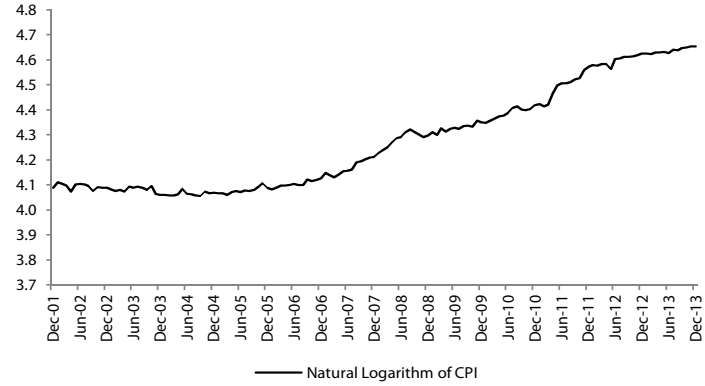
Source: Maldives Monetary Authority

Figure 2: Natural Logarithm of Real Gross Domestic Product, Dec 2001–Dec 2013



Source: National Bureau of Statistics

Figure 3: Natural Logarithm of Consumer Price Index, Dec 2001–Dec 2013



Source: National Bureau of Statistics

Table 1: Descriptive Statistics

Variable	Observations	Mean	Standard deviation	Minimum	Maximum
lnM2	145	22.987	0.592	21.903	23.916
lnCPI	145	4.277	0.204	4.057	4.656
lnRGDP	145	21.011	0.256	19.767	21.351

As per the general framework presented above, the dependent variable used is lnCPI. The data was obtained from the National Bureau of Statistics (2013) and is defined as the natural logarithm of the consumer price index for Male'. Augmented Dickey Fuller (ADF) tests indicated that the variable is non-stationary, and in particular, integrated of order 1[2] at the 5% significance level.

The independent variables of interest are *lnM2* and *lnRGDP*, obtained from the Maldives Monetary Authority and the National Bureau of Statistics (2013) respectively. *lnM2* is defined as the natural logarithm of the total money supply, including currency in circulation, demand deposits, time and savings deposits, and securities. ADF unit root tests suggest that *lnM2* is integrated of order 1 at the 5% level. Meanwhile, *lnRGDP*, which is the natural logarithm of real GDP (seasonally adjusted) also tested to be I(1)[3]. As the national accounts are published annually in the Maldives, the proportional Denton (1971) disaggregation method is used to compute monthly real GDP. Tourist bednights is used as the indicator series in the disaggregation process.

3.3 Estimation Techniques

An implication of the I(1) nature of the three variables is that conventional methods will likely lead to spurious regression, that is, indicate the presence of a significant relationship between variables when there truly is none. As such, a VECM is chosen (based on cointegration test results which follow) as the method of estimation in this case, as this will overcome the problems associated with the non-stationary series, and provide information on both the long-run and short-run dynamics.

2 A constant term was included in all unit root test regressions. Time trends were only included in the levels ADF tests as indicated by the plots of the variables.

3 MacKinnon's (1996) critical values are used for lnM2 and lnCPI. ADF tests indicated that lnRGDP is I(0). However, this contradicts with mainstream theory and so the stationarity of lnRGDP was re-checked using Kwiatkowski et al. (1992), that is, KPSS tests. Due to the low power of the ADF test, the KPSS tests are given priority in the case of lnRGDP. It should be noted that the null hypothesis (H0) of a KPSS test is that a given series is stationary, whereas for ADF tests, the H0 is that a given series is non-stationary.

Table 2: Unit Root Test Results[1]

lnM2 – levels	-2.4918	(ADF)
lnM2 – 1st difference	-6.4099***	(ADF)
lnCPI – levels	-2.1154	(ADF)
lnCPI – 1st difference	-3.5258**	(ADF)
lnRGDP – levels	0.1790**	(KPSS)
lnRGDP – 1st difference	0.1866	(KPSS)

Test statistics are reported.

Significance Levels: *** $P < 0.01$ ** $P < 0.05$ * $P < 0.1$

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To determine the structure of the VECM, Vector Autoregression (VAR) models of different lag orders were initially estimated using *lnM2*, *lnCPI* and *lnRGDP* as endogenous variables, and the dummy variable Tsunami and its first three lags as exogenous variables (constant terms were also allowed in the regressions). The model selection is based on the Bayesian Information Criterion (BIC), which indicated that a VAR model with one lag of all variables is most suitable. A Lagrange Multiplier (LM) test of autocorrelation on the residuals from the VAR(1) model did not reject the H_0 of no serial correlation at the 5% level up to and including the first twelve lags. The structure of the VAR(1) model is given below[4].

$$z_t = \rho + A_1 z_{t-1} + A_2 n_t + \varepsilon_t$$

$$\begin{pmatrix} lnCPI_t \\ lnM2_t \\ lnRGDP_t \end{pmatrix} = \begin{pmatrix} \rho_1 \\ \rho_2 \\ \rho_3 \end{pmatrix} + \begin{pmatrix} A_{1,11} & A_{1,12} & A_{1,13} \\ A_{1,21} & A_{1,22} & A_{1,23} \\ A_{1,31} & A_{1,32} & A_{1,33} \end{pmatrix} \begin{pmatrix} lnCPI_{t-1} \\ lnM2_{t-1} \\ lnRGDP_{t-1} \end{pmatrix} + \begin{pmatrix} A_{2,11} & A_{2,12} & A_{2,13} & A_{2,14} \\ A_{2,21} & A_{2,22} & A_{2,23} & A_{2,24} \\ A_{2,31} & A_{2,32} & A_{2,33} & A_{2,34} \end{pmatrix} \begin{pmatrix} tsunami_t \\ tsunami_{t-1} \\ tsunami_{t-2} \\ tsunami_{t-3} \end{pmatrix} + \begin{pmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \end{pmatrix}$$

4 In the VAR equation below, ϱ is a vector of constant terms, z_t is a vector of all the endogenous variables and h_t is a vector of all exogenous variables.

Based on the selected VAR model, trace tests were conducted to determine the rank of the matrix Π in the corresponding VECM (see below) as per Johansen (1995). An unrestricted constant is used in one test, while a restricted trend is used in the other. The results indicate that the rank of Π is two. Equivalently, this means that there are two cointegrating relationships between the variables, and that both of these relationships are stationary around constant means. The following VECM is therefore estimated.

$$\Delta z_t = \delta + \Pi z_{t-1} + B_1 h_t + \varepsilon_t$$

$$\begin{pmatrix} \Delta lnCPI_t \\ \Delta lnM2_t \\ \Delta lnRGDP_t \end{pmatrix} = \begin{pmatrix} \delta_1 \\ \delta_2 \\ \delta_3 \end{pmatrix} + \begin{pmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_3 \end{pmatrix} (\beta_1 \quad \beta_2 \quad \beta_3) \begin{pmatrix} lnCPI_{t-1} \\ lnM2_{t-1} \\ lnRGDP_{t-1} \end{pmatrix} + \begin{pmatrix} B_{1,11} & B_{1,12} & B_{1,13} & B_{1,14} \\ B_{1,21} & B_{1,22} & B_{1,23} & B_{1,24} \\ B_{1,31} & B_{1,32} & B_{1,33} & B_{1,34} \end{pmatrix} \begin{pmatrix} tsunami_t \\ tsunami_{t-1} \\ tsunami_{t-2} \\ tsunami_{t-3} \end{pmatrix} + \begin{pmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \end{pmatrix}$$

where $\alpha_3 = 0$

4. Results

4.1 Long Run Relationships

The results from the Johansen test for cointegration indicate that there are two long run (cointegrating) relationships between M2, real GDP and the price level. The first can be depicted as:

$$lnCPI = -6.486 + 0.468 lnM2$$
$$(0.050)$$

This relationship between the money supply and price level indicates that a 1% increase in the money supply results in a 0.5% increase in the general price level in the long run. It implies that the proposition of money neutrality does not hold in the case of the Maldives, as only half of the impact of rises in money supply is fed onto the price level over time. The result contradicts with Adam (2012, b) who estimated that the long-run elasticity of prices to the money supply is 0.95, which is close to what money neutrality suggests. The discrepancy between the results could be due to differences in the models employed and time period in these two studies. In particular, Adam (2012, a) included practically relevant variables like the Nominal Effective Exchange Rate and the prices

of foreign trade partners, while this study restricts the estimation equation to the naïve version of the quantity theory of money. As mentioned before, the aim of this paper is to apply the quantity theory of money to the domestic case. This result shows that the basic quantity theory does not hold for the Maldives.

The second cointegrating equation is:

$$lnRGDP = 14.173 + 0.298lnM2$$
$$(0.022)$$

This implies that a 1% increase in the money supply leads to a 0.3% increase in real GDP in the long run. The persistent increase in real GDP following increases in the money supply can be due to a feedback effect via government expenditure. As monetization is a prominent reason as to why M2 increases in the Maldives, the resulting public expenditure which in turn affects national output could be contributing to this long term effect. However, theory suggests that even if monetary expansions boost national income in the short to medium term, output eventually goes down towards potential in the long run. Therefore, this also suggests that long run money neutrality with respect to real output does not strictly hold in the Maldivian economy.

4.2 Short Run Analysis

As Table 3 shows, the short run analysis suggests that price shocks tend to dissipate at a rate of 3% per month (which is the coefficient of the error correction term of interest, that is, ec_CointEq1). The negative sign of the coefficient and its significance at the 1% level is evidence that an equilibrium relationship between prices, real income and the money supply does exist. The slow reversion to equilibrium implies that price setting in the local economy is to a significant degree characterized by sticky prices, possibly owing to factors such as menu costs or staggered contracts. The fit of this naïve model is not unreasonably low, with 8% of all variation in the data explained by this first cointegrating equation under the adjusted R-squared measure.

The second cointegrating equation (presented in Table 4) indicates that following a shock, real GDP reverts towards equilibrium at a rate of 8% per month. This coefficient is also negative and significant (at the 5% level), and the model does much better in terms of the goodness of fit with 92% of the variation in the data explained in this case.

Table 3: Results for the VECM – Short Run Dynamics

Dependent Variable: $\Delta lnCPI_t$	
Error Correction	
ec_CointEq1	-0.031***
	(0.011)
ec_CointEq2	0.01
	(0.018)
$\Delta lnCPI_{t-1}$	-0.121
	(0.083)
$\Delta lnRGDP_{t-1}$	-0.034
	(0.027)
$\Delta lnM2_{t-1}$	-0.033
	(0.038)
$Tsunami_t$	-0.009
	(0.012)
$Tsunami_{t-1}$	-0.034
	(0.035)
$Tsunami_{t-2}$	0.018
	(0.024)
$Tsunami_{t-3}$	0.015
	(0.014)
Constant	0.005***
	(0.001)
R^2	0.138
Adj. R^2	0.079
Number of Observations	142

Test statistics are reported.

Significance Levels: *** $P < 0.01$ ** $P < 0.05$ * $P < 0.1$

Note: ec_CointEq1 and ec_CointEq2 are the error correction terms for the cointegrating equations 1 and 2 respectively.

Table 4: Results for the VECM – Short Run Dynamics

Dependent Variable: $\Delta lnRGDP_t$	
Error Correction	
ec_CointEq1	-0.083**
	(0.033)
ec_CointEq2	-0.283***
	(0.053)
$\Delta lnCPI_{t-1}$	-0.162
	(0.245)
$\Delta lnRGDP_{t-1}$	-0.061
	(0.079)
$\Delta lnM2_{t-1}$	-0.131
	(0.112)
$Tsunami_t$	-1.152***
	(0.034)
$Tsunami_{t-1}$	0.267***
	(0.102)
$Tsunami_{t-2}$	0.143**
	(0.071)
$Tsunami_{t-3}$	-0.096**
	(0.041)
Constant	0.014***
	(0.003)
R^2	0.928
Adj. R^2	0.923
Number of Observations	142

Test statistics are reported.

Significance Levels: *** $P < 0.01$ ** $P < 0.05$ * $P < 0.1$

Note: ec_CointEq1 and ec_CointEq2 are the error correction terms for the cointegrating equations 1 and 2 respectively.

This implies that although changes in real output were found to persist in the long run to a certain extent following a change in the money supply, there still is some degree of reversion to the trend level of output in the short run.

Based on the results, long run neutrality of money does not appear to strictly hold in the Maldives. This means that monetary policy could have a role in influencing real output depending on the phase of the business cycle. However, it is also clear that real output does exhibit reversion to trend following any deviation from it in the short run. This suggests that although a potential stabilization role for monetary policy exists, the effectiveness of such measures may be limited. In addition, as increases in the money supply do not lead to proportional increases in the price level in the long run, the money supply could be used as a policy tool without generating too much inflationary pressure.

5. Conclusion

This study investigated the proposition of long run money neutrality for the Maldives using the basic form of the quantity theory of money. It was found that money neutrality does not strictly hold in the long run, and that real output and prices tend to revert to trend or equilibrium following any deviations, albeit at a slow rate. This implies that monetary targeting could be utilized to some extent to influence economic activity without too much of a burden in the form of inflation. It is important to highlight that this study restricts the estimation equation to the naïve version of the quantity theory of money and therefore is only intended as a starting point for future studies in the area. Therefore, extending the model to capture other relevant factors will be necessary to identify policy implications.

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