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Full Length Research Paper

Dynamic modeling of stability of money demand and minimum wages

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Dynamic modeling is a vital policy instrument in measuring macroeconomic stability of the economy and monetary planning. This study was conducted to explore long term dynamic behavior of the narrow money supply to investigate the nexus between money demand and minimum wages and their impact on macroeconomic stability in Sri Lanka. The empirical approach was directed to estimate a Vector Auto regression (VAR) function through unit root and cointegration, and vector error correction models. The coefficients of the Vector Error Correction Model (VECM) were used to determine the long term elasticity of the dynamic model, and impulse response function was derived to examine the stability of the macroeconomic equilibrium. The multiplier effect depicted that though 72% of the long-run effect can be found, minimum wage on money demand, time adjustment of wage is sluggish compared to money demand changes. The impulse response behavior of the minimum wage underscored the macroeconomic stability of the wage-money demand adoption in Sri Lanka. Finally, monetary policy implications were recommended for the relevant entities to adjust minimum wage with the money demand to preserve the narrow money supply.

Key words: Dynamic modeling, money demand, minimum wage, impulse response function.

INTRODUCTION

Adamant monetary policy in a particular economy is integral in structuring a business environment of a country. However, numerous studies on money demand have been conducted to investigate the causal underline factors to change money demand in diverse economies. Although, the demand for narrow money is a controversial issue in monetary studies for theory and policy, various researches has been conducted to provide the pragmatic evidences for the monetary instability and policy alternatives.

A significant proportion of the empirical research in monetary economics during the previous years has been devoted to search for robust econometric specifications of empirical models of the demand for money with theoretical rationality. Among the many scholarly works, the works of Hendry and Ericson (1991) for the US and the UK demand for money have contributed enormously to the debates on money demand forecasting and policy (Wolters et al., 1998; Beyer, 1998). Some works on money demand integrated with the monetary base, Narrow Money (M1): “a category of the money supply that includes all coins, currency and demand deposits”, as monetary aggregates and the GDP as the scale variable predicting a linear specification (Carrasquilla and Renteria, 1991; Oliveros and Misas 1997; Gómez, 1998). Empirical studies that have contributed to examine the money demand on different economies showed the recent development of the area to provide monetary policy. King et al. (1988a, 1988b) argued that short and long run economic fluctuations are seen as responses of a competitive economy to persistent stochastic shocks in its technology. Pre-cointegration studies of the demand for money in Caribbean countries included Bourne (1974), Howard (1979; 1981), McClean (1982), Worrell (1985), Watson and Ramkissoon (1987), and Watson (1988) for a critical review of the pre-1990 literature

JEL: C22, C53, E41, E52.

provide the importance of investigating the money demand of the country for macroeconomic stability. An early Caribbean application of the cointegration approach is Craigwell (1991) that looked at the demand for money in Jamaica using the Engle-Granger procedure. One of the more promising developments in the recent literature is on the VAR approach (Pesaran and Smith, 1998; Garratt et al., 1999). Traditional structural VAR modeling, following the lead of Blanchard and Quah (1989), typically employs covariance restrictions in order to derive some ideas about the VAR content of the model for monetary policy.

In the case of Sri Lanka as revealed by the Central Bank (2004), drastic changes in the food and energy prices have been adversely affected by stability of money demand, with the impact of inflation, appears to be a constraint to the economic growth, which ranks as fourth most problematic factors creating a cohesive business environment as in Figure 1. The policies aimed at promoting competitiveness need to focus on minimizing monetary risks and providing business friendly economic environment, in which enterprise can choose from a wide array of options to improve their competitiveness. The role of the government is to facilitate macroeconomic and institutional framework, leaving enterprises to take business decisions regarding the improvement of competitiveness across the economy. Thus, monetary stability has a key role as major facilitating factors of the competitiveness and thereby business environment and ultimately leads to economic growth and the development (CBSL, 2004). Therefore, investigation of the monetary stability of Sri Lanka in long term basis and forecasting money demand is vital to determine the appropriate monetary policy.

Rationale for monetary policy

Macroeconomic management can be improved through prudent physical, monetary and income policies, while establishing an environment focusing on operating market oriented policy regime. There is need for the country to have a strong and sustainable fiscal adjustment strategy to improve macroeconomic management of the monetary and fiscal policy. There has been monetary policy attempts to influence the economy by operating on monetary variables such as the quantity of money, growth rates and the rate of interest.

There are substantial studies on money demand and its fluctuation in the economy which attempted to understand the risk of money demand in future with the relevant macro-variables forecasting the future and reporting a close long-run relation between money demand and inflation. The finding relies on the presence of countries with high money growth and inflation. It is a direct result that a close relationship exists within countries with relatively small changes in money growth. However, even if a close relationship between money growth and inflation exists over the long run, that relationship might not be visible over short time horizons. Consequently, a close relationship between money growth and inflation that exists only over long time horizons use for policymakers trying to control inflation over the next months or quarters rather than years. Money will no longer be seen as a proper standard dimension for guiding monetary policy decisions without a stable demand function. Hence, a reliable stable relation between the money stock and other macro variables such as output, interest rates, and prices need to be captured with the money demand function to be stable. Most empirical results suggest that a relatively close relationship between money growth and consumer price inflation seems to exist at least over long time horizons. This finding could serve as a reminder that ignoring money growth for too long a period may be unwise when central banks aim at keeping consumer price inflation in verifying. Therefore, investigating the money demand nexus in Sri Lanka is vital for relevant government entities to determine and predict the incidences to prepare future monetary policies.

The rest of the paper is organized as follows. The second section briefly outlines the theoretical considerations behind the empirical models for money demand. The third section describes the data sources and empirical model of money demand. The next section presents the estimation results and forecasting results, while the final section includes conclusion and policy implications.

THEORETICAL BACKGROUND

Money demand has been contemplated with the stability of the economy. In the empirical section the money demand model was specified for the long-term demand for money as following:

$$M / P = f(GDP, OC) \quad (1)$$

Where the demand for real balances *M/P* is measured as a ratio of narrow money aggregate *M* in nominal term and the price level *P*. Estimation of the real demand for money implicitly implies that money neutrality and price homogeneity hold in the long run. The demand for real money is modeled as a function of the two categories of variables: the scale variable that reflects the scope of economic activity, typically approximated by the real GDP, and the opportunity costs of holding money OC, approximated by the long-term interest rate IR and by the inflation CPI, which largely reflect two main purposes for

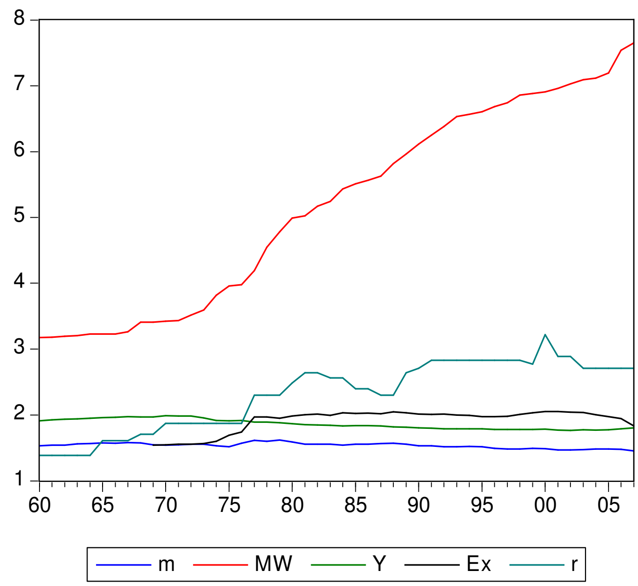

Figure 1. Annual changes of Money demand, minimum wages, real income, exchange rate and interest rate in Sri Lanka (X- log value and Y- Years for all graphs).

holding money as stipulated by the economic theory as represented by Equation (2). The first motive for holding money is to perform transactions and in this analysis the magnitude of transactions is represented by the real GDP. The second motive for holding money is portfolio diversification, where the interest rate indicates the rate of return to financial assets not included in the monetary aggregates and the inflation rate represents the cost of holding money instead of holding real assets (Ericsson, 1998).

The long-run money demand, when log transformed, reads as follows:

$$\Delta Ln\, m_t = \beta_1 + \beta_2 \ln Y_t + \beta_3 \Delta \ln MW_t + \beta_4 \ln r_t + \beta_5 \ln Ex_t + \varepsilon_t \quad (2)$$

Where the coefficients β_2, β_4, and β_5 denote the long-run elasticities of money demand (m_t) with respect to income (Y_t) and to interest rate (r_t), and the long-run semi-elasticity of money demand with respect to exchange rate (Ex_t), respectively.

The former coefficient is positive as demand for money increases with income, whereas the latter two coefficients are negative. An increase in the long-term interest rate leads to shift in portfolio towards the longer-term investment and hereafter reduces demand for money. Similarly, rise in inflation reduces the value of monetary assets and henceforth tends to reduce demand for it. Finally, the term ε denotes the error-correction term that measures deviations from the long-run equilibrium given in Equation (2). As mentioned by Sriram (2001), this is the ultimate specification structure for the money demand that is common to most of the studies even though each study may be different from the rest in choice of either the dependent or independent variables.

The main objective of the paper is to establish a long run dynamic nexus of money demand and minimum wages for Sri Lanka. The sub objectives are to evaluate a dynamic behavior of the narrow money demand, and its stability in the economy. Further, the analysis was extended to test the dynamic changes of the narrow money demand with the changes of minimum wage. The policy objective of the paper is to develop the monetary policy for responsible entities in Sri Lanka.

DATA AND ECONOMETRIC MODELLING

The secondary data used for the analysis were annual observations of the variables from 1960 to 2007 from Central Bank of Sri Lanka. The Consumer Price Index was collected from Department of Census and Statistics Sri Lanka while the minimum wage was determined by the Central Bank of Sri Lanka was used to establish a dynamic model of the money demand and minimum wages.

These macroeconomic variables are specified into the following econometric modeling as:

$$m_t = \beta_0 + \beta_1 Y_t + \beta_2 r_t + \beta_3 Ex_t + \varepsilon_t \quad (3)$$

Where m_t = $\ln(M_t^d / P_t)$ = the natural logarithm of the real narrow money deman. P_t = consumer price index. Y_t = $\ln(GDP_t / GDPD_t)$ = the logarithm of real GDP. $GDPD_t$ = GDP Deflator. r_t = interest rate. Ex_t = real exchange rate. ε_t = stationary disturbance term

Money demand and income are only expressed in logarithms. The problem confronting the estimation of the demand function for money is that the real income, money demand, price level, interest rate and exchange rate can all be characterized as nonstationary *I* (1) variables. As such, each variable can be explained without any tendency to return to a long-run level. However, the theory expressed in the equation asserts that there exists a linear combination of these nonstationary variables that is stationary.

Unit root test

Unit root test investigates the stationary nature of the variables in time series data. The Augmented Dickey-Fuller (ADF), Phillips-Perron (PP) test was used to investigate the stationary behavior of the time series variables (Dickey and Fuller, 1979; Phillips, 1987; Phillips and Perron, 1988). The PP tests are based on the following ADF regression, and the critical values are the same as those used for the ADF tests:

$$\Delta y_t = \delta_0 + \delta_1 y_{t-1} + \delta_2 t + \sum_{i=1}^{n} \phi_i \Delta y_{t-1} + \varepsilon_t \quad (4)$$

Where Δ is the difference operator, Y is the natural logarithm of the series, t is a trend variable, δ and ϕ are the parameters to be estimated and ε is the error term.

The PP unit root test is utilized in this case in preference to ADF unit root tests for the following reasons. The PP tests do not require an assumption of homoscedasticity of the error term (Phillips, 1987) and the test corrects the serial correlation and autoregressive heteroscedasticity of the error terms (Phillips and Perron, 1988).

Vector autoregression estimation and cointegration

A vector autoregression (VAR) is a model in which K variables are specified as linear functions of p of their own lags, p lags of the other K-1 variables, and possibly additional exogenous variables. Algebraically, a p-order vector autoregressive model is written as VAR (p), with exogenous variables x_t.

A VAR allows the data to determine the precise model specification and treats all variables as potentially endogenous. Thus, a general polynomial distributed lag framework or VAR (k) model:

$$x_t = \prod_1 x_{t-1} + \prod_2 x_{t-2} + \ldots + \Pi_k x_{t-k} + \mu + \varepsilon_t \quad (5)$$

With an equilibrium- correcting form such that,

$$\Delta x_t = \Gamma_1 \Delta x_{t-1} + \ldots\ldots\ldots\ldots + \Gamma_{k-1} \Delta x_{t-k} + \prod x_{t-k} + \mu + \varepsilon_t \quad (6)$$

Where $t=1,\ldots T;$ vector of endogenous variables that are linear functions of past values of and is a (n×1) vector of constants.

Accordingly the multivariate VAR can be developed with the following specifications:

$$\Delta Logm_t = \beta_0 + \beta_1 \log Y_t + \beta_2 \Delta \log MW_t + \beta_3 \Delta \log r_t + \varepsilon_t \quad (7)$$

Where m_t is the logarithm of real money supply, Y_t is the logarithm of real income, MW_t is the logarithm of minimum wages. In the model, money demand and minimum wages are integrated while keeping other variables as exogenous.

The presence of long run equilibrium relationship between dependent and independent variables is referred to as cointegration. The two common tests for cointegration are the procedure of Engle and Granger (1987) and the procedure of Johansen and Juselius (Johansen and Juselius, 1990; Johansen, 1992). The two-step procedure of Engle and Granger performs the tests in a univariate setup. Based on these studies, the multivariate cointegration equation can be specified as follows:

$$\Delta L m_t = \theta + \delta \Delta LMW_t + \Pi_1 X_1 \ldots\ldots \Pi_n X_n + u_t \quad (8)$$

Where, m is the money demand and MW is the minimum wage, while Xs are endogenous variables. Following the Johansen and Juselius procedure in defining a vector X_t of n potentially exogenous variables, it is possible to specify the following data generating process and model X_t as an unrestricted vector autoregressive (VAR) involving up to t-kth lag of X_t:

$$X_t = A_1 X_{t-1} +, \ldots A_k X_{t-k} + \varepsilon_t \qquad \varepsilon_t \sim IN(O, \Omega) \quad (9)$$

Where, X_t is (2×1) and each of $A_1$is a (2×2) matrix of parameters in this study. This type of VAR model has been used to estimate dynamic relationships among jointly endogenous variables without imposing strong priori restrictions by Sims in 1980. The VAR system is in the reduced form, in which each variable in X_t regressing with its own lag values and all other variables in the system but not with their lags.

Where;

$$\Gamma_i = -I + \sum_{j=1}^{i} A_j (for I = 1, \ldots. k-1), and\, \Pi = -I + \sum_{j=1}^{i} A_j \quad (10)$$

The Granger representation theorem states that if the coefficient matrix Π has reduced rank $r<n$, then there exists $n \times r$ matrices α and β, each with rank r such that $\Pi = \alpha\, \beta'$and $\beta' X_t$ is stationary. r is the number of cointegrating relations (the cointegrating rank) and each column of β is the cointegrating vector. The elements of α are known as the adjustment parameters in the vector error correct model. The cointegrating vector β is defined as the eigenvalues associated with the r largest statistically significant eigenvalues derived earlier using two test statistics namely, maximum eigenvalue statistic and trace statistic. The first statistic tests the hypothesis that there exist r cointegrating vectors by calculating the maximum likelihood test statistic, LR max, as below:

$$LR_{\max} = -T \ln(1 - \lambda_{r+1})$$

Where T is the sample size and λ_{r+1} is an estimated eigenvalue.

The second statistic, the trace statistics, (LR trace) tests the hypothesis that there exist at most r cointegrating vectors by computing the likelihood test statistic given by:

$$LR_{trace} = -T \sum_{i=r+1}^{n} \ln(1 - \lambda_1) \quad r = 0,1,2,\ldots. n-1$$

Where T is the sample size and $\lambda_{1,\ldots} \lambda_n$ is the estimated n-r smallest eigenvalues. (Park and Hahn, 1999)

Vector error correction models

The above variables are associated with the VAR approach to cointegration, before we can form the VECM, we need to ensure the variables are cointegrated; as with the bi-variate ECMs. There are other considerations though in this case, as if there is more than one cointegrating vector, we can in theory have more than one error correction term. However apart from this the VECM has the same properties as with the bi-variate ECM.

The dynamic relationship includes the lagged value of the residual from the cointegrating regression e_{t-1} besides the first difference of variables appear as regresses of the long-run relationship such as real income, inflation rate, interest rate and real exchange rate. The inclusion of the variables from the long-run relationship can capture short run dynamics, and thus the dynamic relationship is stated as following with the exogenous variables:

$$\Delta m_t = \beta_0 + \beta_1 Y_t + \beta_2 \Delta MW_t + \beta_3 Ex_t + \beta_4 r_t + \beta_5 \varepsilon_{t-1} \qquad (11)$$

It is essential to test if the long-term demand relationship established in the model is given the short-run disturbances. Thus, a dynamic error correction model, forecasting the short-run behavior of minimum wage and Money demand, is estimated on the basis of cointegration relationship. For this purpose the lagged residual-error derived from the cointegrating vector is incorporated into a highly general error correction model. This leads to the specification of a general error correction model (ECM).

After establishing a cointegrating relationship, a VECM can be estimated subsequently to determine the short-run dynamic behavior of minimum wage. The general-to-specific modeling approach was followed, first including two lags of the explanatory variable and of the error correction (EC) term, and then gradually eliminating the insignificant variables in the approach. After experimenting with the general form of VECM, the following VECM is found to be the best fitting model in the data (Banerjee, et al., 1996).

Impulse response function

The impulse response functions can be used to produce the time path of the dependent variables in the VAR, to make shocks from the explanatory variables such as money demand and minimum wage. If the system of equations is stable any shock should decline to zero, an unstable system would produce an explosive time path. Consider a basic VAR (1) model:

$$Y_t = A_1 Y_{t-1} + u_t$$

Where *y* is a narrow money supply, if we then assume a simple two narrow money supply system, then the matrices and vectors in full would be:

$$\begin{bmatrix} y_t \\ z_t \end{bmatrix} = \begin{bmatrix} a_{10} \\ a_{20} \end{bmatrix} + \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} \begin{bmatrix} y_{t-1} \\ y_{t-1} \end{bmatrix} + \begin{bmatrix} u_{1t} \\ u_{2t} \end{bmatrix}$$

The next step is to calculate the value for each dependent variable, given a unit shock to the variable y_t at time $t = 0$. The value of each dependent variable can be determined using the IRM of the series to promote numerous coefficients of the variables.

The temporal values are changed from $t = 0,1,2....$ etc. In this case there is no effect in the z_t variable due to the way the model is set up, however if the y_{t-1} variable had been significantly different to zero, then the shock would have affected both variables.

The specification for the analysis is:

$$\begin{bmatrix} y_t \\ z_t \end{bmatrix} = \begin{bmatrix} \bar{y} \\ \bar{z} \end{bmatrix} + \sum_{i=0}^{\infty} \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}^i \begin{bmatrix} u_{1t-1} \\ u_{2t-1} \end{bmatrix}$$

The specification can be explained into the matrix system that provides the functions in the system to the elaborated in the form of the IRM equation.

$$\begin{bmatrix} u_{1t} \\ u_{2t} \end{bmatrix} = \left[1/(1-b_{12}b_{21})\right] \begin{bmatrix} 1 & -b_{12} \\ -b_{21} & 1 \end{bmatrix} \begin{bmatrix} \varepsilon_{yt} \\ \varepsilon_{zt} \end{bmatrix}$$

$$\begin{bmatrix} y_t \\ z_t \end{bmatrix} = \begin{bmatrix} \bar{y}_t \\ \bar{z}_t \end{bmatrix} + \left[1/(1-b_{12}b_{21})\right] \sum_{i=0}^{\infty} \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}^i \begin{bmatrix} 1 & -b_{12} \\ -b_{21} & 1 \end{bmatrix} \begin{bmatrix} \varepsilon_{yt} \\ \varepsilon_{zt} \end{bmatrix}$$

Since the notation is getting unwieldy, the model can be simplify by defining the 2×2 matrix ϕ_i with elements $\phi_{jk}(i)$

$$\phi_i = \left[A_1^i /(1-b_{12}b_{21})\right] \begin{bmatrix} 1 & -b_{12} \\ -b_{21} & 1 \end{bmatrix}$$

Finally the specification can be developed into a matrix form which includes the IRF specification of the variables including the coefficients derived from the specification.

$$\begin{bmatrix} y_t \\ z_t \end{bmatrix} = \begin{bmatrix} \bar{y} \\ \bar{z} \end{bmatrix} + \sum_{i=0}^{\infty} \begin{bmatrix} \phi_{11}(i) & \phi_{12}(i) \\ \phi_{21}(i) & \phi_{22}(i) \end{bmatrix}^i \begin{bmatrix} \varepsilon_{yt-i} \\ \varepsilon_{zt-i} \end{bmatrix}$$

More compactly:

$$x_t = \mu + \sum_{i=0}^{\infty} \phi_i \varepsilon_{t-i}$$

The four sets of coefficients $\phi_{11}(i)$, $\phi_{12}(i)$, $\phi_{21}(i)$ and $\phi_{22}(i)$ are called the impulse response functions.

This process continued until the value of the dependent variable either becomes zero (stable) or very large (unstable). We could have done the same process with y_{2t}, although in this case the dependent variable would have been affected by both explanatory variables, giving two separate time paths.

EMPIRICAL RESULTS

The paper investigates a long term dynamic relationship between money demand and minimum wages for Sri Lanka from 1960 to 2007 by using a dynamic model. The empirical model specification uses Unit-root test,

Table 1. Tests for unit roots.

Unit roots	Augmented Dickey-Fuller		Phillips-Perron	
	Levels	First differences	Levels	First differences
Lm_t	-3.32**	-4.28***	-2.31	-4.62***
LY_t	-3.14	-3.44**	-3.42**	-4.07**
LMW_t	-2.30	-3.43**	-2.34	-4.44***
Lr_t	-1.61	-8.01***	-1.61	-8.01***
LEx_t	-2.34	-4.60***	-2.24	-4.13***

1. The lag parameters on the variables in ADF regressions are selected by Akaike Information Criterion.
2. The null hypothesis of the PP is that of stationarity and can be rejected when the reported statistic exceeds asymptotic critical values of -4.53, -3.67, and -3.27 at 1, 5, and 10% levels, respectively. 3. (***) Significant at 1% level. (*) Significant at 10% level and I-Intercept/ T-Trend. [Note: Lm – Log for Money Demand, LY-Log of real Gross Domestic Product, LMW- Log of Minimum Wages, Lr – Log of Interest Rate, LEx – Log of Exchange Rate].

Table 2. Johansen and Juselius cointegration rank test.

Hypothesized No. of CE(s)	Eigenvalue	Trace statistic	5 % critical value	Maximum Eigenvalue	5 % critical value
None *	0.709	85.625	69.819	45.747	33.877
At most 1	0.442	39.878	47.856	21.587	27.584
At most 2	0.289	18.290	29.797	12.628	21.132
At most 3	0.138	5.662	15.495	5.506	14.265
At most 4	0.004	0.156	3.841	0.156	3.842

Series: Lm, LGDP, LMW, Lr, LEx.

Table 3. Cointegrating vectors.

LM test statistic[a]	Joint-Jarque-Bera test statistic[b]	Cointegrated equation
10.283	16.969	$m_t = 2.146 - 1.774Y_t + 0.127MW_t - 0.043Ex_t + 0.017r_t$
		(0.438) (0.432**) (0.413***) (0.477***) (0.324***)

Number of observations = 48; optimal lag length = 1; (*), (**) and (***) indicate 10%, 5% and 1% level of significance, respectively; and figure in the parentheses indicate *t*-statistics. [a]The null hypothesis of no serial correlation at lag order 1 is not rejected at the 5% level of significance. [a]The null hypothesis of residual are multivariate normal is not rejected at the 5% level of significance.

Cointegration, Vector Error Correction Model, Impulse Response Function. The results of the dynamic model were investigated in the following section.

Unit root test

Based on the unit root test as depicted in Table 1, all unit root tests yield remarkably similar results for all variables LM_t, MW_t, Ex_t, Y_t and r_t are non stationary in the levels *I*(0) but become stationary with the first differences *I*(1). Thus, the conclusion was that all series are *I*(1) at 1% of significance.

Cointegration test

Cointegration test specified that m_t, and MW_t share common integration properties. For the testing of the presence of a common trend, a long run cointegrating relationship between the variables was embarked. Table 2 provides the existence of cointegration relationship between money demand and minimum wages. The cointegration results of Table 3 revealed that there is an

Table 4. Vector error correction model.

Model	Money demand	Minimum wage
EC_{t-1}	-0.662(0.136)***	-0.852(0.844)***
Δm_{t-1}	0.263(0.135)	1.314(0.836)**
Δm_{t-2}	-0.059(0.151)***	0.793(0.932)***
ΔMW_{t-1}	0.022(0.030)	0.158(0.185)
ΔMW_{t-2}	0.035(0.036)***	-0.042(0.224)**
C	-0.935(0.313)***	0.742(1.937)***
Y	0.344(0.127)**	0.301(0.783)**
r	0.186(0.038)**	0.012(0.240)**
Ex	-0.026(0.015)***	-0.043(0.095)***
$EC_t = m_t - 0.348MW_t - 0.374$		
R-squared	0.600	0.348
Adj. R-squared	0.494	0.175
S.E. equation	0.013	0.078
F-statistic	5.638	2.007
Akaike AIC	-5.686	-2.041
Schwarz SC	-5.302	-1.657
Diagnostic tests		
Residual Serial Correlation- LM test		13.246
Joint Jarque-Bera Normality test		12. 834

(***) Significant at 1% level; t=1.679, p<0.05; t=2.412, p<0.01.

empirical long run relationship at zero order level between money demand and minimum wage in Sri Lankan economy.

According to Table 3, the estimated cointegrating vector is $m_t = 2.146 + 0.127MW_t$ which indicates the long-run effect of MW_t on money demand is 0.13. Further, all other exogenous variables are significant. Based on this long run evidence, it can be concluded that the increase of minimum wage does increase money demand. Further, the real income, exchange rate and interest rate are both internal and external factors that affect the money demand changes in long run. The results of the diagnostic tests, LM test and the normality test, showed the significant statistical linkage in the long run estimates.

Vector error correction model

The results of short run estimates revealed at least one of the lagged variables of all variables in the system is statistically significant at 5 or 1%. The result indicates that the error correction term, EC_{t-1} has negative sign (-0.0662) as expected, and is statistically significant; thus providing the evidence of cointegration relationship among variables in the model. Further confirmation of the behaviour of ECM was tested with the Lagrangean Multiplier and Joint Jarque-Bera Test of autocorrelation and normality. The dynamic effect of money demand and the minimum wage as estimated by VECM in Table 4 showed that the long run interaction is significant for both variables and the signs are as expected. The multiplicative effect for money demand and wage rate were calculated and multiplier effect of the minimum wage stood at 0.6842, while the adjustment speed for the minimum wage and the money demand were 0.0022 and 0.0028 respectively. The loading factor that measures the speed of adjustment back to the long-run equilibrium level is statistically significant and correctly signed as negative. This implies that an error correction system exists so that the deviation from long run equilibrium could have a significant impact on money demand. This provides further support for the use of an error correction framework. Further, the estimated value of EC_{t-1} is -

Table 5. Variance decomposition responses of money demand.

Years	Money demand	Minimum wage
1	100.0000	0.000000
2	99.54866	0.451341
3	96.23357	3.766426
4	95.84800	4.152002
5	95.44464	4.555357

Note: variables are log levels as specified in ECM, with one cointegrating vector. Lag length of variable is two.

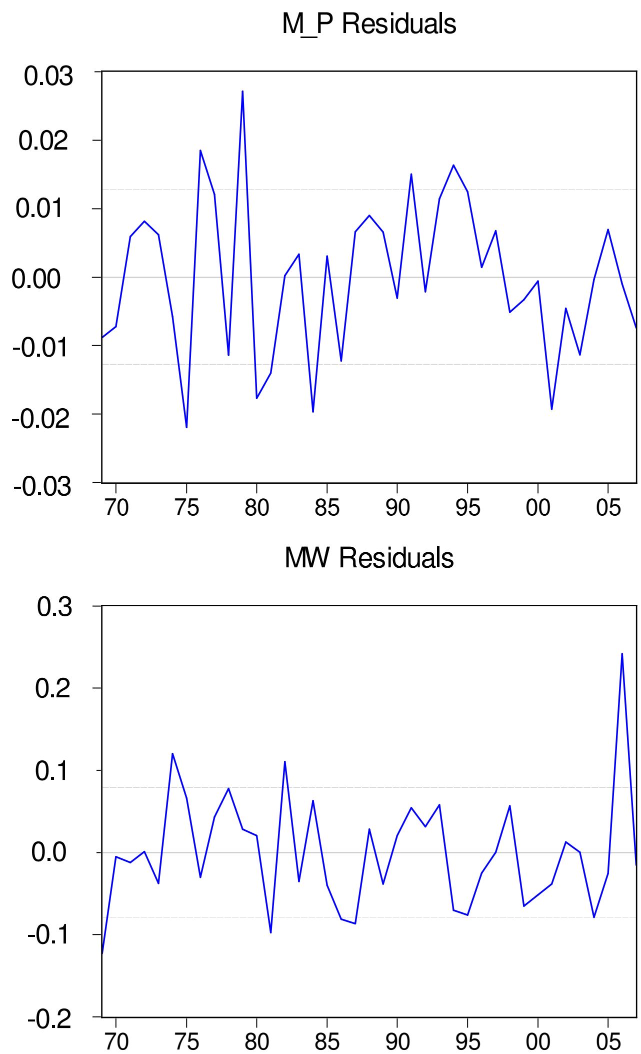

Figure 2 . Residuals of money demand and minimum wages.

0.0662, indicating that the adjustment speed to the long run equilibrium in response to the equilibrium caused by the short run shocks of the previous period is 6.6% in the economy. The evidence of the calculations depicts that minimum wage adjusts very slowly relative to money demand adjustment.

Variance decomposition (VDC) (Table 5) provides the evidence on the VDC estimates which contain an increasing trend, even though the magnitude of the estimates is low. Accordingly, the results implied that the minimum wage is a relatively minor-league in explaining forecast error variance of money demand in Sri Lanka.

Additionally, the impulse response function (IRF) examined various responses of money demand to changes in minimum wage. The IRF derived from ECM accounts for the dynamic responses based on shock of minimum wage (Figures 2 and 3). The response of money demand to one standard deviation shock of minimum wage is equivalent to zero indicating the stability of the system. In summary, these findings provide the policy challenges that Sri Lankan economy requires a proper macroeconomic climate to tackle money demand changes in the economy.

The impulse response functions can be used to produce the time path of the dependent variables in the VAR to shocks from all the explanatory variables. If the system of equations is stable any shock should decline to zero, an unstable system would produce an explosive time path. The impulsive response model in Figure 3 showed the LMW and money demand separately to examine the shocks on LMW by one standard difference of money demand. The same process can be applied with money demand too, although in this case the dependent variable would have been affected by explanatory variables, giving two separate time paths. Accordingly, the system becomes stable since minimum wage and the money demand close to zero.

Theory on money demand suggested the demand for money is determined by the money demand, interest rate, income growth and minimum wages. However, the relationships of these macro-variables vary with the money demand as predicted by the VAR model.

However, these relationships and the macroeconomic stability are vital for this monetary policy development in Sri Lanka. Therefore the results indicated that the changes in money demand is a combination of changes in macro variables which need to be monitored by the relevant government entities to persevere monetary stability of the country. The empirical investigation which provides the pragmatic evidences on fluctuations of narrow money demand imply that the wage rate needs to be adjusted based on the changes in money demand, being vulnerable to economic shocks and money demand insecurity. Hence the study attempted to build a nexus between money demand and minimum wage by establishing a stable macro-economy.

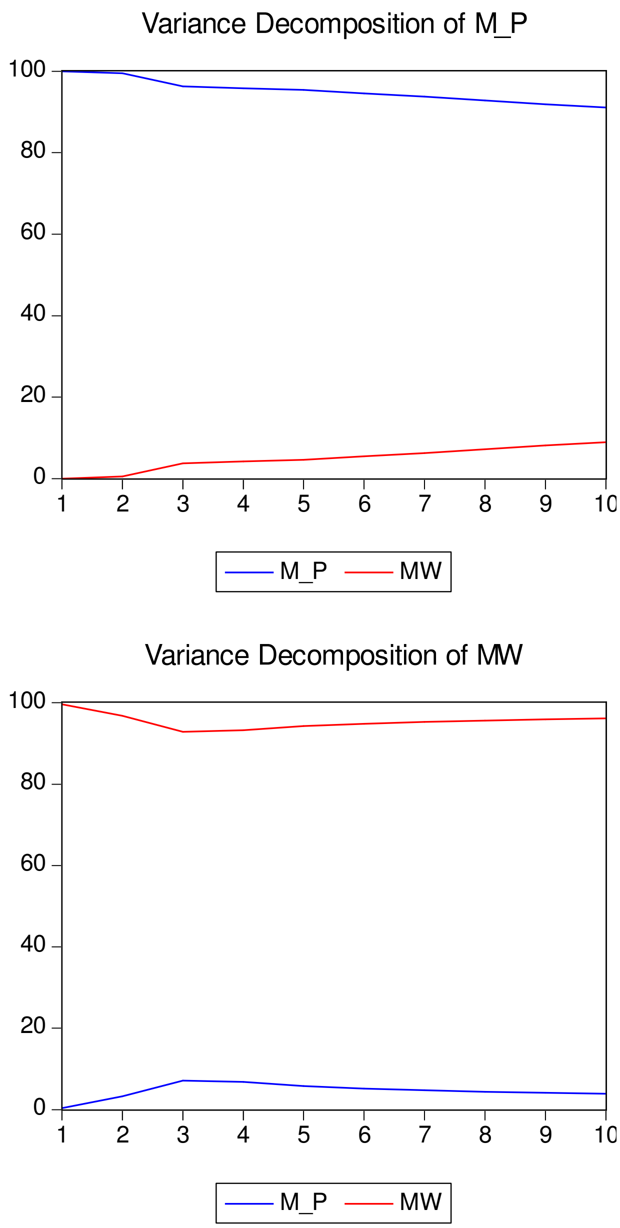

Figure 3. Impulse response functions of money demand and minimum wages.

Conclusions

This study draws key policy conclusions for money demand stability in Sri Lanka. The long run relationship between minimum wages and money demand implies that policy determinations need to focus on the impact of minimum wage adjustment on money demand. Besides, the multiplier impact depicted that though 72% of the long-run effect can be found through minimum wage on money demand; time adjustment of wage is very sluggish compared to money demand changes. The impulse response behavior of the minimum wage underscored the macroeconomic instability of the wage-money demand adoption in Sri Lanka. Finally, policy implications can be suggested for the relevant entities to adjust minimum wage with the money demand to preserve the narrow money supply.

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