DO STOCK PRICES PLAY A SIGNIFICANT ROLE IN FORMULATING MONETARY POLICY? A CASE STUDY*

1. Introduction

The theory of money demand has been explained using different models. Economic theory says that a basic money demand function depends on variables that reflect the level of transactions in the economy such as real income or real wealth, and opportunity cost variables such as the rate of interest or the rate of inflation. This setting does not take into account investment decision by investors, which are reflected in the stock price movements. The money demand function is one of the key models monetary policy makers' use, as certain measures of money are reliably linked to objectives of policy. These may include intermediate targets such as long-run economic growth (represented by percentage change in real GDP) and steady inflation. The Australian government influences money supply and changing short-term interest rates to ease or tighten the level of economic activity.

The general perception among policy makers is that a theoretically coherent and empirically robust money demand function is crucial for sound monetary policy formulation. Most papers in the literature show money demand as function of interest rates, real income but some papers introduce variables like real stock prices in their models.

According to Friedman (1988) movements in stock prices may have two kinds of effect, a positive income effect and a negative substitution effect. There are several reasons why a growth in stock

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prices may have positive wealth effects, that is, an increase in demand for money. Increases in capital gains tend to increase shareholders wealth, thereby producing a positive effect. The risk-return trade-off concept in finance tells us that fluctuations (measured by variance or standard deviation) of stock prices indicate an increase of risk in the market, thereby resulting in higher expected returns. This increase in expected return from risky assets may result in investors shifting from safe assets and moving towards equities. Friedman argues that a change in relative valuation does not have to be accompanied by a decrease in risk aversion or an increase in risk preference. Thus, the resulting increase in relative risk may induce economic agents to hold larger amounts of safer assets, such as money, in their portfolio. For some investors, an increase in stock prices may induce a rise in the volume of financial transactions. Investors will require higher money balances to facilitate the increase in financial transactions. This effect is particularly large in countries where equities are frequently traded on-line, as the rate of transfer in money balances is rather instantaneous.

Stock prices may also impose a negative substitution effect on the demand for money balances. The substitution effect implies that as stock prices rise, equities become more attractive when compared to other components in a portfolio. This may result in investors putting a hold on investing in other assets such a house, land, new car etc., and shifting from money to stocks. In summary, the two situations above indicate that the net effect of stock market prices on demand for money may be have a positive income or a negative substitution effect.

Our study has been motivated by Choudhry (1996), where he models the traditional money demand as function of income (proxied by the log of real GDP), interest rate and real stock prices. The inclusion of stock prices in the money demand function can explain two situations. The coefficient of the real stock price is not restricted or expected to have a particular sign. If the coefficient in a cointegrated VAR model is positive then it indicates an income effect and if it is negative, a substitution effect.

So the money demand function that includes stock prices may be represented as:

$$(\text{Nominal Money/Price})^d = f\,(\underset{(+)}{\text{Income}},\ \underset{(-)}{\text{interest rate}},\ \underset{(+\ or\ -)}{\textit{real}\ \text{stock prices}}) \quad (1)$$

$$(M/P)^d = f(y, i, sp)$$

This function states that the demand for real money balances (consisting of nominal money M1, M2, M3 etc.) and the price level

(P) is positively related to real income and negatively related to the rate of interest and may be positively or negatively related to stock prices.

Our main focus in this paper is to test whether the above relationship does hold in Australia. We test the existence of a long-run relationship between money demand and real stock prices in Australia. If real stock prices are found to be significant in the money demand function, then we determine the size and direction of the effect of stock prices on demand for money. We also test the influence of each variable by shocking the variance and observing the impact on other variables in the system. We then try to explain these shocks by using theory and institutional factors operating in the Australian economy. These factors play an important role in explaining the money demand as we use two definitions of money (M1 and M3) and we see how monetary policy actions and government regulation might affect the movements in the variables in the money demand function. We find that M1 and M3 give us the best measures of the narrow and broad money balances.

In previous studies the concept of 'stock prices and money demand' has been represented by volume of transactions or returns on securities and is considered as a variable in the money demand function (Hamburger, 1966; Hamburger and Kochin, 1972; Hamburger and Keran, 1987; Keran 1971). Friedman (1988) provides a study of the direct relationship between stock prices and money demand. Depending on the time period, Friedman is able to find positive and negative effect of stock prices based on United States data. McCornac (1991) using Japanese data obtains similar results. These procedures, however, used standard OLS techniques and assumed long-run stationarity of the variables.

A recent study by Carlson *et al*. (2000) argues that a stable money demand function was not present in the 1990s. He questions the usefulness of the broad monetary aggregates in explaining the behaviour of nominal activity and opportunity cost of holding money. If there is no evidence that such a relationship exists, there is no empirical basis for assigning any role in monetary policy to a broad aggregate. If a stable relationship can actually be established from the data, the questions remain. Are the deviations from the long-run equilibrium sufficiently small and free from persistence to facilitate policy-making objectives or to allow pursuit of monetary rules? Do deviations from the long-run equilibrium actually portend changes in the pace of the nominal economy? Is the relationship resilient to innovations that characterise the macroeconomy? How should policy makers react if the movements in the equity market influence the money demand function? Can the existence of narrow and broad definitions of money, formed from any of the monetary aggregate measures, assist monetary policy makers? We attempt to answer these questions by using modern time series techniques.

Our paper is set out as follows: Section 2 summarises the Johansen technique of cointegration and discusses the cointegrating VAR models, long-run structural modelling, vector error-correction models, generalized variance decompositions, generalized impulse response functions and persistence profiles. We present the variables being used in our models and the sources of data in Section 3. The empirical results of all the techniques used are discussed in Section 4 followed by some concluding remarks and shortcomings of the study and possible future work in the area of estimating the long-run money demand function in Section 5.

2. Methodology

Either cross-sectional or time-series approaches have been adopted to test a hypothesis or exogeneity/endogeneity relationship between variables. The cross-sectional approach has a major shortcoming in testing exogeneity/endogeneity relationship between variables because firstly, they are not appropriate in capturing the dynamics of the variables involved. Secondly, the implicit assumption of the cross-sectional studies is that the parameters across units/countries remains constant. This assumption is not realistic in the context of countries having different institutions, structures, and stages of development. Finally, the results derived from a cross-section of countries may not be fully appropriate for a particular country. The time-series studies of individual countries are more appropriate for testing a hypothesis of exogeneity/endogeneity relationship between variables in the context of a particular country. The recent time-series studies based on cointegration have applied either vector error-correction and/or variance decompositions methods for testing exogeneity/endogeneity relationship or Granger causality. Although these time series techniques are an improvement on cross-sectional studies in testing exogeneity/endogeneity relationship between variables, one of the major limitations of error-correction/variance decompositions methods is that they are based on the estimates of the cointegrating vectors which are atheoretical in nature. The most recently developed 'Long Run Structural Modelling' (LRSM) technique takes care of that major limitation of the conventional cointegrating estimates.

LRSM endeavours to estimate theoretically meaningful long-run (or cointegrating) relations by imposing on those long-run relations (and then testing) both identifying and over-identifying restrictions based on theories and *apriori* information of the economies. For testing each restriction the results are presented in tables and one should check the LR statistic in each case whether the null of restriction/s should be rejected or accepted.

Hence to test the money demand relationship we would apply the following procedures: after examining the unit root tests and the order of the VAR, the Johansen cointegration tests will be applied. The cointegrating estimated vectors will then be subjected to exactly identifying and overidentifying restrictions based on theoretical and *apriori* information of the economy. The test of cointegration is designed to examine the long-run theoretical or equilibrium relationship and to rule out spurious relationship among the variables. But the evidence of cointegration cannot tell us which variable is leading (i.e., exogenous) and which variable is lagging (i.e., endogenous). That can be done by the test of vector error-correction model (VECM) that can indicates the direction of Granger-causality both in the short and long run. The VECM, however, cannot tell us which variable is relatively more exogenous or endogenous. The variance decomposition technique is designed to indicate the relative exogeneity/endogeneity of a variable by decomposing (or partitioning) the variance of the forecast error of a variable into proportions attributable to shocks (or innovations) in each variable in the system including its own. The proportion of the variance explained by its own past shocks can determine the relative exogeneity/endogeneity of a variable. The variable that is explained mostly by its own shocks (and not by others) is deemed to be the most exogenous of all. The impulse response function (IRF) will then be applied. It is designed to map out the dynamic response path of a variable due to a one-period standard deviation shock to another variable. The IRF is a graphical way of exposing the relative exogeneity or endogeneity of a variable. Finally, the persistence profiles will be applied. They are designed to estimate the speed with which the variables get back to equilibrium when there is a system-wide shock (unlike the IRF which traces out the effects of a variable-specific shock on the long-run relationship).

3. Data

The data used consists of quarterly observations on Australian macro economic variables obtained from Datastream International.

The variables used in this study include Money Stock (M1 and M3), Nominal GDP, the 5-year and 10-year Government Bond rate and the All Ordinaries stock price index. We use the CPI to deflate all variables, except the interest rates to test our model. The data are quarterly starting from 1972.Q2. All the variables are in logs except for the two interest rates. All the variables are seasonally unadjusted as we take care of seasonality by introducing quarterly seasonal dummies in estimating the models. We are restricted to using only quarterly data as the CPI index (used as a deflator index) and the GDP figures for Australia are only calculated on a quarterly basis.

4. Empirical results and discussions

4.1 Unit Root Tests

The cointegration test requires that the different economic series are integrated of order one. In other words, the data should be stationary in their first differences but not in levels. To determine the order of integration, we use the Augmented Dickey-Fuller (ADF) test, and the KPSS test. Table 1 shows that the ADF test confirms that LRM1 (log of real M1), LRM3 (log of real M3), LRGDP (log of real GDP), STINT (short-term interest rate), LTINT (long-term interest rate) and LRSTOCK (log of real stock price) are difference stationary or I (1). Schwert (1987) and DeJong *et al*. (1992) have tested the power of the ADF test in that these tests often tend to accept the null too frequently against the stationary alternative. It appears that the failure to reject the null may be simply due to the standard unit root tests having low power against stable autoregressive alternatives with roots near unity. In view of the growing controversy surrounding the general test for unit root, we employ the KPSS test proposed by Kwiatkowski *et al*. (1992).

The KPSS test has a null that an observable series is stationary around a deterministic trend. The series is expressed as the sum of deterministic trend, random walk and stationary error, and the test is the Lagragian Multiplier (LM) test of the hypothesis that the random walk has zero variance. The asymptotic distribution of the statistic is derived under the null and under the alternative that the series is difference stationary. The procedure calculates the eta (mu) and eta (tau) statistics. With the ETA (mu) statistic, the null hypothesis is that the series $\{X_{(t)}\}$ is stationary around a level, while with ETA (tau) statistic, the null hypothesis accepts that $\{X_{(t)}\}$ is trend stationary. Some data show conflicting results when using the

ADF and KPSS tests, but our two tests show all the variables to be I (1).

TABLE 1 - *Unit Root Tests*

Variable	Lags	ADF[b](μ)	KPSS[c](mu)	KPSS[c](tau)
LRM1	12[b],6[c]	-1.178	5.321***	0.278***
ΔLRM1	12[b],6[c]	-8.924***	0.021	0.011
LRM3	12[b],6[c]	-2.123	3.621**	0.228***
ΔLRM3	12[b],6[c]	-5.638***	0.029	0.051
STINT	12[b],6[c]	-1.129	4.658**	0.323***
ΔSTINT	12[b],6[c]	-4.991***	0.154	0.091
LTINT	12[b],6[c]	-1.453	3.678***	0.423***
ΔLTINT	12[b],6[c]	-9.982***	0.1089	0.085
LRGDP	12[b],6[c]	-1.128	5.245***	0.597**
ΔLRGDP	12[b],6[c]	-6.723***	0.200	0.098
LRSTOCK	12[b],6[c]	-1.923	6.235**	0.394**
ΔLRSTOCK	12[b],6[c]	-10.564***	0.189	0.045

ADF = Augmented Dickey-Fuller, and KPSS = Kwiatkowski, Phillips, Schmidt and Shin.
b. H_0: Variable X has a unit root.
c. H_0: Variable X is stationary.
***, **, * show significance at the 1%, 5% and 10% level.

4.2 Johansen Cointegration

In our paper we have four cointegrating equations based on two definitions of money and two definitions of interest rates. All the four cointegration tests include GDP and stock prices in the equation, but we test the role of different definitions of money (M1 and M3) and the short- and long-term interest rate. We first run the unrestricted VAR model to test for the order of the VAR in our cointegration equation. We find that all four models select a VAR (3) and this gives an excellent opportunity to test the models under the same conditions. We use unrestricted intercepts and restricted trends as Pesaran and Pesaran (1997) suggest this, if the variables have a certain trend in their level form. The Johansen methodology suggests that unrestricted trends can only be used if we have some sound theoretical explanation about the trends in the data.

We chose a lag length of three for the order of the VAR based on the Akaike Information Criteria (AIC). This lag length corresponds to the model with the lowest test statistic for normality among all models with non-autocorrelated errors. In addition, with

TABLE 2 - *Johansen's Cointegration Test*

H_0	H_1	Eigenvalue	Critical Values		Trace Test	Critical Values	
			95%	90%		95%	90%
r = 0	r < 1	52.05*,**	31.79	29.13	92.62*,**	63.00	59.16
r = 1	r < 2	19.74	25.42	23.10	40.57**	42.30	39.34
r = 2	r < 3	14.02	19.22	17.18	20.83	25.77	23.08

Model Specification: Dependent variable: LRM1.
Independent variables: LRGDP, LRSTOCK, STINT.
The order VAR(3) is selected using the Akaike Information Criterion (AIC) by estimating the unrestricted VAR model. Cointegration test is based on unrestricted intercepts and restricted trends in the VAR.
, * means rejection of H_0 at 5% and 10% level of significance.

H_0	H_1	Eigenvalue	Critical Values		Trace Test	Critical Values	
			95%	90%		95%	90%
r = 0	r < 1	59.59*,**	31.79	29.13	94.18*,**	63.00	59.16
r = 1	r < 2	19.74	25.42	23.10	34.59	42.30	39.34
r = 2	r < 3	8.79	19.22	17.18	14.85	25.77	23.08

Model Specification: Dependent variable: LRM1.
Independent variables: LRGDP, LRSTOCK, LTINT.
The order VAR(3) is selected using the Akaike Information Criterion (AIC) by estimating the unrestricted VAR model.
, * means rejection of H_0 at 5% and 10% level of significance.

H_0	H_1	Eigenvalue	Critical Values		Trace Test	Critical Values	
			95%	90%		95%	90%
r = 0	r < 1	44.25*,**	31.79	29.13	89.29*,**	63.00	59.16
r = 1	r < 2	17.81	25.42	23.10	45.04*,**	42.30	39.34
r = 2	r < 3	17.26	19.22	17.18	27.24*,**	25.77	23.08

Model Specification: Dependent variable: LRM3.
Independent variables: LRGDP, LRSTOCK, STINT.
The order VAR(3) is selected using the Akaike Information Criterion (AIC) by estimating the unrestricted VAR model.
, * means rejection of H_0 at 5% and 10% level of significance.

H_0	H_1	Eigenvalue	Critical Values		Trace Test	Critical Values	
			95%	90%		95%	90%
r = 0	r < 1	38.03*,**	31.79	29.13	82.29*,**	63.00	59.16
r = 1	r < 2	17.62	25.42	23.10	44.26*,**	42.30	39.34
r = 2	r < 3	16.81	19.22	17.18	26.64*,**	25.77	23.08

Model Specification: Dependent variable: LRM3.
Independent variables: LRGDP, LRSTOCK, LTINT.
The order VAR(3) is selected using the Akaike Information Criterion (AIC) by estimating the unrestricted VAR model. ***, **** means rejection of H_0 at 5% and 10% level of significance.
Notes: As all the Eigen values for the model showed one cointegrating relationship, we use r=1 for all our models. In both the M3 models the Trace test showed 3 cointegrating vectors and in the model selection criteria AIC showed 4 and SBC showed 1 cointegrating relationship.

quarterly data, a lag length of three has a good deal of economic appeal. It implies two lags of the first difference terms in the VECM specification of the model with remaining short-run dynamics being captured by the adjustment of the variables to restore any equilibrium cointegrating relationships which exist among the variables.

We can see that the trace test and the maximum eigenvalue test confirm at least one nonzero vector between real money balances (M1 and M3), real income, real stock prices, and the short- and long-term interest rate. The trace test statistic tests the null hypothesis that $r = q$ (for $q = 0, 1, 2, 3$) against the unrestricted alternative that $r = 4$. In contrast, the maximum eigenvalue statistic tests that there are r cointegrating vectors against the specific alternative that $r + 1$ exist. From table 2, the trace tests for M1 and M3 show three cointegrating relationships but the eigenvalue test indicates only one and it is generally expected that the power of the eigenvalue test is greater than the trace test. A brief discussion of the lessons underlying this test is given in Johansen (1992). As a result we use one cointegrating relationship amongst all four models. At this stage we can conclude that, there exists a cointegrating relationship between real M1 or real M3, real income, the short- and long-term interest rate and real stock prices in Australia.

4.3 Long-run Structural Modelling (LRSM) and Long-run Elasticities

The estimates of the unconstrained cointegrating vectors for the four models are given in Table 3, Panel A. In order to derive long-run elasticities, we normalize on money balances. To perform this we set the estimated coefficient of LRM1 and LRM3 equal to -1 and divide each of the cointegrating vectors by the negative of the relevant money coefficient. The results of this normalisation yield the estimates of the long-run elasticities reported in Panel B of Table 3. We use the chi-square test to see if the variable truly belongs to the cointegrating vector. In such a test the null hypothesis is that the coefficient on the relevant variable is equal to zero.

Looking at the model with M1 and short-term interest rates, the estimated long-run income elasticity is a rather strange -0.18 and the interest rate semi-elasticity is -2.44. The negative income elasticity basically tells us that a 1% increase in income causes a 0.18 percent decrease in the demand for money, whereas a one percent increase in interest rate causes a 2.44% decrease in money demand. The negative relationship is difficult to comprehend but the coefficient of interest

TABLE 3 - *Cointegrating Vectors, Long-run Elasticity of the Money Demand and Unitary Elasticity of Income Models*

A. Unrestricted Cointegrating vectors

	Australia	
Variables	Real M1	Real M3
Money	2.491	3.490
Real GDP	0.044	-3.197
Short-term Interest rate	6.093	5.698
Real Stock prices	-0.287	-0.286
Time Trend	-0.011	-0.005
Money	-2.563	3.563
Real GDP	-2.491	0.727
Long-term Interest rate	-6.833	6.242
Real Stock prices	-0.018	-0.109
Time Trend	0.019	-0.018

B. Long-run elasticity (Normalising on Money)

	Australia	
Variables	Real M1	Real M3
Real GDP	-0.176	0.916
Short-term Interest rate	-2.446[a]	-1.632[a]
Real Stock prices	0.115[b]	0.082[b]
Time Trend	0.004	0.001
Real GDP	0.972	-0.204
Long-term Interest rate	-2.666[a]	-1.752[a]
Real Stock prices	-0.007	0.030[c]
Time Trend	0.008	0.005

C. Likelihood ratio test statistics (Over-identifying restrictions)

	Australia	
Null Hypothesis	Real M1	Real M3
$\eta_{income} = 1$	-0.176 / (1.60)	0.916 / (0.02)
$\eta_{income} = 1$	0.972 / (6.94)*	-0.204 / (1.32)

Notes: in panel C we compare a model incorporating the over identifying restriction to test for income elasticity of demand to be one. We compare these results to an unrestricted model using a likelihood ratio test; the test has a $\chi^2(1)$ distribution under the null hypothesis; the critical value is 3.84. [a, b, c] Significance at the 1%, 5%, 10% level. (Panel C) * implies rejection of the null at the 5% level.

rate makes sense as interest rates are inversely related to money demand. When the long-term interest rate is used we get almost unitary elasticity (0.97) of income with respect to money demand and long-term interest semi-elasticity is -2.67 and the stock prices have a small effect on the money demand function.

At this stage we can really put the long-run structural modelling (LRSM) to the test by imposing an over-identifying restriction of 1 on the LRGDP coefficient to test the unitary elasticity hypothesis given that our result is equal to 0.97. The chi-square statistic obtained from this restriction shows that unitary elasticity of income holds for the M3 model when we use the short-term interest rate indicating near proportional increase in demand for money with a 1% increase in income. This is not a surprising finding as M3 has more categories of money that are more likely to be influenced by real income changes (in our case GDP). Although M1 does not reject the null using the short rate, we reject this finding, as the long-run elasticity is negative. We make the same conclusion with M3 and the long-term interest rate. We now proceed with our investigation by removing this over-identifying restriction so that consistency is maintained throughout.

Our main focus was to test the positive income and negative substitution effects of stock prices, we can see from Panel B that the coefficients of the stock prices indicate positive income effect in three situations and one small negative substitution effect. In the model using M1 and short-term interest rates, we found that a 1% increase in stock prices resulted in 0.115% increase in money demand. Our findings are similar to Choudhry (1996), in that the money demand model (M1) with short-term interest rates, indicate real stock prices have the biggest income effect. The magnitude of the effect is rather small compared to Choudhry (1996), but the direction of causation on money demand is the same. Although Choudhry (1996) used M2 to represent a broad definition of money, he found a negative substitution effect when the long-term interest rate was used. We use M3, a much broader category of money stock and hence we feel that stock prices should have positive effect on money demand as investors have money in non-banking financial institutions and unit trusts, which are part of M3.

4.4 Vector Error Correction Model (VECM)

In order to ascertain the direction of causality, the VECM may be employed given the presence of cointegration amongst variables. This is achieved based on the earlier analysis identifying one cointegrating vector, which in turn provides us with one error-correction term for constructing the VECM models.

As noted earlier the significance of the error-correction term implies that the corresponding dependent variable responds to the deviation from long-run equilibrium observed in the prior period. The estimated VECM are presented in Table 4a and 4b. The coefficient of the error-correction terms in row one of the tables gives us the most important information as to the endogeneity and exogeneity of the variables. Table 4a is based on M1 and the short- and long-term interest rate. The error-correction term for M1 (dependent variable) model is significant (t-ratios in parentheses) indicating that the stock prices affect M1 as a component of the error-correction term. The size of the coefficient is correct (negative) and it indicates that 19.5% of the disequilibrium is corrected within a single quarter. This finding is in accord with economic theory, which says that money is an endogenous variable. The coefficient of the differenced variables in column 1 of Table 4a indicates that changes in the lag of M1 two quarters prior, has some influence in current changes in M1. The changes in short-term interest rates two quarters prior also affect changes in M1 indicating the lag-effect between interest changes and money demand as the public take time to adjust their money balances.

In summary, what is interesting is that in all the four error-correction models, both M1 and M3 are significantly affected (either at 5 or 10 per cent level) *by the stock price* variable as a component of the error-correction term.

4.5 Generalized Variance Decompositions (VDCs) and Causal Relativities

We discuss the results of the variance decompositions to see the effect of the shock to the forecast error variance of each of the variables in particular when the *stock prices* are shocked. The VECM is extremely useful as the dynamic framework gives us an opportunity to test the in-sample temporal causality. But the VECM does not give us the relative endogeneity or exogeneity of each of the variables. The impulse response functions (IRFs) and variance decompositions (VDCs) give us more information by letting us test the relative strength of the variables. The shocks to the system of variables and the partitioned forecast error variance are presented in Table 5a to 5d. When decomposing the different variables we test the

TABLE 4a - *VEC Model Estimates*

Equation	$\Delta LRM1_t$	$\Delta LRGDP_t$	$\Delta STINT_t$	$\Delta LRSTOCK_t$
$\xi_{\tau-1}$ (Error Correction term)	-0.195* (-7.676)	-0.023 (-1.504)	0.014 (0.733)	-0133 (-1.129)
α	0.511*** (7.727)	0.065 (1.595)	-0.039 (-0.757)	0.352 (1.148)
$\Delta LRM1_{t-1}$	0.118 (1.482)	0.066 (1.358)	0.097 (1.574)	0.407 (1.105)
$\Delta LRM1_{t-2}$	-0.407* (-5.361)	0.076 (1.623)	0.027 (0.451)	0.228 (0.649)
$\Delta LRGDP_{t-1}$	0.176 (1.174)	-0.115 (-1.249)	-0.036 (-0.310)	-0.411 (-0.590)
$\Delta LRGDP_{t-2}$	0.101 (0.697)	-0.224*** (-2.510)	0.266*** (2.358)	-2.182** (-3.233)
$\Delta STINT_{t-1}$	0.036 (0.244)	0.058 (0.639)	0.127 (1.103)	0.224 (0.326)
$\Delta STINT_{t-2}$	0.367*** (2.255)	0.122 (1.373)	0.127 (1.131)	0.676 (1.007)
$\Delta LRSTOCK_{t-1}$	0.021 (0.965)	-0.025 (-1.849)	0.009 (0.552)	-0.018 (-0.174)
$\Delta LRSTOCK_{t-2}$	-0.003 (-0.152)	0.035*** (2.601)	0.014 (0.805)	-0.045 (-0.441)
Equation	$\Delta LRM1_t$	$\Delta LRGDP_t$	$\Delta LTINT_t$	$\Delta LRSTOCK_t$
ξ_{t-1} (Error Correction term)	-0.208* (-7.906)	-0.019 (-1.163)	0.036 (2.170)	-0.249*** (-2.080)
α	1.137* (7.929)	0.105 (1.204)	-0.194*** (-2.178)	1.362 (2.088)
$\Delta LRM1_{t-1}$	0.156*** (2.018)	0.068 (1.445)	0.014 (0.294)	0.304 (0.867)
$\Delta LRM1_{t-2}$	-0.372* (-5.059)	0.093*** (2.093)	0.046 (0.997)	0.197 (0.588)
$\Delta LRGDP_{t-1}$	0.430*** (2.818)	-0.064 (-0.694)	0.079 (0.831)	-0.121 (-0.175)
$\Delta LRGDP_{t-2}$	0.304*** (2.038)	-0.213*** (-2.352)	0.049 (0.534)	-1.904*** (-2.807)
$\Delta LTINT_{t-1}$	0.166 (0.901)	-0.012 (-0.109)	-0.012 (-0.106)	0.835 (0.998)
$\Delta LTINT_{t-2}$	0.677** (3.760)	0.220*** (2.010)	-0.118 (-1.054)	0.603 (0.735)
$\Delta LRSTOCK_{t-1}$	0.033 (1.556)	-0.026 (-1.984)	-0.002 (-0.106)	-0.025 (-0.259)
$\Delta LRSTOCK_{t-2}$	0.002 (0.797)	0.037*** (2.821)	0.005 (0.340)	-0.069 (-0.705)

Table 4b - *VEC Model Estimates*

Equation	$\Delta LRM3_t$	$\Delta LRGDP_t$	$\Delta STINT_t$	$\Delta LRSTOCK_t$
ξ_{t-1} (Error Correction term)	-0.063 (-1.945)	-0.101** (-4.922)	-0.099** (-3.849)	-0.200 (-1.202)
α	0.034*** (2.179)	0.053* (5.268)	0.047** (3.717)	0.104 (1.276)
$\Delta LRM3_{t-1}$	0.182 (1.792)	0.117 (1.809)	0.189*** (2.334)	0.659 (1.260)
$\Delta LRM3_{t-2}$	-0.032 (-0.305)	0.147*** (2.246)	0.108 (1..311)	-0.005 (-0.009)
$\Delta LRGDP_{t-1}$	-0.021 (-0.143)	-0.252*** (-2.677)	-0.240*** (-2.016)	-0.538 (-0.703)
$\Delta LRGDP_{t-2}$	0.006 (0.043)	-0.371** (-4.037)	0.085 (0.737)	-2.274** (-3.045)
$\Delta STINT_{t-1}$	-0.088 (-0.733)	0.015 (0.196)	0.174 (1.823)	0.004 (0.007)
$\Delta STINT_{t-2}$	0.120 (1.009)	0.092 (1.219)	0.181 (1.902)	0.259 (0.421)
$\Delta LRSTOCK_{t-1}$ $\Delta LRSTOCK_{t-2}$	0.012 (0.599) -0.003 (-0.170)	-0.036*** (-2.800) 0.027*** (2.125)	-0.010 (-0.636) 0.0001 (-0.0004)	-0.020 (-0.195) -0.038 (-0.367)
Equation	$\Delta LRM3_t$	$\Delta LRGDP_t$	$\Delta LTINT_t$	$\Delta LRSTOCK_t$
ξ_{t-1} (Error Correction term)	-0.075*** (-2.277)	-0.111** (-5.466)	-0.048*** (-2.094)	-0.352*** (-2.103)
α	0.281*** (2.208)	0.415* (5.512)	0.175*** (2.082)	1.312*** (2.114)
$\Delta LRM3_{t-1}$	0.186 (1.830)	0.121 (1.930)	0.058 (0.831)	0.747 (1.445)
$\Delta LRM3_{t-2}$	-0.033 (-0.329)	0.161*** (2.587)	0.098 (1.404)	0.083 (0.161)
$\Delta LRGDP_{t-1}$	0.034 (0.247)	-0.146 (-1.686)	0.050 (0.516)	-0.534 (-0.751)
$\Delta LRGDP_{t-2}$	0.067 (0.486)	-0.290** (-3.428)	0.017 (0.181)	-2.140** (-3.069)
$\Delta LTINT_{t-1}$	-0.014 (-0.096)	0.015 (0.167)	0.148 (1.437)	0.343 (0.452)
$\Delta LTINT_{t-2}$	0.166 (1.129)	0.225*** (2.467)	0.028 (0.278)	-0.027 (-0.037)
$\Delta LRSTOCK_{t-1}$	0.016 (0.806)	-0.037** (-3.124)	-0.014 (-1.070)	-0.037 (-0.374)
$\Delta LRSTOCK_{t-2}$	-0.008 (-0.403)	0.026*** (2.160)	-0.006 (-0.444)	-0.081 (-0.815)

Notes: The error-correction term is noted in the first row, followed by the constant and then differenced lagged explanatory variables. For this table we can see that the order of the cointegrating VAR model is three as there are two lagged coefficients of the explanatory variables. *, **, *** represents significance at the 1%, 5% and 10% level.

relative exogeneity and endogeneity and also report the reactionary profiles of only stock prices. This illustrates how closely the forecast error variance of stock prices is linked to the other variables.

As we are using quarterly observations, we will concentrate on 1, 3 and 6 horizons after the shock. The reason being that each horizon represents a quarter, so the endogeneity or exogeneity of the variables needs to be captured in a sensible time period after the variance is shocked. The short-term is represented by horizon 1 and 3, while horizon 6 represents the long-term observation. Although Microfit calculates shocks through to 60 horizons (quarters), these represent more than half the number of observations used in this study. The effect of a shock (*ceteris paribus*) 60 quarters down the track does not make any economic sense as the Reserve Bank of Australia tends to exercise monetary policy changes at least 2 to 3 times a year. The variance decomposition is not designed to incorporate these changes and hence the result for 60 quarters can be misleading. The main use of the VDCs technique is to determine relative exogeneity or endogeneity of the variables in the model. The exogeneity of a variable can be observed through the main diagonal, where we can see if a variable's own variance is being explained by movements in its own shock over the forecast horizon. If the variable explains most of its own shock, then the variances of other variables contribute very little, therefore making the variable relatively exogenous.

The degree to exogeneity or endogeneity can be justified from the theoretical underpinnings reported in the literature on the long-run money demand. The VDCs reported in Table 5a and 5b are based on the narrow definition of money (M1) and the short- and long-term interest rates. We can see that shocks to the variance of short-term interest rates and real stock prices are self-explained, thus showing the relative exogeneity of the variables. Looking at 6 quarters following the shock the diagonal shows only 20.47% of the shock in the variance of real M1 is explained by its own shock, whilst 81.97% of real GDP, 87.8% of short-term interest rates and 80.84% of real stock price is explained by own shock. From Table 5a we can basically conclude that M1 is the most endogenous, whilst GDP, STINT and LRSTOCK are exogenous variables. This means that M1 tends to follow rather than lead the other three variables and that the real stock prices explain 15.54% of the variance of M1. We also find that around 14.43% of the variation in stock prices is controlled by short-term interest rates. This is a significant finding and shows the close link between variation in interest rates and stock prices. Due to the turmoil in stock markets the reserve bank

TABLE 5a - *Generalized Variance Decompositions based on LRM1, LRGDP, STINT and LRSTOCK*

	Decomposing LRM1 Fluctuations		Decomposing LRGDP Fluctuations	
Horizons	Real Money (LRM1)	Real Stock Price (LRSTOCK)	Real GDP (LRGDP)	Real Stock Price (LRSTOCK)
1	78.06	6.00	87.23	0.94
3	53.16	12.91	83.65	2.86
6	20.47	15.54	81.97	5.02
12	5.99	12.50	68.23	8.78
24	2.57	10.68	51.99	11.30
60	1.31	9.95	41.17	12.87

	Decomposing STINT Fluctuations		Decomposing LRSTOCK Fluctuations	
Horizons	Short Term Interest Rate (STINT)	Real Stock Price (LRSTOCK)	Real Stock Price (LRSTOCK)	Short Term Interest Rate (STINT)
1	90.06	7.96	89.30	9.84
3	86.95	5.10	85.69	10.72
6	87.80	3.55	80.84	14.43
12	89.21	2.60	74.02	19.71
24	90.68	2.01	69.31	23.33
60	91.97	1.52	66.64	25.38

Notes: When the variance of the real stock prices is shocked we find that short-term interest rates play a bigger role in explaining the variance of stock prices as we move further out of sample. Overall the majority of the variance of the real stock price is self-explained. Other GVDC results are available on request from the authors.

TABLE 5b - *Generalized Variance Decompositions based on LRM1, LRGDP, LTINT and LRSTOCK*

	Decomposing LRM1 Fluctuations		Decomposing LRGDP Fluctuations	
Horizons	Real Money (LRM1)	Real Stock Price (LRSTOCK)	Real GDP (LRGDP)	Real Stock Price (LRSTOCK)
1	85.68	1.73	86.28	1.10
3	77.86	2.66	82.61	1.70
6	33.10	3.03	84.46	1.87
12	11.14	1.49	81.38	2.39
24	7.69	0.90	69.24	2.89
60	6.91	0.69	54.31	3.32

	Decomposing LTINT Fluctuations		Decomposing LRSTOCK Fluctuations	
Horizons	Long Term Interest Rate (LTINT)	Real Stock Price (LRSTOCK)	Real Stock Price (LRSTOCK)	Long Term Interest Rate (LTINT)
1	89.77	3.81	96.22	3.73
3	82.46	2.81	88.84	5.49
6	80.37	2.09	76.29	11.60
12	78.56	1.64	62.42	18.56
24	77.48	1.40	53.02	23.34
60	76.82	1.27	47.56	26.12

Notes: The above GVDCs show that all variables are exogenous except real money (M1). The bottom table indicates that long-term interest rates have the biggest influence when real stock price is shocked although most of the shock is self-explained. Other GVDC results are available on request from the authors.

Table 5c – *Generalized Variance Decompositions based on LRM3, LRGDP, STINT and LRSTOCK*

	Decomposing LRM3 Fluctuations		Decomposing LRGDP Fluctuations	
Horizons	Real Money (LRM3)	Real Stock Price (LRSTOCK)	Real GDP (LRGDP)	Real Stock Price (LRSTOCK)
1	82.69	4.14	89.52	0.82
3	77.58	5.77	76.24	5.08
6	68.81	8.43	62.06	8.31
12	57.25	11.64	46.27	11.37
24	50.89	13.37	39.91	12.53
60	47.06	14.42	36.56	13.16

	Decomposing STINT Fluctuations		Decomposing LRSTOCK Fluctuations	
Horizons	Short Term Interest Rate (STINT)	Real Stock Price (LRSTOCK)	Real Stock Price (LRSTOCK)	Short Term Interest Rate (STINT)
1	85.30	12.68	83.06	13.91
3	87.53	10.95	81.96	14.47
6	83.95	9.22	81.82	15.15
12	57.21	8.05	81.99	15.19
24	33.15	6.92	82.29	14.97
60	14.97	5.93	82.46	14.83

Notes: When the variance of the real stock prices is shocked we find that short-term interest rates play a bigger role in explaining the variance of stock prices as we move further out of sample. Overall the majority of the variance of the real stock price is self-explained. Other GVDC results are available on request from the authors.

Table 5d - *Generalized Variance Decompositions based on LRM3, LRGDP, LTINT and LRSTOCK*

	Decomposing LRM3 Fluctuations		Decomposing LRGDP Fluctuations	
Horizons	Real Money (LRM3)	Real Stock Price (LRSTOCK)	Real GDP (LRGDP)	Real Stock Price (LRSTOCK)
1	87.13	3.27	89.82	2.78
3	84.99	3.97	86.01	3.22
6	77.21	6.15	68.57	4.34
12	61.84	9.79	37.61	6.59
24	50.81	12.35	23.09	7.67
60	43.44	14.07	15.42	8.24

	Decomposing LTINT Fluctuations		Decomposing LRSTOCK Fluctuations	
Horizons	Long Term Interest Rate (LTINT)	Real Stock Price (LRSTOCK)	Real Stock Price (LRSTOCK)	Long Term Interest Rate (LTINT)
1	88.74	9.53	89.13	8.36
3	87.02	11.25	83.25	11.30
6	84.88	11.42	79.32	14.50
12	76.16	10.49	77.37	16.01
24	67.25	9.45	76.84	16.48
60	60.26	8.64	76.50	16.77

Notes: Generalized variance decompositions are scaled so that they sum to 100. The GVDCs are based on a VEC model using a 6 quarter lag and a single long-run relationship through all 6 variables. The long-run relationship was identified using exact identifying restrictions. The GVDCs are estimated using a procedure due to Koop *et al*. (1996). The above GVDCs show that all variables are exogenous, excepting real money (M3). From the bottom table we can see that long-term interest rates have the biggest influence when real stock price is shocked, although most of the shock is self explained. Other GVDC results are available on request from the authors.

of Australia has been reluctant in putting up interest rates as this would dampen investment and the much needed positive earnings by companies.

In Table 5b we find that long-term interest rates explain 11.60% of the variation in stock prices. This evidence again shows an indirect influence of stock price shocks on money through short- and long-term interest rates.

In Table 5c and 5d we replace M1 with M3 and use the short- and long-term rate to see if these combinations show different results. In Table 5c, after horizon 6, 68.81% of shocks in LRM3 are self-explained and 8.43 percent are explained by the stock prices. The shocks to STINT and LRSTOCK again indicate that these variables are highly exogenous. So if we compare our results here to Table 5a we can see that short-term interest rates and stock prices are the most exogenous and M1 and M3 are the most endogenous variables, although LRGDP does show some endogeneity when it is shocked.

The output presented in Table 5d shows that after the 6^{th} horizon, the principle diagonal still illustrates the long-term interest rate to be the most exogenous variable. The endogeneity of M3 is slightly reduced, as 77.21% of the shocks are self explained compared to 68.81% in Table 5c. Through all the shocks we can see that the long-term interest rate is the most influential variable compared to other variables. Shocks to the variance of stock price for example is mainly self-explained but looking at the remainder of the shock, 14.5% of it is explained by the long-term interest rate. This again illustrates the influence of stock prices on short- and long-term interest rates which in turn could influence the demand for money. This shows how stocks prices influence the monetary policy decision on the level of interest, which at this stage seem to be largely driven by movement on the financial markets.

Now that we have identified the exogeneity and endogeneity of the variables, we must propose some suggestions to the policy makers. The exogeneity of the interest rate (and stock prices) as well as the endogeneity of money demand suggest that interest rate is the key variable to manipulate if the government wanted to control money demand. This emphasises why interest rate is the key monetary policy tool used in most countries, although some governments still target the money supply instead of directly changing the cash rate. Monetary targets for M3 were discontinued in early 1985, the authorities noting that shifts in M3 were unsuitable as a measure of money, and unreliable as principal indicator of monetary policy (see Battelino and McMillan, 1989 and Grenville, 1990).

4.6 Persistence Profiles

The above analysis of the adjustment coefficients provides interesting insights into nature and speed of adjustment following a disturbance, which pushes the system away from equilibrium. However, given the endogeneity of some of the variables in the system and the fact that there exists one equilibrium relationship in the data, a simple analysis of the adjustment coefficients can provide only a partial account of this process. Recently, Pesaran and Shin (1996) have proposed the analysis of the persistence profile for each of the cointegrating vectors following a system wide shock (rather than variable-specific shock). This provides a useful estimate of the speed with which the economy or market under consideration returns to equilibrium once shocked. Formally the persistence profile (H_Z) for the *i*th cointegrating vector (CV) is defined as the difference between the conditional variance of the n step and n-1 step ahead forecasts, i.e.

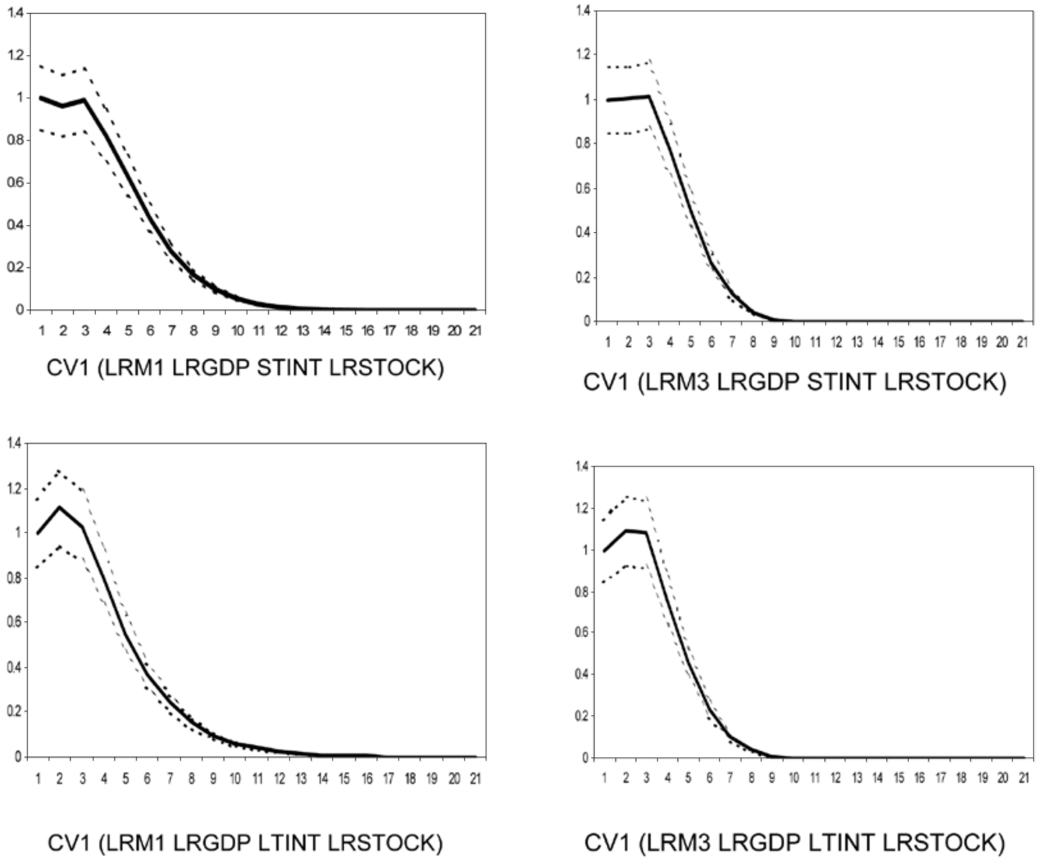
$$H_Z(n)=V(\beta_i Z_{t+n} | I_{t-1}) - V(\beta_i Z_{t+n-1} | I_{t-1}) \quad \text{for } n=0,1,2,... \qquad (2)$$

where I_{t-1} is the information setup to time $t-1$ and $V(\beta_i Z_{t+n} | I_{t-1})$ is the conditional variance of βZ_{t+n} based on this information set. When the above profile is scaled, i.e. normalized by dividing by $H_Z(0)$, it will take a value of unity at impact i.e., n = 0. In the case where βZ_{t+n} represents a cointegrating relationship, the effect of a system-wide shock should eventually disappear as the market returns to its long-run equilibrium (as 'n' increases). Conversely, in the case of relationships among $I(1)$ variables that are not cointegrated, the effects of a system-wide shock will tend to persist forever. Using this reasoning, Pesaran and Shin (1996) argue that a graphical analysis of the above profile provides further visual evidence about the stationarity of the economic relations identified above together with an estimate of the number of periods before equilibrium is restored.

The persistence profiles for the four cointegrating variables are graphed in Figure 1. From the graph, it is clear that all the profiles gradually taper off toward zero as the forecast horizon is extended. Hence, this provides further evidence that one stationary relation is identified for the four cointegrating vectors.

Interestingly, the profiles for M1 and M3 with long-term interest rates overshoot, in the sense that immediately following the shock both vectors rise initially, i.e. move away from equilibrium, and then fall. An even closer look at these CV's indicates that after 2 horizons (or 2 quarters) the shock tapers down faster for the M3 model than it does for the M1 model (is flatter after 2 horizons) thus indicating

FIGURE 1- *Persistence Profiles for the 4 Cointegrating Vectors*



Notes: The above graphs show the persistent profiles for the four cointegrating vectors. The variables in brackets denote the dependent variable followed by the 3 independent variables used in the cointegrating relationship.

some extra persistence of long-term interest rates on M1 compared to M3. This is in accordance with money demand theory, which states that short-term interest rates have greater influence on narrow definitions of money in comparison to broad definitions. The speed of adjustment back to equilibrium is faster for M3 compared to M1. We can see that after approximately 9 quarters (M3) and 13 quarters (M1) all the disequilibrium has been corrected.

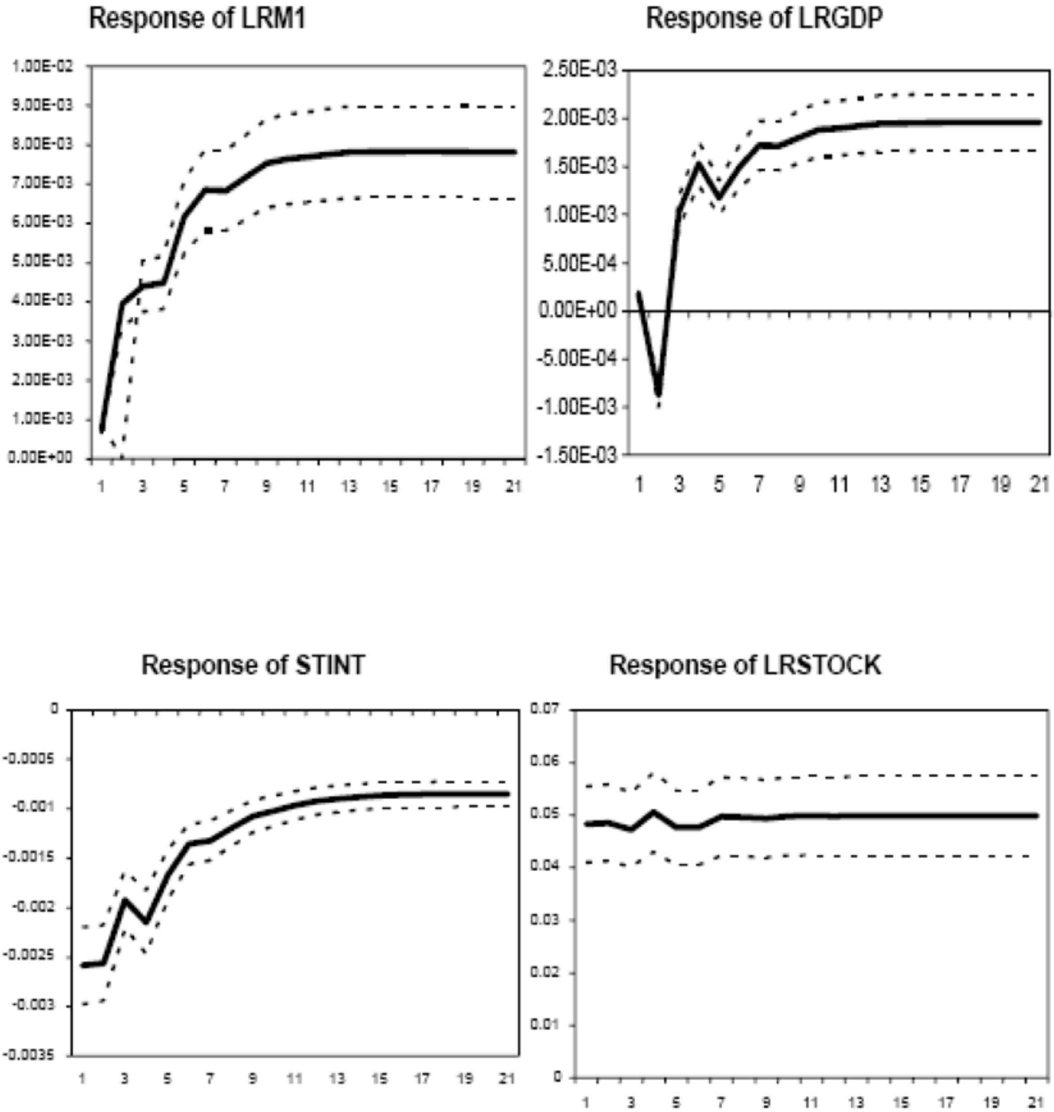
Looking at it even closely, the persistence profiles for M1 and M3 with short-term interest rates tell us a slightly different story. The system wide shock for M1 undershoots slightly for the first 2 quarters and then overshoots for only 1 quarter before returning to equilibrium. The over shooting is not as great compared to M1 with long-term interest rate. This initial downward trend could be explained as lag effect. The public will usually take some time to adjust their actual money holdings to their desired levels as shocks occur through interest rates, income and stock prices. The Hamburger money demand function tries to illustrate this effect by including a lagged M1 value in the money demand function. Please refer to Hamburger and Keran (1987) for further reference.

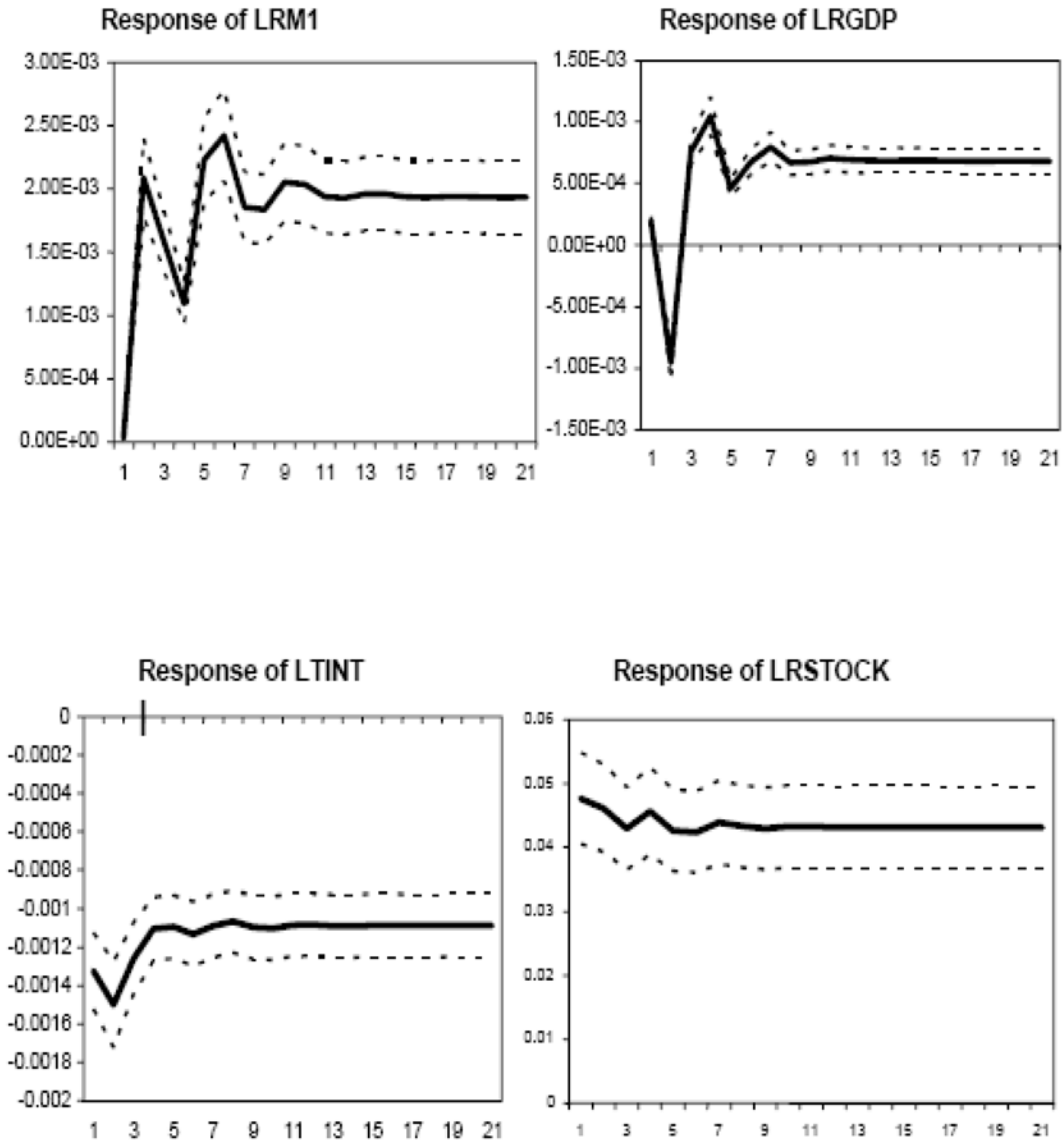
4.7 Generalized Impulse Response Functions

It is also possible to examine the impulse responses of the individual variables within the cointegrated VAR to a variable-specific shock. If shocks to a particular variable have a permanent impact on other variables then policy makers have some idea when to intervene. In other words according to the movements in the shocks, the corresponding horizon will indicate when policy makers should intervene and correct the permanent shock if need be. If shocks to certain variables do not have permanent effects on other variables, then the policy makers should not intervene and could be advised not to make policy changes. In other words automatic stabilisers can be extracted from the model and then we can fully concentrate on the variables that experience the permanent shock.

In light of prominence given to stock prices in this model, it is particularly interesting to examine the response of M1, M3, GDP and interest rates given innovation in stock prices. The impulse response functions presented in Figure 2a show the M1 model with short and long-term interest rates, real GDP and real stock prices. In the first half of Figure 2a, the innovation from LRSTOCK has a positive impact on LRMI within the first 2 quarters and then moves even higher in the following two quarters. The system reaches a higher steady state after 7 quarters. There is a small lag effect on GDP and only after 2 quarters the system moves into positive territory reaching a new equilibrium after 5 quarters. The shock from real stock prices causes short-term interest rates to increase thus showing the closer link between equity markets and instruments of monetary policy.

FIGURE 2a - *Generalized Impulse Response Paths of Shocks in LRSTOCK*





Notes: The horizontal axis refers to the quarters after shock. The vertical axis refers to standard deviations. Charts provide generalized impulse response functions (GIRF) or reactionary profiles for the response of variables in the money demand function when one standard deviation rise to each of the explanatory variables included in the system. Dashed lines represent single standard error bounds around the point estimates. GIRFs are based on a procedure developed by Koop *et al*. (1996). All 8 IRF charts are based on M1 being the explanatory variable, the difference being that the top four charts are based on the short-term interest rate and the bottom four based on the long-term interest rate. As the focus of the paper is the influence of stock prices on money demand, we only present the relevant results.

In the second half of Figure 2a, the innovation in stock prices result in large positive permanent effect on LRMI when long-term interest rates are included in the model. The lag effects in GDP are again evident through this model, but GDP reaches equilibrium at a slightly faster rate than before. The movements in long-term interest rates are much smaller than short-term interest rates indicating perhaps that long-term rates are driven more by other variables.

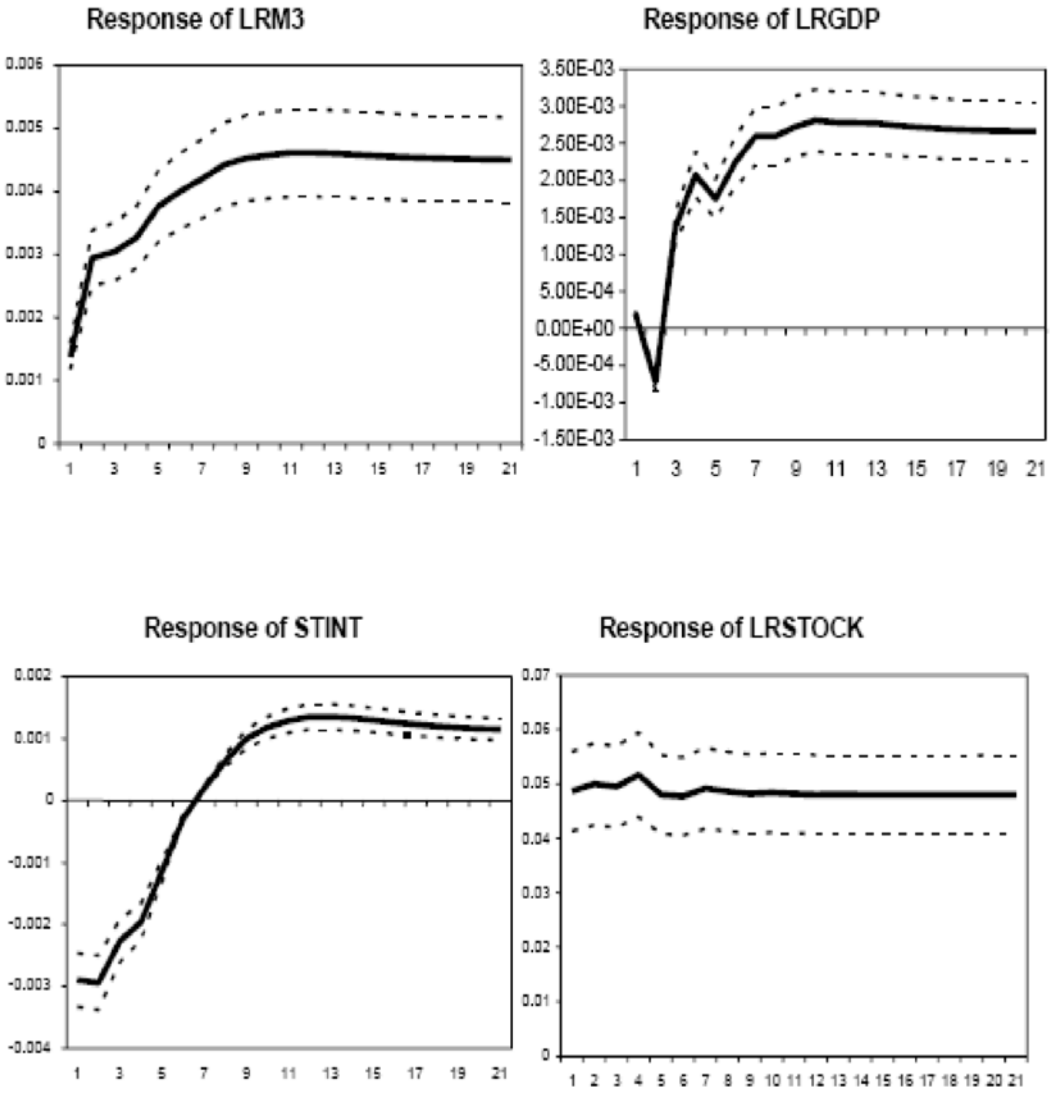
We can see that stock prices hardly deviate in any direction when shocked themselves. The first few quarters do show little upward and downward movements, indicating the corrective nature of stock markets when there are sudden upward or downward shifts. This also illustrates the fact that shocks in equity markets are mean reverting, meaning the market usually corrects itself.

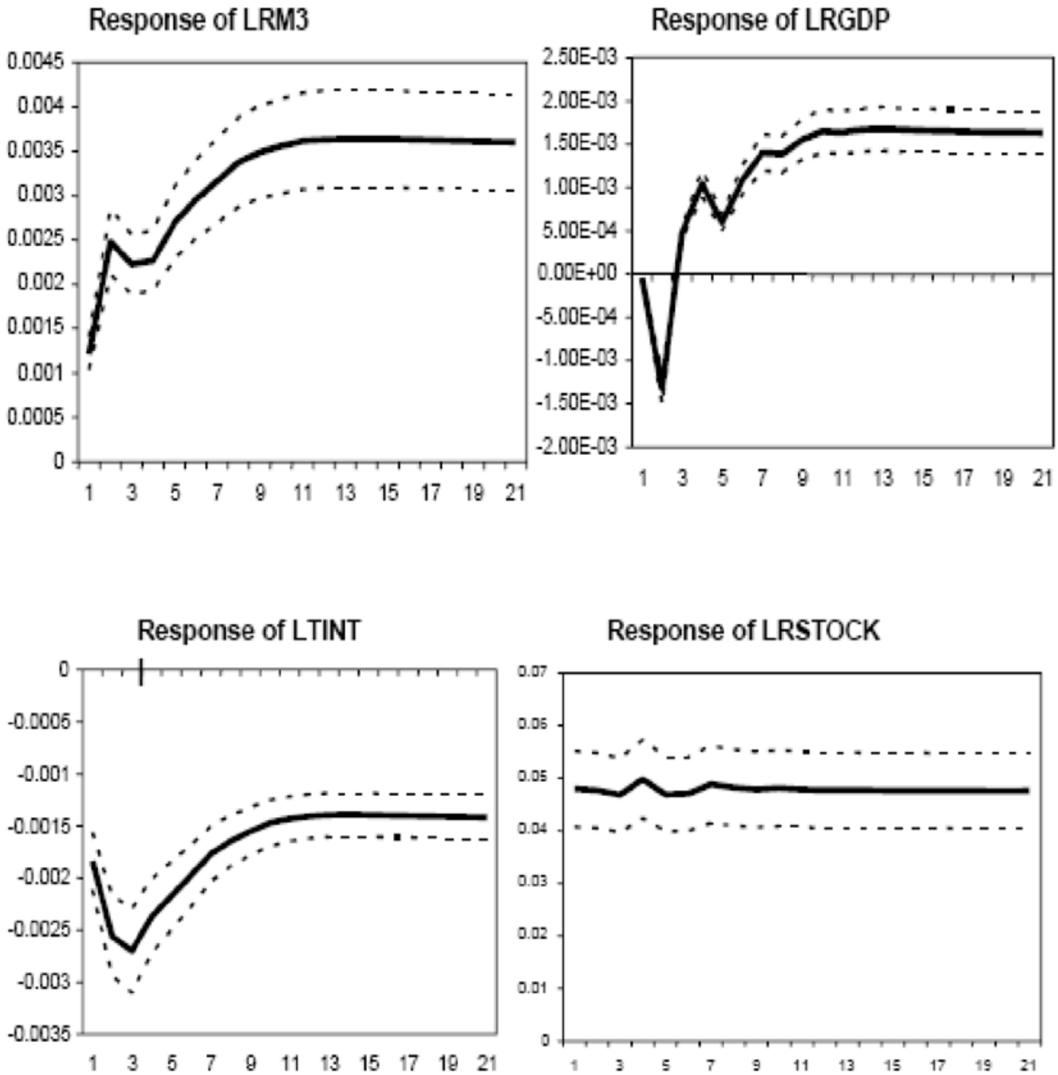
From Figure 2b we can see that a one-standard deviation shock in real stock price results in positive shocks to broad (M3) money. The system steadies after about 2 quarters but then continues to a even higher state. This could perhaps be due to investors adjusting their portfolios before demanding more money to increasing their wealth share in equity. We can see that GDP tends to over shoot the equilibrium in Figure 2b and then moves into a higher positive steady state. This again indicates that a one-standard deviation shock to LRSTOCK causes GDP to return to new steady state equilibrium after approximately 10 quarters. In this model the reaction of short-term interest rates is quite high but long-term rates seem to move more slowly. This again shows that through movement in short-term rates the reserve bank of Australia conducts its monetary policy rather than monetary targeting.

Figures 2a and 2b show that money stock (M1 and M3), real GDP (LRGDP) and interest rates (STINT and LTINT) move towards a new equilibrium when stock prices are shocked. The positive reactionary profile of LRM1 and LRM3 is crucial to our hypothesis that stock prices do have significant impact on money demand. Also the upward movement in the short-term interest rates illustrates how interest rates might rise to control the positive movement in money demand. This is very important as the government has switched its monetary policy stance purely on controlling inflation after 1991.

In summary, with respect to the impulse response functions, we need to caution our readers that generalized impulse responses allow all the variables to move in the system, resulting in some undershooting and overshooting in responses. The overshooting shows own shocks moving in the same direction as the shock being

FIGURE 2b - *Generalized Impulse Response Paths of Shocks in LRSTOCK*





Notes: The horizontal axis refers to the quarters after shock. The vertical axis refers to standard deviations. Charts provide generalized impulse response functions (GIRF) or reactionary profiles for the response of variables in the money demand function when one standard deviation rise to each of the explanatory variables included in the system. Dashed lines represent single standard error bounds around the point estimates. GIRFs are based on a procedure developed by Koop *et al*. (1996). All 8 IRF charts are based on M3 being the explanatory variable, the difference being that the top four charts are based on the short-term interest rate and the bottom four based on the long-term interest rate. As the focus of the paper is the influence of stock prices on money demand, we only present the relevant results.

received from the shocked variable. The failure to overshoot or not converge to a new equilibrium may be caused by opposing forces resulting from movements caused by shocks in the variable itself.

5. Some concluding remarks

This paper has attempted to model the traditional money demand function with the inclusion of the log of real stock prices in the context of Australia. We advance the standard cointegration technique by introducing long-run structural modelling (LRSM) proposed by Pesaran and Shin (2002) to take care of the *atheoretical* nature of the standard cointegration techniques. We find that stock prices have a positive income effect in most of the models indicating that an appreciation in stock prices implies increased risk and return on portfolios thereby increasing the demand for money. Our study, based on the recent rigorous time series techniques tends to indicate that the policy makers cannot afford to ignore the importance of real stock prices in explaining real money demand (both M1 and M3) and hence in formulating monetary policy.

In conclusion we need to be aware that important institutional differences between developed and developing countries may play an important role in formulating the money demand function. The findings from this study cannot be generalized, as the data for individual countries will be unique. There are a lot of papers being written on modelling the money demand function for developing /emerging markets. Choudhry (1996) looks at the money demand function for Thailand and uses the IMF credit to Thailand as one of the key explanatory variables in the money demand function.

In Australia's situation, we need to carefully access the operation of monetary policy by the Reserve Bank and look at the most influential variables that affect money demand. One of the points we make is the level of government regulation in the different components of the M1 measure of money stock as opposed to M3. The inclusion of non-banking financial institutions in M3 means that, this proportion is less subjected to monetary authority banking rules and regulation to holding and lending credit. It might be worthwhile to capture the effects of new regulations applicable to non-banking financial institution in Australia. The Wallis report identifies some of the changes introduced by the Australian Prudential Regulation Authority (APRA). We propose to investigate later the impact of deregulations in the context of income and substitution hypotheses and examine how these changes have affected the overall money demand function.

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ABSTRACT

The recent fluctuations in stock prices around the world and the critical place that the demand function for money holds in the formulation of a country's monetary policy motivated us to investigate the question as to whether real stock prices play any significant role in affecting the demand for money and hence monetary policy. Using Australia as a case study we subject the Australian money demand function (containing real money, interest rates, real income, and real stock prices) to a rigorous econometric scrutiny. The methods applied extend the well established cointegration and error-correction framework by analyzing the out of sample properties via generalized variance decompositions, generalized impulse response and persistence profile functions. We also apply the most recently developed technique of 'long run structural modelling' (Pesaran and Shin, *Econometric Reviews*, 2002) which by imposing exactly identifying and overidentifying restrictions on the cointegrating vector has taken care of a major limitation of the conventional cointegrating estimates in that they were *atheoretical* in nature. We investigate the positive income effects and negative substitution effects of stock prices on money by using short and long form of interest rates together with a narrow and broad definition of money.

Our results tend to indicate that stock prices do play a significant role in the money demand function. A clear policy implication is that a failure to incorporate real stock prices in the money demand function may result in the function being unstable and the monetary policy being far less effective.

Keywords: Money Demand, Stock Prices, Cointegration, Long Run Structural Modelling

JEL Classification: C32, E41, E52

RIASSUNTO

Le quotazioni azionarie influenzano significativamente la politica monetaria? Analisi di un caso

Le recenti fluttuazioni borsistiche mondiali e la posizione critica che la domanda di moneta ha assunto rispetto alla politica monetaria di un paese, ci hanno indotto a verificare se le quotazioni dei titoli azionari influenzano la domanda di moneta e, di conseguenza, la politica monetaria. Consideriamo il caso dell'Australia e sottoponiamo la funzione della domanda (includendo moneta reale, tassi di interesse, reddito e quotazioni azionarie reali) ad una rigorosa analisi econometrica. I metodi applicati estendono la struttura cointegrazione e *error-correction* analizzando le proprietà *out of sample* attraverso scomposizioni di varianza generalizzate, risposte generalizzate agli impulsi e funzioni di persistenza. Abbiamo applicato anche la più recente tecnica di *long run structural modelling* (Pesaran e Shin, *Econometric Reviews*, 2002) la quale, attraverso vincoli di identificazione e di sovra-identificazione sul vettore di cointegrazione, ha ottenuto una maggiore adeguatezza rispetto alle stime di cointegrazione convenzionali per loro natura "ateoretiche". Abbiamo studiato gli effetti reddito (positivi) e gli effetti sostituzione (negativi) che le quotazioni dei titoli azionari hanno causato sulla domanda di moneta, utilizzando tassi di interesse a breve e lungo periodo e considerando aggregati monetari sia ristretti sia ampi. Le nostre ricerche indicano che gli andamenti borsistici hanno un ruolo significativo nella funzione della domanda di moneta. Una chiara implicazione di *policy* è che non includere le quotazioni azionarie (reali) in tale funzione può rendere la funzione stessa instabile e dar luogo ad una politica monetaria molto meno efficace.