IJBF

AN ASIAN STUDY OF THE MONETARY AND BANKING LIQUIDITY IMPACT ON SHARE PRICES

Tin-fah Chung[1] *and M. Ariff*[2]
Taylor's University, Malaysia and University Putra Malaysia

Abstract

Following Friedman's hypothesis that credit expansion will follow a monetary and liquidity binge, we used data from 1968-2012 in Asia (Japan, Korea, China and India) to explore this hypothesis. Our results from applying single and cointegration equations provided empirical support to the above hypothesis. This liquidity binge following a monetary impact on share prices was tested in four major Asian economies. As per the theory's prediction, monetary changes led to a *positive banking liquidity effect,* based on lengthy quarterly equations using the dynamic OLS method. We also showed that banking liquidity changes have a significant *positive* effect on share prices, after controlling for the effects of earning changes, regime changes and the global financial crisis. These findings, obtained after solutions to serious econometric issues in existing studies, appear to provide a clear verification of theory on the monetary effect on banking liquidity *and* banking liquidity's effect on share prices.

Keywords: Money supply, Liquidity, Share prices, Causality, Dynamic ordinary least squares, Cointegration, Structural break.
JEL Classification: E41, E44

1. Introduction

The primary focus of this paper is that money supply is positively related to banking liquidity. Secondly, as an extension of this thesis statement, money supply will be impacted by higher banking liquidity, which will lead to a significant change in share prices. There has been no published consolidated comparative study of the four major Asian economies such as China, India, Korea and Japan, as that we put together in this paper whereby money supply impacts positively on banking liquidity and that banking liquidity affects share

prices. An existing study by (Badarudin et al., 2013) shows similar results for G-7 economies.

The relationship between money and share prices has been studied by both macro and finance economics. King (1966) showed that macroeconomic impact on share prices accounted for 52 per cent while industry and company factors accounted for just 10 and 38 per cent respectively almost five decades ago. Following this macro approach, our findings could be interpreted as suggesting that the source of the money supply impact is from liquidity, and liquidity impacts share prices. This is traceable to Friedman's intuition that money supply is the source of liquidity changes, although there have been studies that pin-point some macroeconomic factors, such as inflation, changes in GDP, etc. as relevant for share price formation. In this study, our attempt was to link the primary source of share price changes in these four major Asian (and other) economies to liquidity and money supply.

Alternative financial economic theories have suggested a set of variables as relevant key determinants of share price changes. Some of these variables are firm-specific factors (as in Lintner-Sharpe-Mossin's famous CAPM, Solnik's exchange rate, Breeden's consumption; Fama's price/book ratio, etc.). Only in Chen et al. (1986) did suggestions arise' that GDP, output, inflation, and term structure are significant macroeconomic factors correlated with non-bank share prices. There is no study except that of Badarudin, op cit., that made a link between Friedman's liquidity and bank share prices by using the advanced Generalized Method of Moments tests to find evidence in G-7 economies for both money supply effect on liquidity, and liquidity effect on bank share prices. This paper is a report of a further investigation of the money supply effect on liquidity, and liquidity effect on *non-bank* share prices in Asia. The link between money supply and non-bank share prices has yet to be studied.

Friedman (1969) suggested that the macro factor, namely money-supply-based liquidity has a positive influence on asset (share) prices. His proposition of a *negative* money-supply effect on interest rate has been verified in a number of studies.[2] Hamilton (1997) attempted to show a liquidity effect by using daily observations, while others (Pagan and Robertson, 1995; Goodfriend, 199; Lepper and Gordon, 1992; Edmond and Weill, 2005; and Thornton, 2007) have not been successful in finding evidence to support liquidity proposition.

Most finance studies built on the firm-specific factors, to share prices; Markowitz (1952), mean variance portfolio; Sharpe (1964), equilibrium asset pricing model; and the widely known capital asset pricing model, CAPM, used finance concepts to connect these factors to share prices. Investors who wish to be successful, need to focus mostly on price-shaping macroeconomic factors, as has been researched by Musílek (1997) and Flannery & Protopapadakis (2002) who consider macroeconomic factors to be the major determinants of shares.

---

[1] The empirical literature on the liquidity effect dates back at least to Cagan and Gandolfi (1969), Gibson (1970a; b), Leeper and Gordon (1992), Goodfriend (1997), Pagan and Robertson (1995), Christiano, Eichenbaum and Evans (1996), Hamilton (1997), Thornton (2001), Carpenter and Demiralp (2006) and Thornton (2007).

Our motivation in this study was to follow up on such validated statements for the dominant source of share price changes as coming from money supply and liquidity.

The rest of the paper is organised as follows. The readers will find in Section 2 a very brief discussion of the money-supply theory, also its variations, and the discussion on (a) liquidity and (b) share price effects. Section 3 is devoted to explaining the hypotheses, methodology and data preparation steps (to correct for stationarity, multicollinearity, serial correlations, and heteroscedasticity), the development of test models for causality tests, the system of equations and the regression models.[3] The findings are discussed in Section 4 before the paper ends with relevant comments in Section 5.

2. A Nexus of Interaction of Monetary, Liquidity and Share Price

In this section, the nexus between monetary and liquidity impact on share prices from academic literature is explored. We first describe the liquidity effect proposition and its impact on monetary expansion, leading to a credit binge and surging share prices. This is demonstrated in the context of an endogenous money-supply framework.

As demonstrated by Friedman (1969), the liquidity effect is the first of three effects on interest rates initiated by an unexpected exogenous change in money supply. Income and inflation are the other two effects of an increase in money supply. In the literature, it is generally accepted that money supply changes do lead to negative interest rate changes as some authors conclude. The linkage between money supply and interest rates has been recognized among-policy makers on the basis of evidence of its interest rate effect more than the unproven liquidity effect.[4] The money stock is itself an asset in the portfolio of wealth-holders. Increases in the stock of money will also cause decreases in the benefits to holders of money from the last dollar of held. Changes in the supply of money are, therefore, a proxy for likely changes in return on money holdings.[5]

The risk-free interest rate has been assumed to be a function of the long-term bond rate. Alternately, it is also conceivable that the demand for money is a function of, among other interest rates, the yield on equities. Any increase in the supply of money will tend to cause all interest rates across the

---

[3] We have tested with VIF for all variables. The results showed that all but 2 variables are multi-collinear. Those two are money and liquidity. We felt that this would not seriously bias in the sense that the coefficient is correct but the signs of the coefficients, t and the F-statistics need to be interpreted carefully because the variances and standard errors of the estimates will increase.

[4] The inability to find conclusive evidence has led researchers like Pagan and Robertson (1995) to suggest that this could be due to different (a) definitions of money, (b) models, (c) estimation procedures and (d) sample periods.

[5] Duca (1995) adds bond funds to M2 and finds the expanded M2 more explainable of the missing M2 from 1990:3 to 1992:4. As an alternative to this approach, Mehra (1997) suggested redefining the opportunity cost of M2 to include the long-term bond rate to capture the increased substitution of mutual funds for bank deposits.

economy in the demand for money to fall. The speed with which the yield on other assets respond depends on the rate at which excess holdings of money balances are reduced. This provides a clue as to how the central bank uses statutory liquidity reserves to influence this to happen. The potential purchasers, such as institutions, dealers, and wealthy individuals, who form the bulk of the floating supply of corporate stocks, are responsive to changes in their money balances (as did the investors in the US market following QE). If so, then the returns on corporate stocks will be affected, and this is a liquidity effect. Thus, stock prices will be responsive to movements in money supply with a negative coefficient through this channel.

The monetary theory is enhanced by the introduction of liquidity as it is the missing link between money and aggregate demand. Increases in liquidity can be observed during business upturns, also when money supply is eased (Quantitative Easing (QE) by the Fed in 2012) on strengthening investments, hence expanding the volume of money, thus also enhancing financial activities that led to an unprecedented share price increase in 2012 in response to QE. Research studies by post-Keynesian economists provide new insights on money being endogenously rather than exogenously determined which is an aspect that needs to be tested in this study. In theoretical as well as in empirical finance, the role of liquidity has been highlighted in recent policy debates especially after the credit splurge of the 1994-2004 that led to asset price bubbles before the Global Financial Crisis (Ariff et al., 2012). Despite its prominent role in conventional theories of the monetary policy transmission mechanism, there has been very little research evidence of a statistically significant or economically meaningful liquidity effect confirmed in the studies to-date.[6]

The main channel of influence of the money supply on dividends (from corporate earnings) is through the firm's expected earnings, especially the expectation effect on share prices from the money supply. Although the current prices of common stock are affected by changing future dividends, the main effect of money supply is on the expected growth rate of dividends arising from the liquidity impact on the incomes of corporations. That influence leads to a *permanent* change in the earnings of firms, which may be thought of as a positive influence from undertaking positive NPV projects by the firms across the economy, given interest rate declines from money-supply increases. This also suggests that a proxy for earnings such as IPI (industrial production index) is a better variable than dividends since earnings are perfectly correlated with IPI and dividends are managerial variables not closely linked to changing earnings.[7] Thus, the money supply and stock prices are positively related through this channel of macroeconomic influence.

---

[6] A number of researchers have argued that the lack of empirical support is due to the Fed's attachment to interest rate targeting in one form or another. They argued that innovations to monetary aggregates, M1, reflect shocks to money demand rather than to money supply. Consequently, the inability to find the liquidity effect is due the nability to isolate a statistically significant variable that reflects the exogenous policy actions of the Fed.

[7] The cointegration tests conducted for the Asian countries, indicated that IPI and GDP are cointegrated in the long-run and that IPI can be used as a proxy for earnings in our share price equations.

The theoretical framework presented by monetarists for a relationship to exist between money supply and stock prices may be viewed from the Simple Quantity Model (SQT) or the more sophisticated Portfolio Theory (PT). The SQT states that an increase in money supply results in a change in the equilibrium position of money held across the economy with respect to other non-money assets (for example shares) in the portfolio balance of asset holders. This process alters the demand for other assets that compete with money balances so that liquidity must affect assets through the rebalancing of the portfolio whenever money supply is altered by regulators.

SQT of money states:

$$M.V. = P.\ Q \qquad \sim \qquad (1.1)$$

where, M is the total amount of money in circulation in an economy during the period, say a year; *P* the corresponding price level; P.Q is the nominal money value of output; *V* is the velocity of money in final expenditures; and *Q* is an index of the real value of final expenditures. An increase in money supply is expected to increase excess supply of money balance, which in turn leads to excess demand for shares.

Share prices are expected to rise as a result of the money-supply increases. This channel of interaction had been described quite some time back as a direct channel for the first time in Sprinkel (1964). He explicitly tested a model incorporating SQT as an asset pricing model. As the supply of money expands, the portfolio of desired versus actual cash holding is thrown out of balance. Since the stock of money must be held by some agents, the prices of other assets as well as goods and services for consumption are bid up to a new equilibrium level. SQT and PT are still in vogue although the question of how the money supply influences the asset prices has newer interpretations, as for example, in Badarudin et al. (2011). Therefore, the relationship between the money supply and stock prices is said to be positive through this adjustment mechanism on assets.

In summary, the most plausible explanation for a valid relationship between money supply changes and stock price changes conditional on liquidity effect seems to be a combination of the SQT and the PT.

Finance literature has focused more narrowly on the pricing of shares. Building on the work of Markowitz's (1952) mean variance portfolio, the capital asset pricing model, CAPM, a widely accepted asset pricing theory, was next introduced. These and later theories have identified firm-specific variables to generate a body of knowledge that is collectively termed the asset pricing models: most tests of these models confirm, consistent with King (1966), that firm-specific factors do not explain the full amount of share price changes. Almost all these variable except the term structure variable, are narrowly chosen fundamental factors associated with firms; variables such as industrial production

index (IPI), income, inflation, liquidity from money supply, etc. This approach brings macroeconomic factors as dominant factors in asset pricing (consistent with King, 1966). Therefore, anyone investing in stocks (shares) should pay attention to these factors. Shortly after acknowledging the importance of such factors for asset returns, the arbitrage pricing theory (APT) has become a focal point of a branch of research incorporating macro factors into the asset pricing literature. Chen et al. (1986) comes to mind as representing this approach. Such a newer model may be referred to as "Macroeconomic Factor Model" (MFM).

A very relevant paper for this research is the portfolio model of Cooper (1970); the assumption in this model is that individuals could hold wealth in two forms, money and common stock (somewhat different from Keyne's money and bond). The marginal returns of stock assets determine the quantities of assets individuals will hold. A portfolio is said to be balanced when the marginal returns to holding these two assets are equal.

$$\mathrm{MNPS}_t^M - \underline{P} = \mathrm{MNPS}_t^S + \underline{r}_t^s \qquad (1.2)$$

where, using the term of the author, the left side is the return to money asset and the right side is the return to stock asset; is the anticipated percentage change in general price levelis the anticipated real pecuniary return of stocks (dividend plus change in stock prices); MNPS_t^s is the marginal pecuniary return to the j-th asset (the risk of j-th assets is incorporated into its pecuniary returns). MNPS_t^M is implicitly a function of demand for money except for returns on alternative assets. An underlying assumption is that the positive income effect on $\mathrm{MNPS}_t^{M,S}$ cancel each other. Thus, the difference between MNPS_t^M and $\mathrm{MNPS}_t^{M,S}$ is primarily a function of money. In this model, money changes induce portfolio adjustments through the MNPS_t schedules and prices. The result is that money supply leads to stock returns.

By re-arranging this equation, it could be shown that the stock return is:

$$\underline{r}_t^s = (\mathrm{MNPS}_t^M - \underline{P}) - \mathrm{MNPS}_t^S \qquad \sim \qquad (1.3)$$

Thus, Cooper's model is equivalent to the asset pricing model in finance. It would be interesting to examine the link between liquidity from money supply affecting the stock prices using the insights provided by Cooper. Friedman's proposition could be extended as money supply having an influence on asset prices, namely non-bank share prices in this study.

Most of these studies use the Monetary Portfolio (MP) model developed by Brunner (1961), Friedman and Schwartz (1963) and Cagan (1972) as their starting premise. An investor is assumed as reaching an equilibrium position in which, in general, he or she holds a number of assets including money in a portfolio of assets. A monetary disturbance such as an unexpected increase (or decrease) in the growth rate of the money supply causes disequilibrium in asset portfolios. Investors attempt to rebalance their desired money positions, which are transmitted as monetary changes to the financial markets at large. Over

time, studying this issue then lapsed until the emergence of the Global Financial Crisis, which has been diagnosed as having been caused by *liquidity surges* that created imbalance in the financial sector and the real sector: (Ariff *et al*., 2012).

3. Hypothesis, Methodology and Data

3.1 Hypotheses and Methodology

It is an empirical question whether principal economic indicators such as industrial production, inflation, interest rates, Treasury bill rate, liquidity, and money supply are significant explanatory factors for share returns. Studies of Hardouvellis (1987), Keim (1985), Litzenberger and Ramaswamy (1982) have shown that share prices are affected by macroeconomic factors up to 50 per cent on average, along the same line as King (1966). In addition, if economic variables are significantly and consistently priced in share returns, they should be cointegrated with share returns. If there is no significant cointegrating relationship between macroeconomic variables on one hand and share returns, the conclusion of a linkage is violated.

This study will use cointegration and Granger causality tests to investigate the relationship between share returns and underlying macroeconomic variables. An alternative approach, which has certain advantages over both the Engle-Granger (1987) OLS and the Johansen (1991) maximum likelihood procedures in cointegration analysis, has been proposed by (Stock and Watson, 1993). Their method improves the Engle-Granger OLS by coping with a small sample and dynamic sources of bias. The Johansen method, being a full information technique, is exposed to the problem that parameter estimates in one equation are affected by any misspecification in other equations.

The Stock Watson method is, by contrast, a robust single equation approach which corrects regressor endogeneity with the inclusion of leads and lags of first differences of the regressors, and for serially correlated errors by a GLS procedure. Lag and lead terms included in DOLS regression have the purpose of making its stochastic error term independent of all past innovations in stochastic regressors. In addition it has the same asymptotic optimality properties as the Johansen distribution.

The procedure advocated by Stock and Watson (1993) involves thr estimation of long-run equilibria via dynamic OLS (DOLS), which corrects for potential simultaneity bias among regressors. DOLS entails regressing one of the I(1) variables on other I(1) variables, the I(0) variables, and the lags and leads of the first difference of the I(1) variables. The essence of incorporating the first difference variables and the associated lags and leads is to obviate simultaneity bias and small sample bias inherent among regressors. Standard hypothesis testing can be undertaken using the robust standard errors derived via the procedure recommended by Newey and West (1987).

It is hypothesized that money supply (MS) is endogenously determined by economic activity as mediated via the deposit-taking institutions (Badarudin

et al., 2013). The literature on post-Keynesian theory on endogenous money is extensive.[7] Economic activity is proxied by real gross domestic product (Y); liquidity (LQ) is endogenously determined by money supply (MS) and share prices (SP) endogenously by liquidity (LQ). Money supply (MS) is also determined by share prices (SP), inflation (CPI), real GDP (Y) and Treasury bill rate (TBR). Liquidity is determined by real GDP (Y), money supply (MS) and lending rate (LR).

A system of equations, comprising 3 simultaneous equations of stock returns (SP) and liquidity (LQ), is developed to be solved endogenously as follows:[8]

$$SP_{it} = f[LQ_{it}^{-}, MS_{it}^{+}, IPI_{it}^{+}] \quad (1.4)$$
$$LQ_{it} = f[MS_{it}^{+}, Y_{it}^{+}, LR_{it}^{-}] \quad (1.5)$$
$$MS_{it} = f[LQ_{it}^{+}, Y_{it}^{+}, TBR_{it}^{-}, SP_{it}^{+}, CPI_{it}^{+}, CPI(1)_{it}^{+}] \quad (1.6)$$

where SP_{it} is aggregate share price index, LQ_{it} is liquidity as proxied by reserve money, MS_{it} is money supply, IPI is industrial production index, Y is real GDP, LR is lending rate, TRB is Treasury bill rate and CPI is inflation. All variables are in logs. These theoretical models are operationalized as follows:

$$\ln SP_{it} = a_0 + a_1 \ln LQ_{it} + a_2 \ln MS_{it} + a_3 \ln IPI_{it} + e_{it} \quad (1.7)$$
$$\ln LQ_{it} = b_0 + b_1 \ln MS_{it} + b_2 \ln Y_{it} + b_3 LR_{it} + z_{it} \quad (1.8)$$
$$\ln MS_{it} = c_0 + c_1 \ln Y_{it} + c_2 \ln LQ_{it} + c_3 \ln SP_{it} + c_4 TBR_{it} + c_5 \ln CPI_{it} + v_{it} \quad (1.9)$$

Two separate sets of hypothesis tests will be conducted to verify the above models. The first set of tests will be conducted on whether money supply is endogenously determined.

3.3 Hypotheses

H_1 : MS causes GDP (suggesting money is exogenous) or there is bidirectional causality (endogenous). Since no tests have been done on this assumption for other countries than Japan (Badaruddin et al., op cit), it is important to test this condition first. It is hypothesised under the alternative hypotheses that there may be unidirectional or bidirectional causality from real GDP to money supply.

The second set of hypotheses shown below will be used to test hypotheses 2 to 3:

H_2 : MS causes liquidity: this follows Friedman's proposition which is still not verified for other countries than Japan.

H_3 : Liquidity causes share prices. This is to test for a bi-directional causality.

It is hypothesised under the alternative hypothesis that money supply causes liquidity and that liquidity causes share price changes.

The data transformation and tests on the data to ensure that the regressions are not spurious, are shown in Appendix 1.

3.4 Findings on Causality Tests

The results on causality are presented in this sub-section. Since this test has yet to be reported in the literature for China, India and Korea, we report these and the results for Japan as well. The results of the Granger causality tests are shown in Table 1 below after data transformation using unit root testing. This table summarizes the test results of the pair of variables for the Granger causality tests. For MS, GDP (important for Hypothesis 1), they indicate bidirectional causality for India and Japan. For China, MS to GDP is instantaneous with no lead and lag relationship, and for Korea, it shows a unidirectional relationship. Hence, these results indicate that money is endogenous in India and Japan, for China it is instantaneous, while for Korea the impact is from money supply to GDP. These relationships reflect the degree of development of financial institutions in these Asian countries, with India and Japan having a high degree of integration with the real sector. For China, the relationship is segmented while in Korea the relationship is from money supply to GDP. For MS, liquidity (Hypothesis 2), the relationship is unidirectional for all countries (except Japan, which is bidirectional). In India and Korea, Liquidity leads money supply, which reflects the use of statutory reserves by the Central Bank to affect liquidity in the banking system. In Japan, there is a bidirectional impact of money supply and liquidity, while in China, the impact is from money supply to liquidity reflecting a multiplicity of instruments (exchange rates, open market operations and rediscount rate) to control liquidity besides relying on statutory reserves[8].

Table 1: Summary of Causality Test Results

		China	India	Korea	Japan
MS	GDP	Instant	MS <--> GDP	MS --> GDP	MS <--> GDP
MS	LQ	MS --> LQ	LQ --> MS	LQ --> MS	MS <--> LQ
MS	SP	MS --> SP	Instant	MS --> SP	Instant
LQ	GDP	Instant	LQ <--> GDP	LQ --> GDP	LQ <--> GDP
SP	GDP	SP --> GDP	Instant	SP --> GDP	GDP --> SP
SP	LQ	LQ --> SP	LQ --> SP	SP --> LQ	LQ --> SP

As a robustness test we also did a multivariate test using 3 endogenous variables, LSPRICE, LRLQ AND LRM2. This was conducted in a VAR framework using the Toda-Yamamoto procedure, which is extolled as the best.

[8] Xie (2004) notes that the PBC has been using growth rates of money and bank lending as explicit intermediate targets. The relationship of these aggregates to real activity has not been necessarily stable over time.

This result (though not reported in this paper) confirms the earlier univariate finding of bidirectional causality between share prices and liquidity, share prices and money supply, liquidity and money supply and money supply and GDP. Hence, it is suggested that there is a causal link among the variables confirmed.

3.5 *Data and Variables*

A description of the data sources and variables was given before we reported on the results for hypotheses 2 and 3. The Datastream database was used for sourcing all data while the International Financial Statistics (IFS) database of the International Monetary Fund (IMF) was used to verify the consistency check for the macroeconomic variables to ensure that there were no errors. The data were quarterly series for the period 1968–2012, where the number after the colon refered to the quarter. Data for all four Asian countries were compiled and it is important to note that income was included as an explanatory variable in some equations specified above. Real gross domestic product (GDP) was used as a proxy for income and since only quarterly data were available for income, the highest frequency was quarter.

As a proxy for earnings, we combined the literature and decided on the use of the industrial production index (IPI) which is highly correlated with earnings of firms and real income. Hence, we used the log change of IPI as a proxy for earnings in the equation for asset pricing: if IPI goes up, the earnings of the firms go up or vice versa. Liquidity is another difficult variable to specify. There are three alternative proxies: bid-ask spread used in market studies (Amihud and Mendelson, 1986); volume of transactions (Amihud, 2002; Chordia, Subrahmanyam and Anshuman, 2001), all for individual stock liquidity studies. Based on the study by Gordon and Leeper (2002) we used reserve money as the correct variable for financial sector liquidity. This appeared as the right choice using reserve money because, if the banking system has more money in the central bank, liquidity declines, and if it keeps less reserve, liquidity goes up. Therefore, liquidity is inversely related to reserves.

As for the data for money supply, M2, values were used.[9] The Treasury bill rate and the bank lending rate were the domestic 3-month Treasury-bill rate and the lending rate respectively. In Datastream, the MSCI stock index values were reliably reported and suitable to be used for share returns, SP, and computed as log change. The consumer price index was used as a proxy for inflation, INF. The bank lending rate, LR, deposit rates, TBR, and real gross domestic product, RGDP, were also obtained. All variables were seasonally adjusted where available and transformed to logarithmic form, with the exception of interest rates, which were the local 3-month Treasury bill rate, TBR and the lending rate, LR.

---

[9] The choice of monetary aggregate has been discussed earlier and its implications on the demand for money have been discussed in Pagan and Robertson (1995) and Duca (1995) on finding the liquidity effect and for the stock market in Parhizgari (2012) on the share price effect.

The asset pricing theory as discussed in Section 2 suggests a relationship between share prices and corporate dividend streams (earnings in this study proxy it) growing at g-rate of growth. In the long run, the g and dividends depend on earnings of the corporations, which directly depends on IPI. Although we were testing the relationship between liquidity and share prices, there was a need to control the effect of earnings changes in the equations. For this, we used the IPI after some initial tests using cointegration. The cointegration tests conducted for the Asian countries, indicated that IPI and GDP were cointegrated in the long-run and that IPI could be used as a proxy for earnings in our share price equations. So, we specified this (earnings and money supply) as control variables in our liquidity equation for share prices.

The table below reveals the expected direction of the tested factors in affecting the dependent variables. It also includes our finding, the details of which will be shown in the next section.

Table 2: Expected and Actual Signs for Variables in Dynamic OLS Estimation

Variables	Expected Sign	Actual		Expected Sign	Actual Sign
Equation 1.7: LSPRICE			Equation 1.8: LRLQ		
LQ	+	+	MS	+	+
MS	+	-	Y	+	+
IPI	+	+	LRate	-	+
DUM(GFC)	+	+	DUM(GFC)	+	+
DUM(Regime)	+	+	DUM(Regime)	+	+
Equation 1.9: LRM2					
LQ	+	+			
Y	+	+			
SP	+	+			
TBRate	-	-			
CPI	+	+			
CPI(+1)	+	+			
DUM(GFC)	+	+			

DUM (GFC) and DUM (Regime) are used as control variables in the equations for Korea and Japan because these two countries are more integrated with the world economies. China and India were more isolated in the earlier years and the variables DUM(GFC) and DUM(Regime) are not included.

4. Findings

The results of these carefully run tests are presented in this section. After discussing the descriptive statistics, the data transformation test results are summarised and interpreted. The causality test results are presented next before

presenting the results of single equations and then the Dynamic Ordinary Least Squares (DOLS) equations results.

4.1 Descriptive statistics

Table 3: Descriptive Statistics of Country Variables Used in Tests

	DLSPRICE	LCPI	LR	LRGDP	LRIPI	LRLQ	LRM2	LSPRICE	TBR
China									
Mean	0.01	4.61	5.86	4.69	2.61	8.93	10.38	5.19	2.54
Median	0.00	4.63	5.58	4.70	2.68	8.77	10.33	5.16	2.25
Std. Dev.	0.14	0.21	0.66	0.38	0.29	0.41	0.39	0.39	0.67
Jarq-Bera	0.11	3.89	12.59	2.34	6.91	4.14	2.14	2.00	15.72
Obs	48	48	48	48	48	48	48	48	48
India									
Mean	0.03	4.61	4.56	-4.44	-0.73	5.32	4.56	6.98	11.95
Median	0.03	4.56	4.53	-3.50	-0.81	5.36	4.33	6.00	12.00
Std. Dev.	0.12	0.27	0.32	7.47	0.37	0.21	0.69	1.55	1.33
Jarq-Bera	0.19	3.12	3.78	0.42	6.30	4.88	7.12	39.39	1.93
Obs	62	62	62	62	62	62	62	62	62
Korea									
Mean	0.02	4.14	8.75	3.99	3.76	10.14	12.75	3.93	11.66
Median	0.02	4.24	8.50	4.12	3.87	10.27	13.06	4.20	11.83
Std. Dev.	0.12	0.49	4.23	0.62	0.84	0.65	1.20	0.91	6.30
Jarq-Bera	7.51	9.26	25.21	10.69	8.84	9.62	13.42	12.34	19.27
Obs	137	137	137	137	137	137	137	137	137
Japan									
Mean	0.01	4.18	4.03	4.96	-0.04	-1.09	1.13	3.83	3.34
Median	0.02	4.48	4.21	5.92	-0.08	-1.11	1.27	4.18	4.15
Std. Dev.	0.08	0.56	0.61	2.27	0.15	0.82	0.78	1.03	2.47
Jarq-Bera	24.06	37.77	31.15	23.32	32.93	6.83	19.43	19.87	25.10
Obs	209	209	209	209	209	209	209	209	209

Note: S.D. is standard deviation. LSPRICE, LRM2, LRIPI, LRGDP, LCPI, TBR, LR and LRLQ are Stock price index, Money supply, Industrial production index, Income, Inflation, Treasury bill rate, Lending rate and Reserve money respectively. All variables are in logarithmic form except for TBR and LR.

Table 3 provides the summary of the descriptive statistics of the variables used in the regression. The variables were transformed into logs (except for LR and TBR) and first differenced (to get the return for SP). The Jarque-Bera (JB) test indicated that most variables for China and India were normal (JB of <5.9 for variables to be considered normal) while in the case of Korea and Japan, the JB tests for normality indicated non-normality (JB >5.9). Most of these variables were skewed (> 0, for normality should be close to 0). A quick read of the values of these variables suggest that these were what one would expect in the panel of Asian countries' (China, India, Korea and Japan) economies. For example, the inflation rate averaged to 4.6 per cent for China and India, higher than the 4.1 per cent for Korea and Japan. The Treasury bill rate the and lending rate over the test period were (2.5 per cent and 5.9 per cent) for China, (7 per cent and 12 per cent) for India, (11 per cent and 8.8 per cent) for Korea and (3.3 per cent and 5.5 per cent) for Japan. These first moment values were as reported for the Asian countries. The mean of difference in LSPRICE or the share price returns was 1-3 per cent pa for the Asian countries, with a maximum return of 36% (China) achieved during the bull phase of 1:2009 and a minimum of -39% (Korea) during the bear phase of 4:1997 of the market correction.

4.3 Single and Cointegration Equation Results

We first discuss the results obtained for each single equation and then the cointegration regressions before presenting the Dynamic OLS (DOLS) results. With cointegration, estimator consistency and accurate information on the extent of parameter uncertainty occur without the need for instruments. One advantage of this over instrumental variable estimators is that this avoids potential problems involved with poorly correlated instruments, within estimation procedures such as the generalized method of moments (see e.g. Bound, Jaeger and Baker, 1995). Estimations with the Johansen (1991) method and the dynamic ordinary least-squares (DOLS) technique of Stock and Watson (1993) generate economically plausible estimates. These coefficients allowed us to obtain estimates of two well-known structural elasticities, the short-run liquidity and interest and the long-run income response to demand for money. The results for each of the three equation for four countries are shown in order.

The statistics presented in Table 4 indicate that the dependent variable - share price - in the first equation is determined by reserve money (that is liquidity LQ), money supply MS and proxy for earnings IPI and IPI(-1). All the variables are significant in terms of the t-statistics. The liquidity impact on money supply in the third equation is quite significant reflecting that reserve increases will lead to a decline in money supply. In the second equation, liquidity is determined by money supply, income or real GDP and lending rate LR. All the variables except for money supply (LRM2) and lending rate (LR) are significant given their t-statistics at the same acceptance levels of 0.01, 0.05 and 0.10.

Money supply in the third equation is determined by income (RGDP), reserve money (LQ), share price (SP), Treasury bill rate (TBR) and inflation

(CPI). The significant relationship between LQ and money (Panel B) in all the four countries (B1, B2, B3 and B4) is as per Friedman's proposition highlighted in the Granger causality test. Except for inflation, all the variables are significant given t-statistics at the 0.01, 0.05 and 0.10 levels of acceptance. The income elasticity of money (Panel C) is less than one, for all four countries (C1, C2, C3 and C4) given we used M2: in endogenous money supply studies the use of M3 quasi money elicits a larger effect because M2 does not reflect the transaction demand for money.

Tables 4A, 4B & 4C are a summary of the results from running single equation regressions on selected individual Asian countries. These countries are China, India, Korea and Japan. The t-statistics are in square brackets, while . ***, **, * denote significance at the 0.01,0.05 and 0.1 levels respectively. The model parameters reported are adjusted R^2, std error, mean, std dev. of dependent variable and sum of square residuals. The reported results are mostly in line with the expected signs except for some exceptions.

Tables 4A, 4B & 4C: Results of Estimation Using Single Equation

Table 4A	***Group 1***		***Group 2***	
Share Price	***China***	***India***	***Korea***	***Japan***
Panel A: DV is Share Price	*(Coefficients with t-statistics in square brackets)*			
C	*1.78*	*11.43****	*-8.55****	*0.01*
	[0.89]	*[10.59]*	*[-5.54]*	*[0.05]*
LRLQ	*1.68****	*2.41****	*0.77****	*-1.04****
	[2.76]	*[30.76]*	*[5.86]*	*[-8.78]*
LRM2	*-1.46***	*-0.96****	*0.41****	*2.48****
	[-1.91]	*[-5.02]*	*[2.39]*	*[21.98]*
LIPI	*0.20*	*0.004*	*1.43**	*-1.16*
	[0.70]	*[1.19]*	*[1.57]*	*[0.70]*
DUM (GFC)			*-0.33****	*-0.65****
			[-2.52]	*[-6.96]*
DUM (Regime)			*0.08*	*-0.26****
			[0.66]	*[-4.14]*
	Model Parameters			
Adjusted R^2	*0.3859*	*0.9776*	*0.8782*	*0.9347*
Std Error	*0.3216*	*0.3040*	*0.3252*	*0.2685*
Mean	*5.1947*	*2.1087*	*3.9203*	*3.8298*
SD of dep var	*0.3926*	*2.0306*	*0.3252*	*1.0349*
Sum of Square Res	*4.4483*	*18.8477*	*13.854*	*14.417*

(continued)

Table 4B

Liquidity (Equation 2)	***Group 1***		***Group 2***	
***Panel B: DV is** Liquidity*	***China***	***India***	***Korea***	***Japan***
	(Coefficients with t-statistics in square brackets)			
C	*-1.47****	*-7.87****	*4.51****	*-1.36****
	[-3.04]	*[-21.95]*	*[10.06]*	*[-3.01]*
LRM2	*0.95****	*0.70****	*0.18****	*0.96****
	[12.50]	*[6.81]*	*[2.56]*	*[7.14]*
LRGDP	*0.06*	*0.71****	*0.78****	*-0.13*
	[0.73]	*[9.81]*	*[6.12]*	*[0.88]*
LRate	*0.04****	*0.02**	*0.03****	*-0.06****
	[2.11]	*[1.61]*	*[4.82]*	*[-4.52]*
DUM (GFC)			*-0.34****	*0.17****
			[-4.72]	*[2.71]*
DUM (Regime)			*0.02*	*0.02*
			[0.39]	*[0.43]*
		Model Parameters		
Adjusted R^2	*0.9595*	*0.9500*	*0.9487*	*0.9665*
Std Error	*0.0826*	*0.0819*	*0.1885*	*0.1506*
Mean	*8.9208*	*-0.7328*	*9.8611*	*-1.1095*
SD of dep var	*0.4107*	*0.3662*	*0.8242*	*0.8224*
Sum of Square Res	*0.3072*	*0.3887*	*5.8266*	*4.5792*

Table 4C

Money Supply (Eq. 3)	***Group 1***		***Group 2***	
***Panel C:** Money Supply*	***China***	***India***	***Korea***	***Japan***
	(Coefficients with t-statistics in brackets)			
C	*1.54****	*8.92****	*3.92****	*-1.62****
	[4.92]	*[24.22]*	*[8.53]*	*[-9.42]*
LRGDP	*0.04*	*0.34****	*0.53****	*0.63****
	[0.71]	*[4.67]*	*[4.41]*	*[13.07]*
LRLQ	*0.75****	*0.89****	*0.20****	*0.30****
	[11.87]	*[12.43]*	*[2.91]*	*[13.07]*
LSPRICE	*-0.03*	*-0.09****	*0.16****	*0.10****
	[-0.73]	*[-3.41]*	*[5.24]*	*[6.82]*
TBRate	*-0.06****	*-0.04****	*-0.02****	*-0.01**
	[-2.72]	*[-8.40]*	*[-4.07]*	*[-1.63]*

(continued)

Table 4C
Money Supply (Eq. 3)

Panel C: *Money Supply*	***China***	***Group 1*** ***India***	***Group 2*** ***Korea***	***Japan***
		(Coefficients with t-statistics in brackets)		
LCPI(1)		*0.79****		
		[2.34]		
DUM (GFC)			*0.33****	*0.10****
			[7.96]	*[3.95]*
DUM (Regime)			*-0.08**	*0.02*
			[-1.95]	*[0.93]*
		Model Parameters		
Adjusted R^2	*0.9698*	*0.9689*	*0.9908*	*0.9939*
Std Error	*0.0686*	*0.0374*	*0.1161*	*0.0611*
Mean	*10.3692*	*5.3173*	*12.732*	*1.1090*
SD of dep var	*0.3953*	*0.2123*	*1.2116*	*0.7833*
Sum of Square Res	*0.2026*	*0.0770*	*1.7379*	*0.7438*

4.4 Results from DOLS[10]

The Stock-Watson Dynamic OLS estimates of the 3 equations are summarized in Table 5 (China), Table 6 (India), Table 7 (Korea) and Table 8 (Japan). The equations were estimated including up to j=±1 leads and lags, the insignificant lags and leads were dropped. The long-run variance shown replaces the usual estimator for the residual variance of V_{it} with an estimator of the long-run variance of the residuals. If we had used OLS as an estimator, the value for the long-run variance would be SE of the regression.

Table 5 (for China) provides a summary of the results using DOLS. The statistics indicate that the dependent variable share price, SP, in the first equation, Panel A, is determined by reserve money LQ, money supply MS and earnings of firms IPI and IPI(-1); the last two being control factors. All the variables except earnings were statistically significant in terms of the t-statistics at the same acceptance levels normally used. This confirmed our findings of a long-run liquidity elasticity impact of 3.1 on share prices. In the second equation for liquidity (Panel B), the money supply effect was evident with an elasticity of 1.75, and was statistically significant, also after controlling for the effects of income, lending rate and stochastic trend. All the variables except income and lending rate were significant in terms of the t-statistics at the same levels normally used.

[10] Single equations were also estimated separately for each of the Asian countries to cross-check on the differences of the OLS and DOLS results. Those results are not reported here. Since DOLS results obviate the simultaneity bias and small sample bias inherent, we report only these results: the OLS results are available for inspection, if needed.

Table 5: Results of Estimation Using DOLS for all Equations for China

Panel B: LRLQ	(Liquidity)		
Variable	Coefficient	t-Statistic	
LRM2	1.75***	5.91	
LRGDP	1.80	1.67	
LR	0.07*	1.73	
C	-16.40***	-3.48	
@TREND	-0.07***	-2.44	
R-squared	0.980754	Mean dep var	8.928131
Adjusted R-squared	0.972935	S.D. dep var	0.388953
S.E. of regression	0.063988	Sum of sqd residual	0.131025
Durbin-Watson stat	0.501774	Long-run variance	0.007587
Panel C: LRM2	(Money Supply)		
Variable	Coefficient	t-Statistic	
LRGDP	0.79***	2.69	
LRLQ	0.20***	7.98	
LSPRICE	-0.03*	-1.83	
TBR	-0.04***	-9.43	
LCPI	-0.96***	-15.29	
C	9.15***	9.71	
@TREND	0.02**	2.49	
R-squared	0.999463	Mean dep var	10.38248
Adjusted R-squared	0.998944	S.D. dep var	0.367329
S.E. of regression	0.011652	Sum of sqd residual	0.003259
Durbin-Watson stat	1.673374	Long-run variance	6.06E-05

In the demand for money equation for China, long-run income elasticity was found to be 0.79, less than 1 as M2 were used with money and interest elasticity of -0.04. Apart from the long-run price elasticity, liquidity elasticity and share price elasticity, which had the opposite sign, all other elasticity had the predicted sign and were highly significant. The coefficient in the linear trend was statistically different from zero at the acceptable levels, indicating that there was a deterministic time trend common to both LRM2 and its determinants. The DOLS for the demand for money is robust to various departures from the standard regression assumptions in terms of residual correlation, hetroscedasticity, misspecification of functional form and non-normality of residuals. Stability tests conducted by plotting CUSM and CUSMSQ (not shown here) suggest that estimated models were stable over the sample period.

Table 6 (for India) provides a summary of the results using DOLS. All the variables except earnings (a control variable) were statistically significant in terms of the t-statistics at the usual acceptance levels of significance. Our finding of a long-run liquidity elasticity impact of 3.9 on share prices was also confirmed

for India. In the second equation for liquidity (Panel B), the money supply effect was evident with an elasticity of 3.86, which was also statistically significant; this was after controlling for the effects of income, lending rate and stochastic trend. All the variables except lending rate were significant with large t-statistics significant at the levels normally used in tests.

Table 6: Results of Estimation Using DOLS for all Equations, India

Panel B: LRLQ (Liquidity)			
Variable	Coefficient	t-Statistic	
LRM2	3.86***	3.64	
LRGDP	1.99***	7.98	
LR	0.02***	2.53	
C	-8.73***	-18.06	
@TREND	-0.02***	-3.42	
R-squared	0.993506	Mean dep var	-0.725948
Adjusted R-squared	0.991630	S.D. dep var	0.357943
S.E. of regression	0.032747	Sum of sqd residual	0.048257
Durbin-Watson stat	1.214469	Long-run variance	0.001431

Panel C: LRM2 (Money Supply)			
Variable	Coefficient	t-Statistic	
LRGDP	-0.98	1.58	
LRLQ	0.55***	5.04	
LSPRICE	0.02	0.41	
TBR	-0.004	-0.44	
LCPI	-1.15***	-8.06	
C	9.57***	10.66	
@TREND	0.03***	4.06	
R-squared	0.995222	Mean dep var	5.325013
Adjusted R-squared	0.992511	S.D. dep var	0.209261
S.E. of regression	0.018110	Sum of sqd residual	0.012135
Durbin-Watson stat	1.044157	Long-run variance	0.000402

In the demand for money equation for India, long-run income elasticity was found to be -0.98, and interest elasticity was -0.004 with correct signs. Besides income elasticity, the long-run inflation elasticity and the coefficient in the linear trend had signs opposite to the theoretical signs. This could be due to an economy with high inflation, a well-documented fact for this economy, and the demand for money was thus seriously affected by inflation. The coefficient in the linear trend was statistically different from zero at conventional levels, indicating that there was a deterministic time trend common to both LRM2 and its determinants.

Table 7 (for Korea) provides a summary of the results again using DOLS. The statistics indicate that the dependent variable share price, SP, in the first equation, was determined by reserve money LQ, money supply MS, earnings of firms IPI and IPI(-1) and dummy for global financial crisis; the last three being control factors. All variables were statistically significant in terms of the t-statistics as used in acceptance for significance. These findings confirmed our *a priori* expectations of a long-run liquidity elasticity impact on share prices, with an elasticity of 1.3.

Table 7: Results of Estimation Using DOLS for all Equations, Korea

Panel B: LRLQ	(Liquidity)		
Variable	Coefficient	t-Statistic	
LRM2	-0.97***	-3.50	
LRGDP	4.33***	5.47	
LR	0.028***	2.23	
DUM	-0.17	-1.22	
DUM1	0.24***	2.32	
C	8.29***	6.67	
@TREND	-0.02***	3.86	
R-squared	0.982527	Mean dep var	9.873795
Adjusted R-squared	0.976606	S.D. dep var	0.786957
S.E. of regression	0.120366	Sum of sqd residual	1.753034
Durbin-Watson stat	0.767867	Long-run variance	0.029771

Panel C: LRM2	(Money Supply)		
Variable	Coefficient	t-Statistic	
LRGDP	2.29***	14.06	
LRLQ	-0.12***	-1.80	
LSPRICE	0.05***	1.99	
TBR	-0.012*	-1.51	
LCPI	0.63***	4.02	
DUM	0.28***	7.58	
DUM1	0.03	1.16	
C	4.13***	9.22	
@TREND	-0.02***	-10.53	
R-squared	0.999549	Mean dep var	12.77017
Adjusted R-squared	0.999197	S.D. dep var	1.152148
S.E. of regression	0.032645	Sum of sqd residual	0.077794
Durbin-Watson stat	0.437193	Long-run variance	0.001909

In the second equation for liquidity, the money supply effect was evident with an elasticity of -0.97 and was statistically significant, after controlling for the effects of income, lending rate, dummies (regime changes and global finance crisis) and stochastic trend. All the variables except for income and lending rate were significant in terms of the t-statistics at the same levels normally used. In the demand for money equation for Korea, long-run income elasticity was found to be 2.29 and interest elasticity was -0.012. Apart from trend coefficient which had the opposite sign, all the other control variables (liquidity, share price, inflation and dummy variable for global finance crisis and regime changes) had the predicted signs and were highly significant. The coefficient in the linear trend was statistically different from zero at conventional levels, indicating that there was a deterministic time trend common to both LRM2 and its determinants.

Table 8 (for Japan) provides a summary of results also from DOLS. The statistics indicate that the dependent variable share price, SP, in the first equation, was determined by reserve money LQ, money supply MS, earnings of firms IPI and IPI(-1). The control dummy for global financial crisis, along with the other last two were significant; this is the consistent with the known fact that the crisis did affect Japan. All the variables were statistically significant in terms of the t-statistics at the same levels used in this research. The Japan findings helped to confirm our *a priori* expectations of a long-run liquidity elasticity impact on share prices, although the signs were different with an elasticity of -1.4. In prior studies by others (for example the G-7 study), it has also been shown that the results were similar.

Table 8: Results of Estimation Using DOLS for all Equations, Japan

Panel B: LRLQ	(Liquidity)		
Variable	Coefficient	t-Statistic	
LRM2	1.61***	3.12	
LRGDP	-1.22***	-2.37	
LR	-0.01	-0.32	
DUM	-0.14	-0.81	
DUM1	-0.06	-0.46	
C	1.85***	1.19	
@TREND	0.004	1.19	
R-squared	0.981806	Mean dep var	-1.092434
Adjusted R-squared	0.975494	S.D. dep var	0.772106
S.E. of regression	0.120868	Sum of sqd residual	2.147546
Durbin-Watson stat	0.422899	Long-run variance	0.041554

Panel C: LRM2	(Money Supply)	
Variable	Coefficient	t-Statistic
LRGDP	0.90***	15.41

(continued)

LRLQ	0.15*		1.85
LSPRICE	0.05***		2.16
TBR	-0.08		-0.84
LCPI	-0.17***		-3.97
DUM	0.08***		-0.98
DUM1	-0.08		-1.67
C	-2.05***		-7.61
@TREND	0.003***		1.73
R-squared	0.999153	Mean dep var	1.134701
Adjusted R-squared	0.998680	S.D. dep var	0.734582
S.E. of regression	0.026686	Sum of sqd residual	0.090443
Durbin-Watson stat	0.284517	Long-run variance	0.001712

Note: Superscripts are p-values. ***, **, * denote significance at the 1, 5 and 10 percent levels respectively. C is a constant for each equation. SP is stock price index, LQ is liquidity as proxy by reserve money, MS is M2 as proxy for money supply, IPI is industrial production index as proxy for earnings, Y is real GDP as proxy for income, TBR is treasury bill rate, CPI is inflation and LR is lending rate.

In the second equation for liquidity (Panel B), the money supply effect was found as per our *a priori* expectation of money supply with an elasticity of 1.61, which was statistically significant, after controlling for the effects of income, lending rate, dummies (regime changes and global financial crisis) and stochastic trend. All the variables except the income and lending rate were significant given the size of the t-statistics and the probability level used in this study. In the money demand equation (Panel C) for Japan, the long-run income elasticity was found to be 0.90, close to most findings of 1 and interest elasticity of -0.08. All the other control variables (liquidity, share price, inflation and dummy variable for global finance crisis and regime changes) had the predicted signs and were highly significant. The coefficient in the linear trend was statistically different from zero at conventional levels, indicating that there was a deterministic time trend common to both LRM2 and its determinants.

6. Conclusion

This paper is a report of an investigation on the (a) money supply effects on interest rate and (b) banking liquidity as well as (c) banking liquidity effect on share price using Asian data from China, India, Korea and Japan. The literature on money supply effect has been widely followed in policy circles, yet propositions (b) and (c) have yet to verified. By adopting all the refinements needed to obtain robust parameter estimates and by using the system of equations (DOLS) developed for this study, the results reported in this paper are useful new findings on the money supply and share pricing literature.

The data for the Asian countries used cover the period of 1968 to 2012, which were quarterly series on all variables. The variables were transformed

to ensure that there was no spurious parameter estimates as an improvement to prior studies. Friedman's 1969 propositions were used; we added an asset pricing equation to these propositions in order to extend the test for a liquidity–credit surge - effect on share prices. Further, we control led for monetary regime changes and the effect of global crisis by specifying dummy variables to correct structural breaks in the time series. The results (using the Granger and Toda Yamamoto tests) reconfirmed the already known evidence that money supply was endogenous and that there was bidirectional causality from money to interest rate as already confirmed in the studies on the post-Keynesian endogenous money theory. They indicated bidirectional causality for all the variables, MS, GDP (important for Hypothesis 1) and Liquidity (Hypothesis 2). All variables had bidirectional impact on one another except for MS to GDP for China (instantaneous with no lead and lag relationship) and Korea, which showed a unidirectional respectively.

These new findings reported here relate to (a) the effect of money supply on banking liquidity that has yet to be confirmed and (b) the banking liquidity effect on share prices. We showed that these effects are significant as they weretested using DOLS to correct for simultaneity and endogeneity, thus, confirming Friedman's second proposition on money effect on banking liquidity. We extended that proposition via a share-pricing equation to test and confirm the banking liquidity effect on share prices. Our data limitation was simply that this research used quarterly series since GDP data were only available as quarterly series and earnings which were available on an annual basis were proxied by industrial production index.

Author information

Chung Tin Fah, PhD, is a senior lecturer at Taylor's University, Subang Jaya, Malaysia. He is a committee member of RAM Rating and Bursa Market Participants. This topic was part of his PhD thesis and he has taught and researched on this topic for several years, publishing articles in journals. He lectures and conducts training in economics and finance. The author wishes to record his gratitude to the two anonymous referees and the editors of the Journal for providing review comments on an earlier version of this paper. Chung Tin Fah may be contacted at: E-mail: tinfah@yahoo.com.

References

Amihud, Y., & Mendelson, H. (1986). Asset pricing and the bid-ask spread. *Journal of Financial Economics, 17:* 223–249.

Amihud, Y. (2002). Illiquidity and stock returns: Cross-section and time series effects. *Journal of Financial Markets, 5:* 31–56.

Arellano, M., & Bond, S. (1991).Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *Review of Economic Studies, 58*.

Ariff, M., Farrar, J., & Khalid, A.M. (Eds). (2012). Regulatory Failure and Global Financial Crisis. Edward Elgar Ltd. UK and USA.

Ariff, M. , Chung, T., & Shamsher, M. (2012). Money supply, interest rate, liquidity and share prices: A test of their linkage. *Global Finance Journal, 23(3):* 202–220.

Badarudin, Z.t., Khalid, A.M. & Ariff, M. (2013). Post Keynesian money endogeneity evidence in G-7 economies. *Journal of International Money and Finance, 33:*146-162.

Badarudin, Z.t., Khalid, A.M., & Ariff, M. (2012). Exogenous or endogenous money supply: Evidence from Australia. *The Singapore Economic Review, 57(4).*

Badarudin, Z.t., Ariff, M., & Khalid, A.M. (2011). Money supply endogeneity and bank stock returns. *Applied Financial Economics, Vol 21. (no 10):* 156-173.

Bailey, W., & Chung, Y.P. (1996). Risk and return in the Philippine equity market: A multifactor exploration. *Pacific Basin Finance Journal, 4:* 197–218.

Bound, J. D., Jaeger, A., & Baker, R. M. (1995). Problems with instrumental variables estimation when the correlation between the instruments and the endogenous explanatory variable is weak. *Journal of the American Statistical Association, 90*:443-50.

Brunner, K. (1961). Some major problems in Monetary Theory. *American Economic Review, (May):*47-56.

Cagan, P. (1972). Channels of monetary effects on interest rates. Columbia University Press, New York.

Carpenter, S., & Demiralp, S. (2006). The liquidity effect in the federal funds market: Evidence from daily open market operations. *Journal of Money, Credit, and Banking, 38(4):* 901-20.

Chen, N.F., Roll, R., & Ross, S.A. (1986). Economic forces and the stock market. *Journal of Business, 59:* 383–403.

Cheung, Y.-W., and K. S. Lai. (1993). Finite-sample sizes of Johansen's Likelihood Ratio Tests for Cointegration. *Oxford Bulletin of Economics and Statistics, 55:*313-328.

Chordia, T., A. Subrahmanyam, & V. R. Anshuman. (2001) Trading activity and expected stock returns. *Journal of Financial Economics, 59:* 3–32.

Christiano, L.J., Eichenbaum, M., & Evans, C.L. (1996a). The effects of monetary policy shocks: Evidence from the flow of funds. *Review of Economics and Statistics, 78(1):* 16-34.

Cooper, R.V.L. (1970). Efficient capital markets and the Quantity Theory of Money. *Journal of Finance, (May*): 338-341.

Dhakal, D., Kandil, M., & Sharma, S. C. (1993). Causality between the money supply and Share prices: a VARiInvestigation. *Quarterly Journal of Business and Economics, 32(3):* 52-74.

Duca, J. V. (1995). Should bond funds be added to M2. *Journal of Banking and Finance, 19(4):* 131-152.

Edmond, C., & Weill, P-O. (2005).Models of the liqudity effect. The new Palgrave dictionary of economics, Palgrave Macmillan.

Effa, Z. B., Ariff, M., & Khalid, A.M. (2013). Post Keynesian money endogeniety in G-7 economies: Is it accommodationist or structuralist or liquidity preference? *Journal of International Money and Finance, 33:* 146–162.

Effa, Z. B., Ariff, M., & Khalid, A.M. (2011). Money supply endogeneity and bank stock returns. *Applied Financial Economics, Vol. 21 (no. 10):* 156-173.

Effa, B. et al. (2011). Endogeneous money supply and bank stock returns: Empirical evidence using panel data. *Applied Financial Economics, 25(6):* 345-356.

Engle, R.F., & Granger, C.W.J. (1987). Cointegration and error correction:Representation, estimation and testing. *Econometrica, 55:* 251-276.

Fama, E.F., & Schwert, G.W. (1977). Asset returns and inflation. *Journal of Financial Economics, 5:*115-146.

Flannery, M. J., & Protopapadakis, A. (2002). Macroeconomic factors do influence aggregate stock returns. *Review of Financial Studies, 15:*751-782.

Friedman, M. (1969). Factors affecting the level of interest rates. In Proceeding of the 1968 Conference on Saving and Residential Financing. Chicago: United States Saving and Loan League, 1969, 11-27.

Friedman, M., & Schwartz, A.J. (1963). Money and business cycles. *Review of Economics and Statistics, (February):* 52-64.

Goodfriend, M. (1997). A framework for the analysis of moderate Inflations. *Journal of Monetary Economics, 39 (1) June:* 45-65.i

Gordon, D.B., & Leeper, E.M. (2002). The price level, the Quantity Theory of Money, and the Fiscal Theory of the Price Level. *NBER Working Papers 9084, National Bureau of Economic Research, Inc.*

Granger, C.W.J. (1988). Some recent development in a concept of causality. *Journal of Econometrics, 39:* 199211.

Granger, C. W. J. (1969). Investigating causal relationship by econometric models and cross section special methods. *Econometrica, 37:*425-435.

Hamilton, J.D. (1997). Measuring the liquidity effect. *American Economic Review, 87(1):* 80-97.

Hardouvelis, G.A. (1987). Macroeconomic information and stock prices. *Journal of Economics and Business, 39(2):* 131-140.

Ibrahim, M. H. & Aziz, H. (2003). Macroeconomic variables and the Malaysian equity market: A view through rolling subsamples. *Journal of Economic Studies, 30:* 6-27.

Im, K. S., M. H. Pesaran, & Shin, Y. (1997). Testing for unit roots in heterogeneous panels. Discussion Paper (University of Cambridge).

Johansen, S. (1991). Estimation and hypothesis testing of cointegration vectors in Gaussian vector autoregressive models. Econometrica 59(6): 1551-1580.

Johansen, S. (1988). Statistical analysis of cointegration vectors. *Journal of Economic Dynamics and Control, 12*: 231-254.

Keim, D. B. (1985). Dividend yields and stock returns: Implications of abnormal January returns. *Journal of Financial Economics*, 14:473-489.

King, B. F. (1966). Market and industry factors in stock price behaviour. *Journal of Business, 39:* 139-190.

Kraft, J., &Kraft, A. (1977a). Common stock prices: Some observations. *Southern Economic Journal, 43:* 1365-1368.

Kraft, J., & Kraft, A. (1977). Determinants of common stock prices in time series analysis. *Journal of Finance, (May):* 417-425.

Kwon, C.S., & Shin, T.S. (1999). Cointegration and causality between macroeconomic variables and stock market returns. *Global Finance Journal, Vol. 10, No. 1*: 71-81.

Laidler, D.E.W. (1985). The demand for money, (3rd ed.). New York: Harper & Row

Leeper, E. M., & Gordon, D.B. (1992). In search of the liquidity effect. *Journal of Monetary Economics, 29:* 341-369.

Litzenberger, R.H., & Ramaswamy, K. (1982). The effects of dividends on common stock prices: Tax effects or information effects? *Journal of Finance, 37(2):* 429-443.

Maddala, G. S., & Wu, S. (1999). A comparative study of unit root tests with panel data and a new simple test. *Oxford Bulletin of Economics and Statistics, 61:* 631–652.

Markowitz, H. (1952). Portfolio Selection. *Journal of Finance*, 7:77-91.

Mehra, Y. P. (1993). The stability of the M2 demand function: Evidence from an error-correction model. *Journal of Money, Credit and Banking, 25 (3):* 455-460.

Mokerjee, R., & Qiao Yu. (1997). Macroeconomic variables and stock prices in a small open economy: The case of Singapore. *Pacific-Basin Finance Journal, 5*:377-388.

Musílek, P. (1997). Změny makroekonomických veličin a akciové kurzy. *Finance a úvěr, 47,* č.3.

Newey, W., & West, K. (1987). A simple positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix. *Econometrica, 55:* 703–708.

Pagan, A.R., & Robertson, J.C. (1995). Resolving the liquidity effect. *Federal Reserve Bank of St. Louis Review, 77(3):* 33-54.

Parhizgari, A.M., & Duong, N. (2011). M1, M2 and the US equity exchanges. *Frontiers in Finance and Economics, Vol. 8, No. 2:* 112-135.

Pesando, J.E., (1974). The supply of money and common stock prices: Further observations on the econometric evidence. *Journal of Finance, (June):* 909-922.

Phillips, P., & Perron, P. (1988). Testing for a unit root in time series regression. *Biometrika, 75(2):* 335-346.

Rochon, L.-P. (2006). Endogenous money, central banks and the banking system: Basil Moore and the supply of credit, In M. Setterfield, (Ed.):

Complexity, endogenous money and macroeconomic theory. Edward Elgar, Cheltenham,UK.

Rozeff, M.S. (1974). Money stock prices: Market efficiency and the lag in effect of monetary policy. *Unpublished doctoral dissertation. Graduate School of Management, University of Rochester.*

Schwarz, G. (1978). Estimating the dimension of a model. *Annals of Statistics*, 6: 461–464.

Sharpe, W. F. (1964). Capital asset prices: A theory of market equilibrium under conditions of risk. *Journal of Finance, 19:*425-442.

Sprinkel, B.W. (1964). Money and stock prices. New York: Richard D. Irwin, Homewood, III.

Stock, J., H. & Watson. M.W. (1993). A simple estimator of cointegrating vectors in higher order demand systems. *Econometrica, 61:*783-820.

Taghizadeh-Hesary, F., & N. Yoshino. (2013). Which side of the economy is affected more by oil prices: Supply or demand? *United States Association for Energy Economics (USAEE) Research Paper, No. 13-139, Ohio, US.*

Taghizadeh-Hesary, F., & N. Yoshino. (2014). Monetary policies and oil price determination: An empirical analysis. *OPEC Energy Review, 38: 1–20.*

Taghizadeh-Hesary, F., N. Yoshino, G. Abdoli, & A. Farzinvash. (2013). An estimation of the impact of oil shocks on crude oil exporting economies and their trade partners. *Frontiers of Economics in China 8: 571–591.*

Thornton, D. L. (2007). Open market operations and the federal funds rate. In open market operations and the financial markets, the Bank of Finland. Reprinted in the *Federal Reserve Bank of St. Louis Review, 89(6),* 549-72.

Thornton, D. L. (2001). The federal reserve's operating procedure, nonborrowed reserves, borrowed reserves and the liquidity effect. *Journal of Banking and Finance, 32:* 155-167.

Toda, H. Y., & Phillips, P.C.B. (1993). Vector autoregressions and causality. *Econometrica, 61*: 1367-1393.

Toda, H.Y., & Yamamoto, T. (1995). Statistical inference in vector autoregressions with possibly integrated processes. *Journal of Econometrics, 66*: 225-250.

Xie, P. (2004). China's monetary policy: 1988-2002. *Stanford Center for International Development Working Paper,* No 217, Stanford University.

Yoshino, Farhad, Hassanzadeh & Prasetyo (2014). Response of stock markets to monetary policy: An Asian stock market perspective. *ADBI Working Paper 497, Tokyo: Asian Development Bank Institute.*

Yoshino, N., T. Nakamura, & Y. Sakai. (2013). International comparison of bubbles and bubble Indicators. *AI & Society, 29(3): 427–434.*

Yoshino, N., & F. Taghizadeh-Hesary. Forthcoming, (2014). Monetary policy and oil price fluctuations following the subprime mortgage crisis. *International Journal of Monetary Economics and Finance, 7.*

Appendix 1: Data Transformation and Test Models

The findings of the two unit root tests and the Johansen cointegration test are discussed in this Appendix.

1-A Unit Root Tests Using Phillips-Perron Fisher Tests

Unit root tests are performed on the variables to prepare the data set for cointegration and causality tests. Cointegration analysis is valid if the unit root test establishes that the order of integration of the variables of interest is *I(1)*. Thus, we validated the stationarity properties of the variables prior to conducting the cointegration tests. For this, the Johansen cointegration equation was applied.

Table 1: Unit Root Tests for China, India, Korea and Japan

Variables	Level		Difference	
	ADF	PP	ADF	PP
China				
MS	-2.272	-2.272	-6.677***	-6.714***
LQ	-1.221	-2.194	-2.881	-11.101***
SP	-3.271*	-2.097	-3.901**	-3.243*
INF	-2.922	-2.825	-6.930***	-7.436***
LR	-2.368	-2.235	-5.296***	-5.290***
TBR	-3.179	-2.392	-5.709***	-5.728***
RGDP	-3.101	-13.577***	-2.844	-28.188***
IPI	-3.134	-3.126	-8.298***	-8.309***
India				
MS	-2.836	-4.351***	-13.447***	-25.801***
LQ	-3.341*	-3.026	-4.267***	-17.033***
SP	-2.532	-2.315	-7.858***	-10.655***
INF	-2.134	-2.882	-4.979***	-10.006***
LR	-3.668**	-3.295*	-9.488***	-9.399***
TBR	-2.345	-7.246***	-6.258***	-19.429***
RGDP	-2.411	-8.582***	-3.205*	-24.238***
IPI	-2.471	-4.108***	-5.488***	-18.748***
Korea				
MS	-0.511	0.725	-6.220***	-8.850***
LQ	-3.046	-3.261*	-3.616**	-14.980***

(continued)

Variables	Level		Difference	
	ADF	PP	ADF	PP
SP	-2.242	-2.050	-8.481***	-8.478***
INF	-3.399**	-1.625	-3.418*	-8.290***
LR	-3.554**	-3.460**	-9.826***	- 12.202***
TBR	-3.269*	-3.384*	-10.861***	-10.857***
RGDP	-0.473	-18.284***	-5.232***	-105.482***
IPI	-2.838	-2.583	-8.766***	-8.842***
Japan				
MS	-1.967	-2.662	-3.995**	-8.805***
LQ	-3.001	-5.173***	-3.909**	-25.985***
SP	-0.592	-0.463	-7.098***	-10.779***
INF	-1.090	-0.298	-3.040	-11.851***
LR	-2.725	-2.562	-6.641***	- 5.898***
TBR	-4.106***	-2.982	-5.940***	-11.049***
RGDP	-1.944	-2.676	-4.902***	-39.023***
IPI	-3.187*	-2.956	-6.929***	-8.349***

Note 1: MS= log of real money supply, SP = log of real stock prices; RGDP = Real GDP; INF = log of consumer price index; LR = lending rate; TBR= deposit rate; LQ= log of liquidity index.
Note 2: Test equation specification: Both intercept and trend are included
Note 3: Lag length selection: AIC

As is evident from these summary results, all variables (except for share price) for China are non-stationary, that is, the null-hypothesis of the unit root cannot be rejected. After differencing, these variables become stationary at 1%, 5% and 10%. Two tests were conducted here – the Augmented Dickey Fuller (ADF) test and the Phillips Perron (PP) test to confirm the findings of stationary. In China's case the variable RGDP was still non-stationary (ADF of -2.844) after the first difference but the PP test (-28.188) confirmed stationary at the 1% level, after differencing. In the case of India and Korea, all variables become stationary after taking the first difference. For Japan, the variable INF was stationary using the PP test (-11.85 at the 1% level) while the ADF test (-3.04) still indicate non-stationary. The section on the Johansen cointegrating results and the DOLS cointegrating results are mentioned below. Though not strictly comparable because of different estimators, lag periods differed, and the use of pre-determined variables in the DOLS estimations (using IPI, LR, TBR, RGDP and CPI) whereas in Johansen we estimated based on the 3 cointegrating variables of SP, LQ and MS.

1-B Johansen cointegration tests

Cointegration results based on Johansen's (1988) procedure are sensitive to the choice of lag length in VAR (Cheung and Lai, 1993). Thus, the optimum lag

lengths of the VAR are determined by minimising the Schwarz (1978) Bayesian Information Criteria (SBC). This criterion is designed to select the model with maximum information available. The general concept of cointegration between variables suggests that there exists an equilibrium or a long-run relationship between two time series provided the series are integrated of the same order. This will be confirmed using the Phillips-Perron test.

1-C Johansen Cointegration Tests for Money Supply, Liquidity and Share Price

This table summarizes the Johansen Cointegration test results of money supply, liquidity and share prices. They indicate that money supply, liquidity and share prices are cointegrated in the long-run for all Asian countries.

Table 2-A: Johansen Cointegration Test Results

	Unrestricted Cointegration Rank Test (Trace)			Unrestricted Cointegration Rank Test (Max Eigenvalue)		
China	No of CE(s) Eigenvalue	Trace Stat	Prob.	No. of CE(s) Eigenvalue	Max-Eigen Stat	Prob.
	None 0.39	55.08*	0.04*	None 0.39	21.29	0.32
India	No of CE(s) Eigenvalue	Trace Stat	Prob.	No. of CE(s) Eigenvalue	Max-Eigen Stat	Prob.
	None * 0.19	81.61*	0.0*	None 0.19*	44.43	0.00*
	At most 1* 0.11	37.18*	0.03*	At most 1* 0.11*	22.77	0.04*
Korea	No of CE(s) Eigenvalue	Trace Stat	Prob.	No. of CE(s) Eigenvalue	Max-Eigen Stat	Prob.
	None * 0.24	90.63*	0.00*	None 0.24*	36.55	0.00*
	At most 1* 0.18	54.07	0.00*	At most 1* 0.18*	26.69	0.01*
	At most 2* 0.13	27.38	0.00*	At most 2* 0.13*	18.92	0.02*
Japan	No of CE(s) Eigenvalue	Trace Stat	Prob.	No. of CE(s) Eigenvalue	Max-Eigen Stat	Prob.
	None * 0.13	60.41*	0.01*	None * 0.13*	28.43	0.05*

1-D Results of the VECM tests

The Johansen (1988) cointegration tests confirm that the variables in equations (6) to (7) are cointegrated.

The resulting long-run coefficients as summarised in Table 3 were obtained through the normalisation of the cointegrating vectors. It should be stressed that the VECM were individually run for each equation and that they

were not run together as a system. This was because the purpose of this section was to determine whether the predetermined variables and the endogenous variables that are on the right hand side had causal effect on the dependent variable. The Johansen cointegrating relationship was estimated using the Maximum Likelihood (MLH) estimator, compared to the DOLS estimator which is estimated using the dynamic least squares. Though not strictly comparable because of different estimators, different lag periods and the use of pre-determined variables in the DOLS estimations (using IPI, LR, TBR, RGDP and CPI for some of the equations) whereas in Johansen we estimated based on the 3 cointegrating variables of SP, LQ and MS and 6 lags. Therefore, there were variations in the results due to the different estimators, cointegrating variables and lag lengths used. However, the coefficients could be used as a cross-check for robustness.

The evidence of cointegrating relations in Table 3 shows that there is a positive relationship in equation (6) between share price index and illiquidity, a major concern of this thesis. This is confirmed from the DOLS equation which we estimated earlier of positive relationship between share price index and illiquidity. Liquidity and share price are found to have a positive relationship for equations (6) and (7), suggesting the presence of a bidirectional relationship similar to earlier results. There is a positive relationship between share price and money supply for equation (8).

Table 3 : Cointegrating relations

	Equations	Cointegrating relation
	$SP_{it} = f\ [LQ^{+}, MS^{+}]$ (6)	
	$LQ_{it} = f\ [MS^{+}]$ (7)	
	$MS_{it} = f\ [LQ^{+}, SP^{+}]$ (8)	
China	$SP_{it} = f\ [LQ^{+}, MS^{+}]$	SP = 2.95 + 2.48 LQ + 2.85 MS
	$LQ_{it} = f\ [MS^{+}]$	LQ = -1.93 + 1.02 MS
	$MS_{it} = f\ [LQ^{+}, SP^{+}]$	MS = 1.62 + 0.87 LQ + 0.37 SP
India	$SP_{it} = f\ [LQ^{+}, MS^{+}]$	SP = -16.82 + 2.68 LQ - 0.2 MS
	$LQ_{it} = f\ [MS^{+}]$	LQ = -2.21 + 1.05 MS
	$MS_{it} = f\ [LQ^{+}, SP^{+}]$	MS = -84.07+ 13.42 LQ + 5.0 SP
Korea	$SP_{it} = f\ [LQ^{+}, MS^{+}]$	SP = 30.47 + 1.05 LQ + 3.32 MS
	$LQ_{it} = f\ [MS^{+}]$	LQ = -5.05 + 1.14 MS
	$MS_{it} = f\ [LQ^{+}, SP^{+}]$	MS = -9.18 + 0.32 LQ + 0.3 SP
Japan	$SP_{it} = f\ [LQ^{+}, MS^{+}]$	SP = -3.35 + 1.75 LQ - 0.77 MS
	$LQ_{it} = f\ [MS^{+}]$	LQ = -2.11 + 1.19 MS
	$MS_{it} = f\ [LQ^{+}, SP^{+}]$	MS = -4.33 + 2.26 LQ + 1.29 SP

Note: SP_{it} is aggregate share price index, LQ_{it} is liquidity as proxied by reserve money and MS_{it} is money supply.