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# Banking Liquidity and Stock Market Prices in ASEAN-3 Economies

# Chung TF<sup>1\*</sup> and Ariff M<sup>2</sup>

<sup>1</sup>Taylor's University, 47500 Subang Jaya, Selangor, Malaysia <sup>2</sup>University Putra Malaysia, 43400, Serdang, Selangor, Malaysia

# Abstract

The Global Financial Crisis has its origins in the surge in banking liquidity, which contributes to the volatility and instability of financial markets by affecting prices of financial instruments. This paper investigates the impact of banking liquidity, money supply and stock prices in ASEAN-3 economies. Although banking liquidity is widely attributed as one of the causes of financial instability, it is not fully verified or investigated despite earlier research attempts. The transmission channel of banking liquidity to banking credit is through net present value projects of firms. With higher net present value, this will support earnings and consequently share prices of firms will respond positively. This is the thesis statement of our paper and according to a major study, 52% of share returns emanate from macro-economic variables. To control for cross-section dependence and heterogeneity, this study use a panel data of 3 similar countries with 3 equations to study the relationship between money supply, liquidity and share prices over the period 2001:4 to 2012:2. Our findings show that banking liquidity is positively related to money supply with a positive impact on share prices.

**Keywords:** ASEAN-3; Liquidity; Bubble; Share prices; Dynamic OLS; Structural break; Bootstrapping

# Introduction

This paper confirms findings on Friedman's proposal that liquidity is positively impacted by money supply, in discussing the money to liquidity nexus. Whenever the Federal Reserve raises the fund rate, this will cause price turbulence in the US financial markets [1]. Fair identified that monetary announcements by the Fed cause 30 per cent changes to stock prices [2]. In an earlier study, King suggests up to 52 per cent of share prices are from market-wide common factors while a later study by Bernanke and Kuttner says a one percent stock price increase is caused by a 25-basis point cut in the federal funds target rates [3,4]. It is for these reasons that monetary policy announcements are well scrutinized and intensely watched by media and market players. Our research objective is to look into how share prices react to monetary news on interest rates, liquidity and money supply. The third proposition of a money-liquidity nexus has not been verified by empirical studies. Money supply impact share prices through its impact on firms cost of capital and firms' capacity to raise new capital and invest, which in turn will affect consumption and economic growth through the wealth effect. When share prices fluctuate, this will impact on firms cost of capital and therefore money supply will have an impact on share price, the thesis statement of this paper.

Given the importance of the impact of money supply on share prices, policy makers are keen to know about the impact of monetary policy on share prices. Studies have shown that the size of the impact of monetary policy on share prices is significant and their effect is not symmetrical. During recession and amidst tight liquidity conditions, the impact of monetary policy on share prices doubles that of normal economic environment. The earlier finance literature, have linked share prices to market-wide macro factors as in the arbitrage pricing theory [5,6]. In macro-economics, the standard IS-LM model used Aggregate demand and Aggregate Supply (AD/AS) to identify the role of equity market in aggregate demand. In later models with better measurement techniques, these are further broken down into long-term and shortterm dynamics.

In this paper, the monetary transmission mechanism to the share market is via bank credits to firms' earnings. This paper links the macro-economic aggregates of money supply to banking liquidity on to share prices in these three ASEAN countries (Malaysia, Singapore and Thailand). Finance theory has identified firm specific factors in share pricing equations, which are short-term in nature. In the longer-term, macro-economic factors will dominate share pricing. For successful investors, Musílek advise them to pay attention to price-shaping macro-economic factors [7]. Similar conclusions were also expressed by Flannery and Protopapadakis [8]. A breakdown of the determinants of share price movements attributed that 52 per cent are contributed by macro-economic factors, 10 per cent by industry factor and 38 per cent by firm specific factors.

GDP, money supply, liquidity, inflation and interest rates are the main macro-economic factors shaping share prices. Among the macro-economic factors, the money to liquidity nexus has yet to be fully verified in Friedman, while his proposition of a *negative* money supply effect on interest rate has been verified in a number of studies.

The main objective of this paper is to report evidence in support of money-to-banking-liquidity to stock price effect in each of three ASEAN countries chosen. These three countries are more homogenous in terms of open capital markets and have implemented large-scale financial liberalization since 1997. We apply recent econometric techniques using dynamic heterogeneous panel unit root estimations and cointegration tests to examine the dynamic relationship among stock price, liquidity and money supply in this paper.

Our paper is organized as below: A very brief discussion of the literature on money supply, liquidity and share prices is provided in Section 2. To prepare the data used in the test models, we transform the data as shown in Section 3. Section 4 contains a discussion of the findings and in Section 5 we conclude on our major findings.

\*Corresponding author: Tin-fah Chung, senior lecturer, Taylor's University, 47500 Subang Jaya, Selangor, Malaysia, Tel: 60122833902; E-mail: tinfah@yahoo.com

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# Literature Review on Money Supply, Liquidity, Share Price and Monetary Regime Changes

In this section, a brief literature review on money supply, liquidity, share price and monetary regime is carried out. The discussion on liquidity effect precedes our discussion on the link between banking liquidity and share prices in the context of monetary transmission mechanism in the latter part of the section.

### Money supply effect in the transmission mechanism

A widely established representation in standard macroeconomics textbook, to show the effect on interest rates of a change in monetary policy (Friedman's interest effect) use:

$$M_t^d = a_1 + a_2 r_t + \varepsilon_t^d \tag{1.1}$$

$$M_t^s = b_1 + b_2 r_t + \varepsilon_t^s \tag{1.2}$$

$$\therefore M_t^d = M_t^s \tag{1.3}$$

where  $M^d$  indicates demand,  $M^s$  supply,  $M_t$  is the log of nominal money,  $r_t$ , is the nominal interest rate, while  $\varepsilon_t^a$  and  $\varepsilon_t^s$  are mutually correlated demand and supply shocks.  $r_t$  responds to shifts in money supply engineered by varying  $\beta_1$  and the relation  $dr_t/db_1 = (a_2 - b_2)^{-1}$  means that the interest rate decreases when money supply increases, provided that a 2<0 and b2 <- a2. The liquidity effect is the negative reaction of changes to interest rate when there is a rise in money supply.

With a decline in interest rates and a corresponding reduction in discount rate (cost of equity) in future cash flow calculation, share prices are expected to rise. Sprinkel explicitly tested a model incorporating Simple Quantity Theory (SQT) as an asset pricing model [9]. With an increase in money supply, the portfolio will be thrown out of balance because the desired holding compared to actual cash holding is in disequilibrium. 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. Through this adjustment mechanism on stocks, money supply and stock prices is positively related. The above mechanism illustrates a combination of SQT and portfolio theory.

Liquidity serves as the missing link between money and aggregate demand. During boom conditions, increases in liquidity bolster investment and financial activities, when money supply is eased (Quantitative easing by the Fed in 2012). After the credit splurge of 1994-2004, which causes the asset price bubbles before the Global Financial Crisis [10], liquidity resurfaces as the focus of research and policy making. The interaction between liquidity and money supply is also the focus of post-Keynesian studies on the endogeneity of money.

### Liquidity effect

The negative link between money supply and interest rates, as shown above, has been widely acknowledged by macroeconomists and policy makers. However, the positive liquidity effect link to income and inflation is not well established. Changes in the supply of money are, therefore, a proxy for likely changes in return on money holdings, which is the basis of why central bank uses statutory reserve requirements to control liquidity and money supply.

All market participants, such as institutions, dealers and wealthy individuals respond to money balance changes. Changes in stock prices and returns will result from this liquidity effect with an negative coefficient through this channel. Despite numerous attempts to measure to this liquidity effect, there has been little success, as the use of low frequency data will mix the effects of policy on economic variables with the effects of economic variables on policy. To overcome this, Hamilton tried to estimate the daily liquidity effect by estimating the response of federal funds rate to exogenous reserve supply shocks using daily data [11].

### Share prices

Share prices are affected by a host of factors - macroeconomic, microeconomic, psychological and subjective factors. Both macroeconomic and microeconomic factors affect the direction and volatility of where stock markets are heading, notwithstanding the role given to psychological and subjective factors in the behavioural finance literature. The dominant role of macroeconomic factors on share prices is exemplified in the theory of Arbitrage Pricing Theory and tested in Chen et al. [6].

Among other studies that link share prices to macro factors are the following for:

Developed markets such as USA, Japan and Europe - Clare and Thomas and Flannery and Protopapadakis [8,12].

Developing markets in East Asia - Bailey and Chung, Mookerjee and Yu, Kwon and Shin, Ibrahim and Aziz (2003) [13-15].

Comparative markets - Cheung and Ng, Bilson, Wongbangpo and Sharma [16-18].

The theoretical underpinning of most of these studies that link macro factors to share prices can perhaps be seen in the portfolio model of Cooper [19]. In the model he assumes that individuals could hold wealth in two forms, money and common stock. A portfolio is said to be balanced when the marginal returns to holding these two assets are equal.

$$MNPS_{t}^{M} - \bar{P} = MNPS_{t}^{s} + r_{t}^{s}$$
<sup>(2)</sup>

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;

 $\overline{P}_t$  is anticipated percentage change in general price level;

 $\overline{r}_i^*$  is the anticipated real pecuniary return of stocks (dividend plus change in stock prices);

 $MNPS_t^*$  is 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. In equilibrium, an underlying assumption is that the positive income effect on  $MNPS_t^{M,S}$  cancel each other.

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

$$r_t^s = (MNPS_t^M - P) - MNPS_t^s$$
(3)

Thus, Cooper's model is equivalent to the asset pricing model in finance, which provides the theoretical framework for this study. It would be interesting to examine the link between the liquidity effects from money supply affecting the stock prices, as proposed in this study [47].

The model of equity pricing used in finance with this kind of effect is:

$$P_{0} = \sum_{t}^{N} = 1 \frac{D_{0} (1 + gt)^{t}}{(1 + i_{t} + r_{t})^{t}}$$
(4)

where  $P_0$  is the current price of a share;  $D_0$  is the dividend at time 0;

g is the constant growth rate of dividends;  $i_t$  is the risk-free rate at time t; and  $r_t$  is the equity risk premium at time t. By substituting EPS (payout ratio), the numerator may be replaced as (POR). Thus, a proxy to represent EPS could be used to test if PO is significantly affected by earnings proxy using the IPI.

The equation "D=EPS (payout)", shows that stock prices are correlated with EPS. In this paper we used Industrial output (IPI as a proxy to represent corporate earnings, as payout ratios are unlikely to change in most economies. A lesson from the recent Global Financial Crisis (GFC) was that share prices lead earnings. The aftermath of the crisis has attracted a lot of rethinking on the impact of liquidity on money supply and share prices.

The Cooper model attempts to capture the relationship between money supply and stock prices as started by Sprinkel [9]. The imbalance in the financial sector and real sector resulting in liquidity surges that led to the GFC has revived interest in this relationship [10].

# The ASEAN-3 (Malaysia, Singapore and Thailand) Economies

In 1967, the Association of Southeast Asian Nations (ASEAN) was inaugurated with four countries. Over time, this group has since expanded to include 10 countries. The aim of ASEAN is to create an integrated economic bloc and promote modernization so that political conflict will be minimized. Broadly, ASEAN can be divided into the more developed four core group which accounts for four per cent of world trade. These four countries have achieved a greater degree of economic and financial integration among themselves and with the developed countries. The remaining six rank lower in terms of development and modernization are at the peripheral.

The ASEAN countries can be divided into two major categories. The inner core group of four countries, accounts for four per cent of world trade, having achieved a greater degree of economic and financial integration among themselves and with the developed countries. However, the remaining peripheral six lag behind in development and modernization. The inner group is generally richer in income and more developed than those at the periphery. As the four core group adopt similar economic and financial regulations with the industrial countries, their financial integration is also higher. On the whole, the ASEAN group exports more merchandise goods over imports, while they are importers of commercial services.

From the mid-1980s, the inner four core group has embarked on capital market reforms to spearhead the development of the financial sector to the same level as those in developed countries. The banking sector has been the focus of these reforms as they bore the brunt of the financial crisis. The reforms have help to reduce the country's reliance on bank borrowings as a source of funding to equity and fixed-income markets to diversify the risks and tap on long-term funds for funding the infrastructure projects. Last year in 2015, the ASEAN group signed an agreement to form the ASEAN Economic Community. This will provide broad strategic measures from 2016-2025 to realize the following objectives: i) highly integrated and cohesive economy; (ii) competitive, innovative, and dynamic ASEAN; (iii) enhanced connectivity and sectoral cooperation; (iv) resilient, inclusive, peopleoriented, and people-centered ASEAN; and (v) global ASEAN. This study using a panel of data from three inner core ASEAN countries (Malaysia, Singapore and Thailand) to investigate whether there is a significant relationship between stock prices and banking liquidity arising from their money supply in these core economies.

# Methodology

Using cointegration analysis to test for a long-term relationship between share prices and underlying macroeconomic variables, we first conduct VECM test. In this test, Johansen cointegrating technique requires the variables in the model should be integrated of first order to pass a test of stationarity. A further vector autoregressive VAR-like model is applied [20,21].

In panel modeling, the estimator bias problem emerges for both static and dynamic models when we introduce heterogeneity in order to obtain different slope coefficient for the different cross section units [22].

# Pool mean group (PMG) and mean group (MG)

To account for the different slopes in dynamic panels, two estimators were proposed by Pesaran [23]: the mean group (MG) estimator and the pooled mean group (PMG) estimator. The long-run parameters for the panel are estimated using an average of their long-run parameters from a regression using ARDL models of individual countries. Separate equations are estimated for each country and the distributions of their coefficients are examined across groups. It is one extreme of estimation because it just makes use of averaging in its estimation procedure. It does not consider any possibility of same parameters across groups.

In samples where there are a large number of observations and large number of groups, Pesaran added the PMGE estimator [23,24]. Both PMG and MG estimators are intermediate estimators because both used averaging and pooling in its estimation procedure. To account for variation in the intercepts, short-run dynamics and error variances across groups, Peseran proposed the PMGE estimator. It avoids the inconsistency problem from heterogeneous short-run dynamics in pooling the long-run parameters.

However, those with long-run dynamics are not allowed to differ across groups. Plus, the PMG relaxes the restriction on the common coefficient of short run while maintaining the assumption on the homogeneity of long run slope. The estimation of the PMG requires re-parameterization.

# Estimator to account for dynamic fixed effects (DFEE)

To overcome the problems of the PMGE and MGE estimators, dynamic fixed effects estimator (DFEE) is also used to cross-checked the co-integrating vector. DFEE specifications control the country specific effects and rely on a pooling of cross-sections. To resolve the problem, the DFEE estimator also restricts the coefficient of co-integrating vector to be equal across all panels like the PMGE. In the PMGE model of Pesaran et al [23,24], an adjustment coefficient PMGE or error correction term,  $\phi_i$  is computed. This  $\phi_i$  indicates the amount of adjustment for each period.

The Hausman test is used to evaluate which estimator, MPG or PMGE is more appropriate. The Null hypothesis test for PMGE is that it is efficient and consistent against the alternative hypothesis: MGE is consistent. It allows for a choice between MGE and DFEE. To decide among the three different estimators, MGE, DFEE and PMGE, the Hausman test is used. As demonstrated by the Granger representation theorem [25], if these results show that the error correction term is significant, we can conclude there is cointegration.

The long run model in (5.1)

$$SP_{it} = \mu_{it} + \beta_{1t}LQ_{it} + \beta_{2t}MS_{it} + \beta_{3t}IPI_{it} + \varepsilon_{it}$$

$$(5.1)$$

will be transformed into the auto-regressive distributed lags ARDL (1,1,1) dynamic panel specification as follows:

$$SP_{it} = \mu_{it} + \lambda SP_{i,t-1} + \beta_{1t}LQ_{it-1} + \beta_{2t}MS_{it-1} + \beta_{3t}IPI_{it-1} + \varepsilon_{it}$$
(5.2)

 $\Delta SP_{it} = \mu_{it} + (\lambda - 1)SP_{i,t-1} + \beta_{1t}LQ_{it-1} + \beta_{2t}MS_{it-1} + \beta_{3t}IPI_{it-1} + \varepsilon_{it}$ (5.3)

From (5.2), by normalizing each coefficient of the right hand side variables by the coefficient of the SP<sub>t-1</sub>, i.e ( $\lambda_i$ -1) or - (1- $\lambda_i$ ) since  $\lambda_i$ <1,

$$\theta_{0i} = \frac{\mu_i}{1 - \lambda_i} \quad \theta_{1i} = \frac{\beta_{10i} + \beta_{11i}}{1 - \lambda_i} \quad \theta_{2i} = \frac{\beta_{20i} + \beta_{21i}}{1 - \lambda_i} \quad \theta_{3i} = \frac{\beta_{30i} + \beta_{31i}}{1 - \lambda_i}$$

By considering the normalized long run coefficient of (5.2), the error correction re-parameterization of (5.2) will be:

$$\Delta SP_{ii} = \mu_{ii} + \phi_i \left( SP_{i,i-1} - \theta_{0i} - \theta_{1i}LQ_{ii} - \theta_{1i}MS_{ii} - \theta_{1i}IPI_{ii} \right) + \beta_{1i}\Delta LQ_{ii} + \beta_{2i}\Delta MS_{ii} + \beta_{3i}\Delta IPI_{ii} + \varepsilon_{ii}$$
(5.4)

←Long run relations→ ←Short run dynamics→

The MG estimator can easily be computed from the long run coefficient of parameters from the average of the parameter value for individual groups. For instance, the dynamic specification as follows:

$$SP_{it} = \mu_{it} + \lambda SP_{i,t-1} + \beta_{1t} LQ_{it-1} + \beta_{2t} MS_{it-1} + \beta_{3t} IPI_{it-1} + \varepsilon_{it}$$
(5.5)

The long-run parameter coefficient for equation above will be:  $\theta_{0i} = \frac{\beta_{1i}}{1 - \lambda}$ 

So, the whole long-run parameter will be represented as the average of long-run parameter across a group as follows:

$$\bar{\theta} = \frac{1}{N} \sum_{i=1}^{N} \theta_i \quad \bar{\mu} = \frac{1}{N} \sum_{i=1}^{N} \mu_i$$

Let  $\phi_i = -(1 - \lambda_i)$ 

When the number of groups and cross sections is considerably large, the estimator for MG will be efficient even when the series is I(1). But the estimator tends to be biased when the number of time series observations is small.

The estimation of PMG and MG will be based on the error correction model in (5.4). The focus is on the long run coefficient (i.e  $\theta_{1i}$ ,  $\theta_{2i}$ ,  $\theta_{3i}$  and  $\theta_{4i}$ ), which indicates the elasticity of LQ, MS and IPI factors towards the SP across different country stock markets. Due to the uniqueness of the operation for each country, the coefficient for each factor might vary across the panels. As the coefficient estimates are for long term equilibrium, it contains the theoretical information which is very important for each country's policy making. The error correction speed adjustment,  $\phi_i$  also provides significant information to the investors:  $\phi_i$  in equation (5.4) provides information on how long it is needed for the short run dynamics to return to long run equilibrium.

Normally, the short run coefficient usually will differ from the long run equilibrium affected by events like seasonality effect (noise), economic boom or recession. But, this temporaneous effects due to the short run dynamic result will eventually return to the long run equilibrium. The positive sign of the  $\phi_i$  implies return to the long run relationships from points above the regression line [26]. The negative sign also shows the return to long run equilibrium but in opposite direction (from below). The  $\phi_i$  is expected to be statistically significant as the insignificant coefficient of  $\phi_i$  (i.e  $\phi_i$ =0) implies the absence of long run equilibrium. In the absence of long run equilibrium, the results will be inconclusive theoretically.

### Panel unit root tests

The existence of unit roots cannot be ruled based on a sufficient

long panel dataset of 10 years. The panel unit root test is carried out using Maddala and Wu and Choi where the p-values of the test statistics for a unit root in each cross-sectional unit (the ADF-test or the PP-test) are shown [27,28].

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The null hypothesis for both Fisher  $(\mathrm{P}_{\lambda})$  Chi-square panel unit root test are shown below:

- H<sub>0</sub>: panel data has unit root (assumes individual unit root process)
- H<sub>1</sub>: panel data has no unit root

We use the two different tests to confirm our results. The selection of the appropriate lag length was made using the Schwarz Bayesian Information Criterion.

### Hypotheses

It is an empirical question [29-31], whether share returns are affected by economic indicators such as industrial production, inflation, interest rates, Treasury bill rate, liquidity, and money supply. King [3], and Thorbecke and Coppock have shown that share prices are affected by macroeconomic factors up to 50% and 32% respectively [32]. The use of cointegation will show whether these economic variables are cointegrated with into share prices. A system of equations comprising stock returns (P) and liquidity (LQ), is developed to be solved endogenously as follows [64]:

$$SP_{it} = f \left\lceil LQ_{it}^{-}, MS_{it}^{+}, IPI_{it}^{+} \right\rceil$$

$$(6.1)$$

$$LQ_{it} = f \Big[ MS_{it}^{+}, Y_{it}^{+}, LR_{it}^{-} \Big]$$
(6.2)

$$MS_{ii} = f \left[ LQ_{ii}^{+}, Y_{ii}^{+}, TBR_{ii}^{-}, SP_{ii}^{+}, CPI_{ii}^{+}, CPI\left(1\right)_{ii}^{+} \right]$$
(6.3)

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 difference in log.

The operational model is parameterized as:

$$\ln SP_{it} = a_0 + a_1 \ln LQ_{it} + a_2 \ln MS_{it} + a_3 \ln IPI_{it} + e_{it}$$
(7.1)

$$\ln LQ_{it} = b_0 + b_1 \ln MS_{it} + b_2 \ln Y_{it} + b_3 LR_{it} + z_{it}$$
(7.2)

$$\ln MS_{it} = c_0 + c_1 \ln Y_{it} + c_2 \ln LQ_{it} + c_3 \ln SP_{it} + c_4 TBR_{it} + c_5 \ln CPI_{it} + v_{it}$$
(7.3)

This is used to test two separate set of hypotheses tests:

- H<sub>1</sub>: MS causes Liquidity
- H<sub>2</sub>: Liquidity causes Share Prices.

### Data and variables

The data series from 2001:4- 2012:2 are sourced from Datastream and cross-checked against the dataset of International Monetary Fund (IMF) for external validity. Quarterly data are used for all three countries. As a proxy for earnings, we use the Industrial Production Index (IPI) which is highly correlated with national income, which in turn is known to determine the earnings of firms in a modern economy [47]. Hence, we use 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.

Another variable liquidity is difficult to specify. In the literature, there are three alternative proxies: bid-ask spread used in market studies [33]; volume of transactions [34,35]; reserve money [36]. In

this paper, we use reserve money as a proxy for banking liquidity, as the amount of liquidity in the banking system depends on how much reserves it has kept with the central bank [37-40]. In this sense, liquidity has an inverse relationship to reserves. All variables are seasonally adjusted where available and transformed to logarithmic form, with the exception of interest rates, which are the local 3-month Treasury bill rate, TBR and Lending Rate, LR [41,42].

Our literature review in section 2 show the relationship between share prices and corporate dividend. The relationship of the two depend in the long run on earnings of the corporations, which directly depends on IPI. There is a need to control for the effect of earnings on share prices and liquidity in the system of equations [43-46]. IPI is chosen as a proxy for earnings, after we confirm the cointegration tests between nominal GDP and IPI [47]. Finally, monetary regime changes and crises are controlled using dummies.

# **Descriptive statistics**

Since the JB statistic for most variables are >5.9, they are not normally distributed, as the variables are skewed (>0, for normality should be close to 0). For the period 2001:4- 2012:2, the average Treasury bill and lending rate are 2.14 per cent and 6.04 per cent respectively. Inflation which is measured as mean difference in log CPI, averaged at 4.66 per cent during the period. DLSPRICE which measure share price returns, show a return of 2 per cent pa during the period, achieving a high of 27% during the boom conditions of 2003 and a low of 42% in the aftermath of 2008 share price correction (Table 1) [48-52].

# Panel unit root tests using phillips-perron fisher tests

The tests on panel unit root tests are carried using Maddala and Wu and Choi [27,28].

Fisher tests as shown in Table 2.

We tested the following hypotheses:

H<sub>0</sub>: the data series in the panel contains a unit root, against

H<sub>1</sub>: at least one of the individual series in the panel is stationary

The decision criteria at the 10 per cent level is: accept null of nonstationary if: p-value >10 per cent and to reject null if: p-value <10 per cent, implying the data is stationary [53-55].

Other than LRGDP and LRLQ, the results in Table 2 show that all the variables contain a unit root at the one per cent and ten cent level of significance [56-58]. For money supply (LRM2), the Fisher chi-square statistic and Choi Z-statistic were 2.263 and 0.941 respectively, with p-values of 0.89 and 0.83, above the 10 percent level of significance. When the variables are first-differenced for testing, the alternative hypothesis of stationary is accepted, which leads us conclude that all variables are integrated of order one or I(1) (Table 2).

After testing for unit root and concluding that these variables are I(1), we carried out the Pedronic panel cointegration test.

# Pedroni panel cointegration tests for money supply, liquidity and share price

The use of panel cointegration is to enable researchers to selectively pool information for common long-run relationships from across the panel, allowing for the associated short-run dynamics and fixed effects to be heterogeneous across different members of the panel [61].

This is implemented as a residual-based test of the null hypothesis:

Null:  $H_0$ :  $\gamma_i$  for all *i*.

Alternative:  $H_{A}$ :  $\gamma_{i} = \gamma < 1$  for all *i*.

The result of panel cointegration test for share price, liquidity and money supply based on Pedroni panel (v, rho, pp and adf) and group (v, rho, pp and adf) statistics shown in Table 3.

Lsprice: The *p*-value for Panel PP-statistics and ADF-statistics was <1% for within dimension and between dimension respectively. Thus we can reject the Null hypothesis of no cointegration. We can safely say that the common and individual auto regression coefficients are cointegrated. Similarly for Lrlq: *p*-values for group-pp for between dimension was less <1% and for lrm2, *p*-values for panel v-statistic was less <5%. Thus we can reject the Null hypothesis of no cointegration. We can safely say that the common and individual auto regression coefficients are cointegrated for share price, liquidity and money supply [27,28].

# **Results of Regression**

The regression estimates are discussed in this section. The cointegrating equations using PMG, MG and DFE on panel data of 3 countries are presented next.

# Cointegrating equations using PMG, MG and DFE on panel data – a comparison

The results from the long-run relationship of share price, liquidity and money supply are presented in Table 4a, and indicate that all

	LCPI	LR	LRGDP	LRIPI	LRLQ	LRM2	LSPRICE	DLSPRICE	TBR
Mean	4.66	6.04	6.73	0	4.64	7.03	5.39	0.02	2.14
Median	4.66	6	4.79	-0.01	5.55	7.93	4.85	0.03	2.28
Maximum	4.83	7.5	11.07	0.33	6.74	9.29	7.38	0.27	4.91
Minimum	4.51	5.3	4.36	-0.29	1.76	4.26	3.93	-0.42	0.21
Std. Dev.	0.08	0.67	2.92	0.14	1.86	1.9	1.14	0.1	1.15
Skewness	0.09	0.46	0.7	0.11	-0.61	-0.54	0.61	-1.04	-0.01
Kurtosis	1.84	1.91	1.51	2.4	1.52	1.52	1.69	6.64	2.23
Jarque-Bera	7.19	10.73	22.07	2.13	19.43	17.53	16.93	92.41	3.1
Probability	0.03	0	0	0.34	0	0	0	0	0.21
Sum	587.24	760.83	848	0.12	585.14	886.28	679.73	2.91	269.34
Sum Sq. Dev.	0.87	56.76	1063.96	2.37	430.78	450.85	163.68	1.36	165.6
Observations	126	126	126	126	126	126	126	126	126

Table 1: Descriptive statistics of the panel variables. Note: All variables are restated in logs except for TBR and LR. DLSPRICE is the difference in share prices measure the return in share prices The variables LSPRICE, LRM2, LRIPI, LRGDP, LCPI, TBR, LR and LRLQ represent Share price index, Money supply, Industrial production index, Income, Inflation, Treasury bill rate, Lending rate and Reserve money respectively.

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Fish	er chi-square statistic		Choi Z-s	statistic
Variables	Level	Difference	Level	Difference
	5.65265	30.1579***	-0.33782	-4.25075***
LSPRICE	-0.4632	0	-0.3677	0
	2.26398	48.5210***	0.94176	-5.72605***
LRM2	-0.8939	0	-0.8268	0
	16.4100*	157.704***	Choi Z-statis           Level           -0.33782           -0.3677           0.94176           -0.8268           -1.8           -0.0359           -1.00672           -0.157           0.78759           -0.7845           0.18243           -0.5724           -2.60151***           -0.0046           0.3815           -0.6486	-10.6652***
LRLQ	-0.0117	0	-0.0359	0
וחוס ו	8.54115	136.321***	-1.00672	-10.3019***
LRIPI	-0.2011	0	-0.157	0
TOD	2.59157	33.7573***	-0.157 0.78759	-4.50771***
IBR	-0.8581	0	-0.7845	0
	5.10797	57.1310***	0.18243	-6.21384***
LCPI	-0.53	0	-0.5724	0
	17.4731***	180.647***	-2.60151***	-12.1164***
LRGDP	-0.008	0	-0.0046	0
	3.2433	33.4376***	0.3815	-4.49963***
LR	-0.7777	0	-0.6486	0

 Table 2: Panel Unit root tests – Fisher Phillips-Perron tests. Note: Numbers in parentheses are p-values. \*\*\*, \*\* denote significance at the 1 and 5 percent levels respectively.

 A denotes first difference. Both variables are taken in natural logarithms.

	LSP	RICE	LR	LQ	LRM2		
	Statistic	Prob.	Statistic	Prob.	Statistic	Prob.	
Panel v-Statistic	0.60132	0.2738	-0.4235	0.6641	1.83068	0.0336	
Panel rho-Statistic	-0.8081	0.2095	0.45856	0.6767	1.62933	0.9484	
Panel PP-Statistic	-2.1612	0.0153*	0.09237	0.5368	0.92784	0.8233	
Panel ADF-Statistic	-3.0326	0.0012*	0.52307	0.6995	1.14167	0.8732	
	Alternative h	ypothesis: individu	al AR coefs. (betwee	n-dimension)			
	Statistic	Prob.	Statistic	Prob.	Statistic	Prob.	
Group rho-Statistic	-0.0431	0.4828	-0.828	0.2038	1.9884	0.9766	
Group PP-Statistic	-1.7587	0.0393*	-2.9274	0.0017*	1.01873	0.8458	
Group ADF-Statistic	-3.0095	0.0013*	-0.9376	0.1742	1.44894	0.9263	

\* denote significance of coefficients.

Table 3: Pedroni residual cointegration test values for the panel.

Variables	M	3	DF	E	PMG					
	Long Run Parameters									
	Coefficient	p-value	Coefficient	p-value	Coefficient p-value	p-value				
LRLQ	-0.79	0.51	-0.63	0.37	-2.61	0.00				
LRM2	1.59	0.01	1.14	0.00	2.61	0.00				
LRIPI	0.84	0.00	1.17	0.00	1.07	0.00				
	Average Co	nvergence	Parameters							
φί	-0.44	0.00	-0.29	0.00	-0.30	0.15				
			Short Run P	arameters	· · ·					
ΔLRLQ	0.38	0.03	0.15	0.09	0.42	0.00				
ΔLRM2	-0.58	0.31	-0.63	0.39	-0.41	0.58				
ΔLRIPI	0.47	0.12	0.37	0.01	0.46	0.17				
Constant	-0.44	0.36	0.09	0.85	-0.34	0.27				

\* denote significance of coefficients.

### Table 4a: 1st Equation – Share Price (LSPRICE).

variables have the correct hypothesized sign. In Table 4a, the long-run coefficients of LRM2, LRLQ and LRIPI seem to be consistent across the three estimators for LSPRICE. There is a negative relationship with liquidity (LRLQ) and positive relationship with money supply (LRM2) and industrial production index (LIPI). The symbol ( $\varphi_i$ ) which measure the error correction term is negative and less than 1 in absolute sense. At the 1% level,  $\varphi_i$  is statistically significant for MG and DFE, but not for PMG (*p*-value of 15%) (Table 4a).

as against LRLQ, LRM2 and LRIPI. The p value for ECT is 3%, 31% and 12%. The null hypothesis of cointegration is accepted for LRLQ (p<5%) and no correlation (p>10%) for money supply and industrial production index [62,63]. We conclude that in the short run (short term), ECT for LRM2 and LRIPI are not significantly affecting LSRICE. We can safely say that LSPRICE depends on the long run equilibrium of the combination between these variables (LRLQ, LRM2 and LRIPI).

However, in the short run (SR), we can see the elasticity of LSPRICE

The ECT coefficient of 0.44 reflects the period in which LSPRIC will return to equilibrium. Here, in the long run, it will take roughly

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Variables	м	G	DF	E	PMO	PMG			
	Long Run Parameters								
	Coefficient	p-value	Coefficient	p-value	Coefficient p-value	p-value			
LRM2	-0.29	0.64	0.93	0.21	0.44	0.08			
LRGDP	2.13	0.10	0.54	0.24	0.53	0.10			
LR	1.21	0.22	0.12	0.63	0.87	0.02			
	Average Co	onvergence	Parameters						
φί	-0.36	0.06	-0.08	0.12	-0.11	0.11			
	Short Run Parameters								
ΔLRM2	0.69	0.01	0.70	0.00	0.83	0.00			
ΔLRGDP	0.56 0.16		0.16 0.65	0.05	0.73	0.11			
ΔLR	-0.46	0.33	-0.03	0.03	-0.30	0.30			
Constant	-3.29	0.00	-0.50	0.00	-0.68	0.05			

\* denote significance of coefficients.

### Table 4b: 2<sup>nd</sup> Equation - Liquidity (LRLQ).

Variables	М	G	DF	E	PMG	PMG		
	Long	Run	Parameters			p-value		
	Coefficient	p-value	Coefficient	p-value	Coefficient p-value			
LRLQ	0.98	0	0.14	0.43	1.01	0		
LSPRICE	-0.26	0.38	0.11	0.27	0.13	0.02		
LRGDP	2.52	0.38	1.5	0	-1.25	0		
TBR	-0.12	0.35	0.02	0.68	0	0.76		
LCPI	-3.65	0.28	-0.38	0.38	1.21	0		
	Average Co	onvergence	Parameters					
φί	-0.26	0.02	-0.08	0	-0.14	0.32		
		Short Run	Parameters					
ΔLRLQ	-0.07	0.72	0.15	0.01	0.03	0.92		
ΔLSPRIC	0.03	0.38	0.02	0.65	0.03	0.46		
ΔLRGDP	-0.1	0.78	-0.15	0.02	0.01	0.96		
ΔTBR	-0.02 0.		0	0.93	-0.02	0		
ΔLCPI	-1.03	0.22	-1.39	0.01	-1.42	0.04		
Constant	0.39	0.72	-0.19	0.07	0.35	0.17		

### Table 4c: 3rd Equation – Money Supply (LRM2).

MG and DFE	MG and PMG
Ho: DFE estimator is efficient and consistent but MG is not efficieint.	Ho: PMG estimator is efficient and consistent but MG is not efficieint.
Eq1 : p-value=no values	Eq1: p-value=no values
Eq2: p-value=no values	Eq2 : p-value=no values
Eq 3: p-value=1.0 >0	Eq 3 : p-value=0.88 >0
For EQ1 and 2, no coefficients in common.and no tests conducted. For Eq3 - Since Ho is not rejected, DFE estimator is efficient and consistent than MG estimator	For EQ1 and 2, no coefficients in common and no tests conducted. For Eq3 : Since Ho is not rejected, PMG estimator is efficient and consistent than MG estimator

Overall Decision: Both DFE and PMG estimators are found to be more eficient and consistent than MG estimator in both Hausman tests, respectively. While PMG estimator dominates the DFE estimator because it permits heterogeneity in shor run coefficients. Hence PMG estimates should be relied upon, among the three estimators.

### Table 4d: Hausman test for selection between.

2.3 periods, or 2 quarters (referring to our data time scale in quarter) for LSPRICE to return to equilibrium if it deviates from regression line (taken as 1 / 0.44).

In Table 4b, the long-run coefficients of LRM2, LRGDP and LR seem to be consistent across the three estimators for LRLQ. There is a negative relationship with money supply (LRM2) and positive relationship with gdp (LRGDP) and lending rate (LR). The symbol ( $\phi_i$ ), the error correction term is negative and less than 1 in absolute sense. The ECT coefficient,  $\phi_i$  are statistically significant for MG at 0.06 while for DFE and PMG are not significant since the p-values are 0.12 and 0.11 respectively (Table 4b).

In Table 4c, the long-run coefficients of LRLQ, LSPRICE, LRGDP, TBR and LCPI seem to be consistent across the three estimators for LRM2. There is a negative relationship with share price (LSPRICE), treasury bill rate (tbr) and inflation (LCPI) and positive relationship with liquidity (LRLQ) and gdp (LRGDP). The error correction term ( $\varphi$ i) is negative and less than 1 in absolute sense.  $\varphi$ i is statistically significant for MG and DFE at 2% and 8% respectively, while for PMG not significant at 32% (Tables 4c, 4d and 5).

In Table 5 statistics refer to final PMG regression of individual countries. We notice that in the long run, ECT for all countries are the same, while in the short run it differs. As each country is unique and heterogeneous, the short run is different. For LSPRICE, all countries (except Thailand) have p value of < than 1%. We conclude that, except for Thailand we do not accept the null hypothesis of no correlation for the ASEAN-3 countries. For LRLQ, (except Thailand), all countries have p-value of < than 1%. This means that, for all countries, we do not accept the null hypothesis of no correlation. For LRM2, all countries

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LSPRICE												
Country	ECT	p-val	LRLQ	p-val	LRM2	p-val	LRIPI	p-val				
Malaysia	-0.10	0.01	0.20	0.26	0.93	0.09	1.01	0.03				
Singapore	-0.71	0.00	0.64	0.35	-0.52	0.56	-0.15	0.49				
Thailand	-0.07	0.31	0.42	0.22	-1.63	0.02	0.53	0.08				
LRLQ												
Country	ECT	p-val	LRM2	p-val	LRGDP	p-val	LR	p-val				
Malaysia	-0.09	0.04	1.05	0.00	1.44	0.01	0.02	0.01				
Singapore	-0.24	0.00	0.66	0.00	-0.11	0.39	0.88	0.06				
Thailand	0.00	0.84	0.77	0.00	0.84	0.00	-0.03	0.20				
LRM2												
Country	ECT	p-val	LRLQ	p-val	LSPRICE	p-val	LRGDP	p-val	tbr	p-val	LCPI	p-val
Malaysia	-0.02	0.10	0.11	0.08	0.09	0.02	-0.53	0.02	-0.03	0.15	-0.28	0.39
Singapore	0.02	0.42	0.42	0.00	0.03	0.34	0.04	0.75	-0.02	0.07	-1.34	0.02
Thailand	-0.42	0.00	-0.46	0.01	-0.04	0.32	0.54	0.00	-0.02	0.10	-2.65	0.00

Table 5: PMG Final Estimation of ECT and SR (individual countries).

(except Thailand) have p-value of >than 1%, which led us to accept the null hypothesis of no correlation [64].

However, the D1lrlq, D1lrm2, D1lripi denotes some very diverse patterns as can be seen in Table 5 above due to a heterogeneous panel of countries. For the dependent variable LSPRICE, LRLQ has no correlation because p-value is >10%, (accept Null hypothesis of no correlation) while the variables LRM2 and LRIPI are correlated with LSPRICE (reject Null hypothesis of no correlation because p-value is <10%) except for Singapore.

For the dependent variable LRLQ, LRM2 is correlated with LRLQ because p-value is <10%, (reject Null hypothesis of no correlation) while the variables LRGDP and LR are correlated with LRLQ (reject Null hypothesis of no correlation because p-value is <10%) except for Singapore for LRGDP and Thailand for LR. In the case of the dependent variable LRM2, we conclude that:

- LRLQ is correlated with LRM2 (all countries, because p-value is <0.10)
- LSPRICE is correlated with LRM2 (except for Singapore) [64],
- LRGDP is correlated with LRM2 (except for Singapore),
- tbr is correlated with LRM2 (except for Malaysia and Thailand)
- LCPI is correlated with LRM2 (except for Malaysia)

## Conclusion

This paper's findings are that money supply affects i) interest rates and ii) liquidity, while liquidity affect iii) share price, using estimators PMG, MG and DFE on a panel of three ASEAN countries. Although the money supply has been extensively covered in the literature and by policy maker, propositions (ii) and (iii) have not been verified. Therefore our findings on this are new in the literature and useful for policy makers.

Our findings confirm the existence of a long run cointegration relationship between share price and liquidity, money supply and industrial production index (IPI) and these are statistically significant. From the literature, empirical evidence has indicated that the Pool Mean Group (PMG) handles homogeneity/heterogeneity across panel data well, and our findings in the second equation confirm our research question that money supply causes liquidity in the short run. Liquidity causes money supply in the long run and is statistically significant. Following this, our second research question that liquidity causes share prices is also shown by the results from the first equation. In addition, while there exists a strong link between stock price and liquidity. Money supply and industrial production (proxy for earnings of firms) is significantly related in the long run, not in the short run, the latter being due to the money supply effect needing more time to convert credits to investments and then profits in the production process.

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