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Liquidity commonality-economic cycle nexus in emerging Asian economies: An ARDL approach

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ABSTRACT

This study investigates the impact of liquidity commonality on the economic cycle for 7 emerging Asian economies over a period of 1997-2018, using Autoregressive Regressive Distributed Lag (ARDL) approach to Cointegration. Gross domestic investment, total consumption expenditure, net trade, and unemployment rate are studied as macro variables in the analysis. The nexus has been discussed both in the short-run and long-run. A significant relationship between economic growth and stock market liquidity commonality is found for large economies including China, India, Indonesia, and Malaysia; however, we found mixed evidence regarding the direction of the relationship for different economies. The aggregate analysis revealed that liquidity commonality has a positive impact on economic growth in the short-run and a negative association in the long-run. As a non-diversifiable risk factor, liquidity co-movement shocks spread the market wide and disrupt the overall functioning of financial markets and eventually affect the economy. For regulators and policymakers and particularly for those in emerging economies, understanding the factors affecting economic cycles and recognizing their dynamics and magnitude is important for policy coordination and market development. Further, the firms in Asian markets operate in legal and regulatory environments distinct from those of firms analyzed in the previous literature. A major knowledge gap pertaining to Asian emerging markets serves as the primary motivation for this study.

1. Introduction

Capital markets offer a decentralized and efficient way of resource allocation. Markets provide investment means to savers, capital to entrepreneurs, and employment opportunities to labor. In an efficient market-based economic system, buyers and sellers have access to an adequately liquid trade environment. Liquidity is a phenomenon experienced frequently by investors, traders, and governments. In the financial market, the frequency by which an asset can be bought or sold without significant effect on its price or the ease of trading security is defined as liquidity. While liquidity is not an independent attribute of specific security (Chordia et al., 2000; Hasbrouck and Seppi, 2001; Huberman and Halka, 2001). The integration of financial markets and rapid advancement in technology have made liquidity associated across assets. The concept of liquidity commonality, i.e., the covariance between stock and market liquidity was first presented by Chordia et al. (2000). Liquidity commonality suggests association in execution costs and has significant inferences for asset pricing and resource allocation. Liquidity has a spill-over effect that affects the overall market.

A recent emerging strand has emphasized the predictive ability of liquidity spill-over on future economic conditions. In this regard, a question has become relevant that whether the sensitivity of stock liquidity has a short-run and long-run impact on the real economy? The answer to this question will help us understand the vital stock market factor that affects the economic cycle. Using data of 1,860 firms from 7 emerging Asian economies over the period 1997-2018, we have investigated the relationship between the economic cycle and liquidity commonality both in the short-run and long run. This study distinguishes it from the previous literature in the following ways. First, stock market liquidity has better predictive power than stock prices as the latter contains a relatively complex blend of information that fades the signals from

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stock returns (Harvey, 1988). The link between the real economy and asset prices has been studied in the existing literature. However, the results are either inconclusive or there is a lack of stability in the predictive ability of stock prices. For instance, Stock and Watson (2003) studied the predictive ability of asset prices in forecasting economic output and found that some asset prices have significant marginal predictive content at some times in some countries. There is considerable instability in the predictive power of asset prices. Campbell et al. (2001) and Guo (2002) investigated the interrelationship between excess stock returns and output growth and found insignificant and marginally significant evidence respectively. Second, the study is based on the forward-looking feature of financial markets. Since the market participants are continuously processing news and information about the future economic states; risk tolerance and preference based on future economic conditions are also subject to constant revisions. Such revisions may lead to trade stimulus. Since trading volumes are directly associated with market liquidity; aggregate liquidity may transmit signals about the future economic state. Third, the research to discover the association between liquidity dimensions and the economic cycle is quite rare. This study is a temporal extension in the existing literature which covers a period of 22 years from 1997-2018. The longer sample period produces more robust results that are less likely to be influenced by short-lived economic conditions. Fourth, a comprehensive analysis of liquidity commonality and economic cycle in emerging markets is missing primarily due to data availability constraints and the small market sizes of emerging markets relative to developed equity markets. The market models used in most developed countries differ from those of the emerging economies. Due to the lack of research on liquidity commonality-economic cycle relationship and the unique market structures of emerging economies, a comprehensive analysis of this issue was much needed.

The findings of this study offer several valuable insights. It is found that stock market liquidity commonality contains useful information for predicting the state of the economy, which complements the study of Næs et al. (2011). The extent to which the real economy is predicted by financial market indicators has long been of concern to investors, analysts, academicians, and regulators. This study has engrossed a different aspect of the stock market i.e., the liquidity commonality. It is commonly observed that market liquidity dries up during economic downturns. However, the connection between the co-movement of trading costs and the economic cycle is much more persistent than previously believed. The variations in portfolio mix are determined by the variations in market players' expectations of the real economy. The findings of this study revealed that the predictability of liquidity commonality for the real economy differs across economies. In particular, the most informative stocks are those of large markets, which are more liquid. By considering that microstructure liquidity measures are relevant for macroeconomic analysis, this paper also enhances our understanding of the mechanism by which liquidity commonality is linked to the macroeconomy. In particular, the instability in the predictive ability of stock prices, an additional predictor that may either respond earlier or differently to the economic shocks is helpful for policy purposes.

The paper is organized as follows. A brief review of the existing literature is provided in the next section. Section three describes our data and variables. Our empirical findings are provided in section four. Section five concludes.

2. Literature review

Liquidity commonality refers to the impact of market-wide liquidity changes on individual stock liquidity. This phenomenon has captured the interest of academicians over the last two decades, who have covered an extensive range of related issues. Although researchers have long been interested in investigating the significant role of liquidity in stock markets, most studies on market microstructures have focused on a single security. Researchers have now argued that liquidity is not merely an attribute of single security rather it encompasses the entire market, which has been coined systematic liquidity, liquidity commonality, or liquidity commonality (Chordia et al., 2000; Huberman and Halka, 2001; Hasbrouck and Seppi, 2001; Choe and Yang, 2010). A number of studies have attempted to explain liquidity commonality in various markets. Given different liquidity measures (quoted spreads, effective spreads, quoted depth), Chordia et al. (2000) found that liquidity of individual stock significantly co-moves with market-wide and industry-wide liquidity. Galariotis and Giouvris (2007) studied the co-movement of liquidity in the United Kingdom during different trade regimes. Similarly, Huberman and Halka (2001) identified liquidity commonality in NYSE quote-driven markets. In a related study, Kempf and Mayston (2008) analyzed liquidity commonality in the Frankfurt Stock Exchange. Fabre and Frino (2004) studied the presence of liquidity commonality in the Australian Stock Exchange (ASX), which is a purely order-driven market. Goyenko and Ukhov (2009) provided evidence of the effect of stock liquidity on bond illiquidity suggesting the flight to the quality phenomenon.

While the focus of commonality literature has been on the equity market, empirical studies have also explored liquidity commonality in various other markets. For example, Subrahmanyam et al. (2012) explored commonality in liquidity in the bond market. Marshall et al. (2013) studied commonality in commodity markets. Corò et al. (2013) examined the commonality of liquidity in credit swap markets. Anthony et al. (2017) provided evidence for liquidity

commonality in secondary corporate markets and found that liquidity commonality increased in varied ways during a global financial crisis. Mancini et al. (2013) conducted the first systematic study on liquidity commonality in foreign exchange markets.

Several researchers have attempted to investigate the link between the real economy and the financial market. It is generally believed that stock markets affect the economy through liquidity. Highly liquid stock markets facilitate investment in the long run, thus support capital allocation and long-term growth expectations (Levine and Zervos, 1999). Naik and Padhi (2015) found evidence of the positive long-term impact of stock market liquidity on economic growth. In a related study, Christiano and Eichenbaum (1995) argued that illiquidity phases occur due to panic selling by the market participants (demand effect), withdrawal of liquidity supply by the market makers (supply effect), or a combination of both. Similarly, Hameed et al. (2010) found that negative market returns reduce the liquidity of the stock, particularly when there is tightness in the funding market. Nazir et al. (2010) studied the impact of market size and liquidity on economic growth. It is found that market size has a stronger impact on economic growth relative to market liquidity. The significance of financial market development in the course of real economic growth is also endorsed by Beck and Levine (2001). Pece (2015) found a bidirectional impact of capital market performance and economic growth in the Romanian economy. To gain insight into the empirical relation between stock market liquidity and the economic cycle, Rösch and Kaserer (2014) explored the drivers of stock market liquidity during the global financial crisis and sovereign debt crisis. The empirical evidence revealed fluctuations in liquidity commonality having peaks during the crisis period. The results were in line with the theory that supports for spiral linkage between funding and market liquidity. In the same vein, Brunnermeier and Pedersen (2009) found that tightness in funding liquidity leads to an increase in liquidity commonality which in turn induces overall market dry-ups. Hoque and Yakob (2017) examined the moderating role of the exchange rate and foreign capital inflow in stock market development and the economic growth nexus. The results suggested a positive moderating role of foreign capital inflow and a negative moderating role of the exchange rate, whereas the interaction of both moderators had a positive impact on stock market development and economic growth relationship. Gibson and Mougeot (2004) found that liquidity risk premium in the U.S. stock market has a linear relationship with the Recession Index. Eisfeldt (2004) suggested a setting where stock market liquidity varies with economic fundamentals i.e., investment and economic productivity. The study conducted by Ake (2010) empirically examined the relationship between stock market development and economic growth in Eurozone. The authors found a positive association between the stock market and real economy for active and liquid stock markets, whereas a negative relationship for less liquid and small markets.

Næs et al. (2011) conducted a study on the stock markets of the US and Norway. The authors found that stock market liquidity is a predictor of the future and current state of different macroeconomic indicators related to economic growth (GDP, investment, consumption, and unemployment). It is further revealed that the liquidity of small firms decreases faster than that of large firms under poor economic conditions, which is consistent with the general belief that the liquidity of small firms is more reflective of economic conditions. Beudeker (2015) analyzed the association between stock markets and the real economic cycle in Eurozone. The results revealed that market liquidity is not a strong predictor of GDP and unemployment growth. However, liquidity commonality explained GDP growth. After the outburst of the financial crisis, the commonality trend of liquidity changes. Switzer and Picard (2016) studied the association between market-wide liquidity and economic cycle in the NYSE. Weak evidence is found regarding the relationship between liquidity fundamentals and economic conditions. Carp (2012) provided empirical evidence that stock liquidity and market capitalization do not have any impact on economic growth. Similarly, Kamran et al. (2018) investigated the impact of stock market liquidity on economic growth and found no significant relationship. On the other hand, Pan and Mishra (2018) attempted to apprehend the interplay between the real economy and the stock market. A negative impact of stock market indicators on the economy was found in long run, however, no evident relationship was found in the short-run. Similarly, Arestis et al. (2001) conceded that high market liquidity negatively affects economic growth. One possible reason is that increased liquidity increases return on investment resulted in reduced saving rates and thereby hampers economic growth.

3. Data and methodology

To investigate the relationship between liquidity commonality and economic cycle; economic and financial time series data for 7 emerging Asian economies is extracted from various sources. Liquidity commonality measure is constructed from a dataset of financial information on 1,860 firms across 7 emerging Asian markets. The following emerging economies are selected from the MSCI emerging market index: China, India, Indonesia, Malaysia, Pakistan, Philippines, and Thailand. The benchmark stock exchange of each country is included for analysis. The list of stock exchanges examined is provided in Appendix A. Non-financial companies listed in representative stock exchanges are selected for this study. Data for stocks are obtained from Datastream and macroeconomic variables are acquired from the World Development Indicators Database. The study covers the period

from 1997-2018. Sources and descriptions of the variables are provided in Appendix B.

Following Næs et al. (2011), the following predictive model will be examined:

$$y_t = \alpha + \beta\gamma_t + \delta X_t + \mu_t \quad (1)$$

where y is the annual growth in GDP for year t, γ_t is the liquidity commonality calculated for year t, X_t is a vector of control variables i.e. total consumption expenditure, gross domestic investment, net trade, and unemployment rate.

$$GDPG_t = \beta_0 + \beta_1\gamma_t + \beta_2 TCE_t + \beta_3 GDI_t + \beta_4 NT_t + \beta_5 UR_t + \mu_t \quad (2)$$

Stock liquidity is broadly defined as the capacity to trade heavy stock quantities quickly at a low cost and with marginal price impacts (Karolyi et al., 2009). The literature on market microstructures has provided a variety of measures for individual stock liquidity. In our analysis, liquidity is measured using the Amihud illiquidity ratio. This price impact proxy measures the daily price response associated with one dollar of trading volume (Amihud, 2002). The ratio is measured as:

$$AmihudILLIQ_t = |r_t|/P_t \times Vol_t \quad (3)$$

where r_t is the daily return and Vol_t is the daily trading volume of shares. The r_t and Vol_t of stocks are calculated with the following formula:

$$r_t = [100 \times \{ln(P_t) - ln(P_{t-1})\}]$$
$$Vol_t = [ln(N_t)]$$

where P_t and P_{t-1} are the closing price on day t and t-1, respectively and N_t is the number of stocks traded on day t. Daily data are used to measure the liquidity of stock *i*.

Liquidity commonality in the stock markets of the selected countries is measured following Chordia et al. (2000), Fabre and Frino (2004), Zhang et al. (2009), Dang et al. (2015), Anthony et al. (2017), Moshirian et al. (2017) and Tissaoui et al. (2017). A market model is used by applying time series regression to investigate the liquidity commonality of each stock in each year:

$$\Delta L_{i,t} = \beta_0 + \beta_1 \Delta L_{m,t} + \beta_2 \Delta L_{m,t+1} + \beta_3 \Delta L_{m,t-1} + \beta_4 R_{m,t} + \beta_5 R_{m,t+1} + \beta_6 R_{m,t-1} + \beta_7 RV_{i,t} + \varepsilon_{i,t} \quad (4)$$

where $\Delta L_{i,t}$ is the percentage change in the liquidity of stock *i* from day_{t-1} to day_t and $\Delta L_{M,t}$ is the percentage change in market liquidity from day_{t-1} to day_t. We define market liquidity as the equally-weighted average of the daily liquidity of all stocks in the market (excluding stock *i*) on day t. A one-day lead ($\Delta L_{M,+1}$) and one day lag ($\Delta L_{M,t-1}$) are included to capture market movement adjustments. $R_{M,t}$, $R_{M,t+1}$ and $R_{M,t-1}$ are the concurrent, one-day lead and one-day lag equally weighted market returns, respectively. Market return variables are included to identify any spurious dependence arising from the relationship between returns and liquidity. $RV_{i,t}$ is the percentage change in a stock's squared return, which is a measure of stock return volatility effects on stock liquidity (Tissaoui et al., 2017; Galariotis and Giouvris, 2007). Eq. 4 is estimated for each stock *i* for each year to obtain an R^2 statistic. The R^2 measure for regression is used to measure the percentage change in the daily variation in the liquidity of stock *i* due to daily variations in market liquidity. A higher R^2 value denotes more variation in the liquidity of an individual stock due to market liquidity. We use Gamma ($\boldsymbol{\gamma}$), the logarithmic transformation of R^2, to measure liquidity commonality so that the explanatory variable can be used in our subsequent analysis.

$$\Upsilon = \log\left({R^{2i}}/{(1 - R^{2i})}\right)$$

The logarithmic transformation is the ratio of explained versus unexplained variance. Since R^2 is the bound range between zero and one, liquidity commonality is obtained from the log of the transformed R^2. Gamma (γ) is a monotonically increasing function of R^2. It has a more normal distribution than R^2 due to transformation. Therefore, it has been preferred over R^2 in empirical studies. A higher γ value indicates greater stock liquidity sensitivity to market liquidity. Market liquidity commonality is the equally-weighted average of the liquidity commonality of all stocks in the market for year t.

Several methods are used in the existing literature to capture the long-term association among different variables. The most commonly used approaches like maximum Engle and Granger (1987) and Phillips and Hansen (1990); required integration of all variables of order I(1). Further, the results from these methods are not robust for small samples. Considering the stated problems, the Autoregressive Distributed Lag (ARDL) cointegration approach is used in the current study. The ARDL approach was presented by Pesaran and Shin (1998) and modified by Pesaran et al. (2001). This approach involves the estimation of an Error Correction Model (ECM) which has numerous advantages over conventional cointegration techniques. First, it can be applied to small samples (Pesaran et al., 2001). Secondly, the ARDL approach can estimate both short-run and long-run dynamics of the model simultaneously. Third, the approach uses sufficient lags to acquire the data generation procedure in a general to particular modeling framework. Besides, it can be applied regardless of whether the regressors are integrated of order I(0) or I(1) or mutually cointegrated (Pesaran and Shin, 1998). Once the lag order for ARDL is identified, Ordinary Least Square (OLS) can be employed for estimation.

An ARDL representation of Eq. 2 is given below:

$$\Delta GDPG_t = \beta_0 + \sum\beta_i \Delta GDPG_{t-1} + \sum\beta_i \Delta\gamma_{t-1} + \sum\beta_i \Delta TCE_{t-1} + \sum\beta_i \Delta GDI_{t-1} + \sum\beta_i \Delta NT_{t-1} + \sum\beta_i \Delta UR_{t-1} + \mu_t \quad (5)$$

where the value of i ranges from 1-p.

After ARDL estimation, an Error Correction Model (ECM) is constructed subsequently. An ECM representation of Eq. 5 is given below:

$$\Delta GDPG_t = \alpha_0 + \sum\alpha_i \Delta GDPG_{t-1} + \sum\beta_i \Delta\gamma_{t-1} + \sum\lambda_i \Delta TCE_{t-1} + \sum\delta_i \Delta GDI_{t-1} + \sum\eta_i \Delta NT_{t-1} + \sum\varphi_i \Delta UR_{t-1} + ECM + \mu_t \quad (6)$$

The stability of the model is conducted by using the Cumulative (CUSUM) test.

4. Results

4.1. Unit root test

The underlying assumption of ARDL methodology is that none of the variables to order I(2). Thus, we start our analysis by testing the stationarity status of variables to ensure that none of the variables is integrated of order I(2) or higher. The findings of the Augmented Dickey-Fuller and Phillip Parren test for each country are presented in Table 1. The Augmented Dickey-Fuller test requires the independent and identical distribution of time series which may not be applicable to whole data so the Phillip Parren test is also applied which allows heterogeneous distribution of data. The results confirmed that all the variables are integrated of order one or lower.

The results of the panel unit root test of 7 emerging Asian economies are presented in Table 2.

The findings reveal that all the variables in the panel are stationary at level.

4.2. Autoregressive distributed lag model

In the ARDL approach, the first step is to estimate Eq. 5. Table 3 indicates country by country results for the ARDL model. As annual data is used for analysis; therefore, a short lag length is employed.

Table 1: Unit root test

Countries	Variables	ADF-Level	ADF-1st Difference	PP-Level	PP-1st Difference
China	GDPG	-1.3594	-4.4555***	-1.3575	-4.4669***
	γ	-1.4739	-4.5160***	-1.4598	-4.5325***
	TCE	-3.7459	-6.5880***	-3.7555	-9.7347***
	GDI	-1.8997	-4.4679***	-1.8998	-4.4678***
	UR	-2.1721	-2.4974**	-2.1722	-2.4974**
	NT	-2.6500*	-6.0443***	-2.6246	-6.0756***
India	GDPG	-4.2875***	-5.9034***	-4.3341***	-14.1550***
	γ	-4.0534***	-6.2655***	-4.0244***	-15.5903***
	TCE	-1.5290	-4.6626**	-4.1276***	-9.8600***
	GDI	-5.4719***	-9.2850***	-5.4605***	-23.0180***
	UR	-2.1892	-2.7932**	-1.4433	-2.7960**
	NT	-3.3407**	-6.2876***	-3.3407**	-7.7703***
Indonesia	GDPG	-3.5008**	-11.8511***	-3.5008**	-10.2203***
	γ	-2.3767	-6.8599***	-3.5398**	-15.9922***
	TCE	-5.1182***	-19.4906***	-5.0806***	-15.7438***
	GDI	-6.7336***	-5.2754***	-3.4853**	-7.5340***
	UR	-1.9615	-3.2122**	-1.1767	-3.2122**
	NT	-22.4097***	-4.5041***	-12.6637***	-4.5041***
Malaysia	GDPG	-5.9759***	-5.3201***	-6.1538***	-15.1820***
	γ	-3.2587**	-4.1643***	-5.6603***	-25.6907***
	TCE	-8.9379***	-8.3940***	-3.7467**	-7.8049***
	GDI	-4.4085***	-7.9439***	-4.4100***	-8.9472***
	UR	-4.3998***	-5.7972***	-4.3351***	-6.7845***
	NT	-4.1389***	-40.1221***	-13.7047***	-4.3823***
Pakistan	GDPG	-2.3181	-4.0447***	-2.3993	-4.0407***
	γ	-1.9441	-4.5409***	-1.9441	-4.5409***
	TCE	-2.5823	-5.2977***	-2.5975	-5.3592***
	GDI	-2.3083	-5.6388***	-2.3083	-5.6388***
	UR	0.9821	-6.1359***	0.6075	-6.1333***
	NT	-4.3213***	-6.9362***	-4.3208***	-17.4172***
Philippines	GDPG	-4.8980***	-6.3863***	-4.9366***	-12.7760***
	γ	-4.5674***	-6.2249***	-4.8792***	-11.4962***
	TCE	-3.9743***	-6.3307***	-3.9361***	-7.6397***
	GDI	-3.2417**	-5.8563***	-3.3086**	-9.3027***
	UR	-3.1044**	-4.8179***	-3.1193**	-5.5890***
	NT	-4.1001***	-6.0942***	-4.0811***	-12.2978***
Thailand	GDPG	-3.8699***	-7.9041***	-3.8975***	-7.8301***
	γ	-5.0190***	-5.6703***	-5.0240***	-18.8113***
	TCE	-3.4328**	-7.6331***	-3.3640**	-7.2779***
	GDI	-2.9161*	-6.8774***	-2.8240*	-6.5703***
	UR	-1.7098	-12.6493***	-1.7098	-11.9148***
	NT	-4.1459***	-4.4716***	-13.7340***	-4.4716***

Note: ***p<0.001, **p<0.005 and*p<0.01 level of significance

Liquidity commonality, gross domestic investment, and total consumption expenditure have a positive and significant relationship with economic growth whereas net trade and unemployment rate have no significant impact in the case of China. The impact of the lag of liquidity commonality had a positive impact on economic growth but adversely affects the real economy in the current period for

India. Gross domestic investment has positive whereas the unemployment rate has a negative impact on the real economy. Gross domestic investment and net trade have significant and positive, whereas liquidity commonality and unemployment rate have a significant and negative impact on GDP growth in the case of Indonesia. On the other hand, total consumption expenditure has an insignificant relationship with the real economy.

Table 2: Panel unit root test

Variables	Method	Test Statistics Level
GDPG	Levin, Lin and Chu t*	-17.98***
	Breitung t-stat	-4.25489***
	Im, Pesaran and Shin W-stat	-12.2543***
	ADF-Fisher Chi-square	288.267***
	PP-Fisher Chi-square	73.4574***
γ	Levin, Lin and Chu t*	-11.7505***
	Breitung t-stat	-3.25489***
	Im, Pesaran and Shin W-stat	-7.28429***
	ADF-Fisher Chi-square	74.6807***
	PP-Fisher Chi-square	66.5510***
TCE	Levin, Lin and Chu t*	-11.1624***
	Breitung t-stat	-3.98147***
	Im, Pesaran and Shin W-stat	-9.07656***
	ADF-Fisher Chi-square	96.9182***
	PP-Fisher Chi-square	64.1426***
GDI	Levin, Lin and Chu t*	-6.35263***
	Breitung t-stat	-2.47165***
	Im, Pesaran and Shin W-stat	-5.38379***
	ADF-Fisher Chi-square	56.8334***
	PP-Fisher Chi-square	43.4082***
NT	Levin, Lin and Chu t*	-375.229***
	Breitung t-stat	-1.67079**
	Im, Pesaran and Shin W-stat	-175.327***
	ADF-Fisher Chi-square	802.695***
	PP-Fisher Chi-square	114.835***
UR	Levin, Lin and Chu t*	-6.71675***
	Breitung t-stat	-4.7529***
	Im, Pesaran and Shin W-stat	-7.41161***
	ADF-Fisher Chi-square	70.0005***
	PP-Fisher Chi-square	364.521***

Note: ***p<0.001, **p<0.005 and*p<0.01 level of significance

The impact of the lag of liquidity commonality had a significant and negative impact on economic growth but has a positive impact on the real economy in the current period for Malaysia. Total consumption expenditure has a positive and significant, whereas the unemployment rate has a negative and significant relationship with economic growth. The lag of net trade had a significantly negative impact on the real economy; however, there is no significant impact in the current period.

Gross domestic investment and total consumption expenditure have a positive and significant, whereas net trade has a negative and significant relationship with economic growth in the case of Pakistan. Liquidity commonality and unemployment rate have insignificant relation with GDP growth. Gross domestic investment, total consumption expenditure, and net trade have a positive and significant relationship with GDP growth for the Philippines. Liquidity commonality has no impact on economic growth. The impact of a lag of unemployment on GDP growth was positive but there is no impact in the short run. Total consumption expenditure and net trade have a positive and significant, whereas the unemployment rate has a negative impact on GDP growth. Liquidity commonality has no effect on economic growth in the case of Thailand. F statistics for all countries' models is significant indicating that the models are an overall good fit.

4.3. Pooled mean group test/panel ARDL model

The panel data of 7 emerging Asian economies are analyzed by applying pooled mean group test which is the panel ARDL model. The findings are reported in Table 4. The results provided evidence of cointegration of variables where the cointegration coefficient is negative and significant, depicting a long-run relationship between GDP growth and explanatory variables.

Table 3: Autoregressive distributed lag estimates

Countries	Independent Variables	Coefficient	S.E	t Statistics	P-value
China	GDPG(-1)	-0.1247	0.1706	-0.7311	0.4777
	γ	0.1141	0.0497	2.2957	0.0390
	GDI	0.1304	0.0509	2.5642	0.0236
	TCE	0.2784	0.1056	2.6366	0.0205
	NT	0.0045	0.0062	0.7206	0.4839
	NT(-1)	0.0097	0.0054	1.7811	0.0983
	UR	-0.6501	0.5356	-1.2136	0.2465
	C	2.9585	2.4696	1.1980	0.2523
	R-squared	0.9064	F-statistic		17.9739
	Adjusted R-squared	0.8559	Prob (F-statistic)		0.0000
	Durbin-Watson stat	2.1017			
India	GDPG(-1)	0.2621	0.2254	1.1627	0.2658
	γ	-0.2431	0.1322	-1.8387	0.0889
	γ(-1)	0.2460	0.1272	1.9343	0.0751
	GDI	0.1022	0.0653	2.5717	0.0422
	TCE	0.3099	0.3054	1.0148	0.3287
	NT	-0.0133	0.0105	-1.2591	0.2301
	UR	-0.9449	2.9515	-3.4464	0.0107
	C	-5.5227	17.6191	-1.4486	0.1711
	R-squared	0.5558	F-statistic		2.3237
	Adjusted R-squared	0.3166	Prob (F-statistic)		0.0898
	Durbin-Watson stat	2.0636			
Indonesia	GDPG(-1)	0.1089	0.0683	1.5952	0.1347
	γ	-0.1270	0.0363	-3.5001	0.0039
	GDI	0.1402	0.0380	3.6902	0.0027

	TCE	-0.2228	0.2383	-0.9348	0.3669
	NT	0.0038	0.0011	3.3725	0.0050
	UR	-0.3311	0.1529	-2.1660	0.0495
	C	6.9254	1.6097	4.3024	0.0009
	R-squared	0.9870	F-statistic		140.699
	Adjusted R-squared	0.9800	Prob (F-statistic)		0.0000
	Durbin-Watson stat	1.8381			
Malaysia	GDPG(-1)	-0.3253	0.0961	-3.3849	0.0061
	γ	0.0574	0.0283	2.0254	0.0678
	γ(-1)	-0.0581	0.0263	-2.2117	0.0491
	GDI	-0.0215	0.0433	0.4977	0.6285
	GDI(-1)	-0.0664	0.0352	-1.8863	0.0859
	TCE	0.7319	0.1138	6.4308	0.0000
	NT	0.0024	0.0018	1.3114	0.2164
	NT(-1)	-0.0038	0.0011	-3.3519	0.0065
	UR	-3.1132	1.2476	-2.4953	0.0298
	C	12.8625	3.8774	3.3173	0.0069
	R-squared	0.9783	F-statistic		55.0760
	Adjusted R-squared	0.9605	Prob (F-statistic)		0.000
	Durbin-Watson stat	2.2111			
Pakistan	GDPG(-1)	-0.4024	0.2660	-1.5129	0.1562
	γ	-0.1235	0.0702	-1.7591	0.1040
	GDI	0.1141	0.0536	2.1275	0.0548
	GDI(-1)	0.0489	0.0422	1.1604	0.2684
	TCE	0.2858	0.1115	2.5622	0.0249
	TCE(-1)	0.1715	0.1344	1.2761	0.2261
	NT	-0.0020	0.0007	-2.7557	0.0174
	UR	-0.2506	0.2031	-1.2337	0.2409
	C	7.3820	2.3432	3.1504	0.0084
	R-squared	0.8495	F-statistic		8.4673
	Adjusted R-squared	0.7492	Prob (F-statistic)		0.0006
	Durbin-Watson stat	2.4017			
Philippines	GDPG(-1)	-0.1771	0.1663	-1.0655	0.3095
	γ	0.0018	0.0157	0.1158	0.9099
	GDI	0.1892	0.0903	2.0951	0.0601
	TCE	0.5492	0.1483	3.7034	0.0035
	TCE(-1)	-0.2652	0.1623	-1.6346	0.1304
	NT	0.0623	0.0284	2.1951	0.0505
	NT(-1)	0.0478	0.0200	2.3917	0.0358
	UR	-0.7064	0.6525	-1.0826	0.3021
	UR(-1)	1.5928	0.7976	1.9970	0.0712
	C	-1.7091	3.9228	-0.4357	0.6715
	R-squared	0.9307	F-statistic		16.4030
	Adjusted R-squared	0.8739	Prob (F-statistic)		0.0000
	Durbin-Watson stat	2.2455			
Thailand	GDPG(-1)	-0.1475	0.1482	-0.9952	0.3760
	γ	-0.0347	0.0495	-0.7000	0.5225
	GDI	0.0795	0.0809	0.9829	0.3813
	GDI(-1)	0.1845	0.0526	3.5095	0.0247
	TCE	1.0469	0.2012	5.2022	0.0065
	NT	0.0038	0.0016	2.4515	0.0703
	UR	-2.8316	1.2111	-2.3381	0.0795
	C	6.0771	4.4211	1.3745	0.2413
	R-squared	0.8902	F-statistic		18.9291
	Adjusted R-squared	0.8432	Prob (F-statistic)		0.0000
	Durbin-Watson stat	1.8936			

The long-run coefficients imply a significant relationship with GDP growth. Liquidity commonality is found to have a negative impact on GDP growth in the long run, which means that co-movement of market-wide liquidity has an adverse impact on the real economy in the long run. Whereas, gross domestic investment, total consumption expenditure, unemployment rate, and net trade have a positive and significant association with GDP growth. The evidence for liquidity commonality and macro variables are significant at 10% and 1% level respectively.

In the short run, the predictors affect the real economy differently. The short-run coefficient for liquidity commonality is positive and significant at a 10% level, which means that in short-run liquidity commonality has a positive association with the real economy. The short-run coefficients of gross domestic investment and unemployment rate show a negative impact on the real economy. On the other hand, total consumption expenditure and net trade have no significant relationship with GDP growth in the short-run.

4.4. Bounds test for cointegration

The results of the Bounds Cointegration Test for the long-run association are reported in Table 5. The F-statistics for each country is higher than the critical bounds at a 1% level of significance i.e., 4.68. This implies that the null hypothesis of no

cointegration is rejected. Thus, there is a cointegrating relationship among the variables.

Table 4: Pooled mean group/panel ARDL model

Variable	Coefficient	S.E	t Statistics	P-Value
Long Run Equation				
γ	-2.5904	0.1798	-2.4374	0.0539
GDI	0.218	0.0366	5.9631	0.0000
TCE	0.515	0.1065	4.8376	0.0000
UR	0.9932	0.1867	5.3188	0.0000
NT	0.0019	0.0006	3.2278	0.0019
Short Run Equation				
COINTEQ	-0.7451	0.1864	-3.9981	0.0001
Δ γ	4.8284	2.5487	2.0018	0.0620
Δ γ(-1)	-1.0779	1.3410	-0.8038	0.4241
Δ GDI	-0.0444	0.0423	-1.7835	0.0971
Δ GDI(-1)	-0.0563	0.0355	-1.5851	0.1171
Δ TCE	0.0088	0.1056	0.0834	0.9338
Δ TCE(-1)	-0.0891	0.122	-2.0264	0.0676
Δ UR	-0.4571	0.5738	-0.7966	0.0282
Δ UR(-1)	1.0018	0.3465	2.8915	0.0050
Δ NT	-0.0001	0.0015	-0.0828	0.9342
Δ NT(-1)	-0.0017	0.0016	-1.8983	0.0877

Table 5: Bounds Cointegration test

Country	F Statistics	Conclusion
China	4.9659***	Cointegration
India	4.8005***	Cointegration
Indonesia	15.324***	Cointegration
Malaysia	10.4022***	Cointegration
Pakistan	5.0141***	Cointegration
Philippines	5.8737***	Cointegration
Thailand	20.5435***	Cointegration
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	2.26	3.35
5%	2.62	3.79
2.50%	2.96	4.18
1%	3.41	4.68

Note: ***p<0.001 level of significance

4.5. Long-run estimates

As Bounds Test has confirmed the long-run nexus, the results of the country-wise presence of a long-run relationship among the variables are reported in Table 6.

Liquidity commonality, gross domestic investment, total consumption expenditure, and net trade have a positive and significant, whereas the unemployment rate has a negative and significant long-term relationship with economic growth for China. For India, total consumption expenditure has a positive and significant, whereas liquidity commonality and net trade have a negative and significant long-run association with GDP growth. Gross domestic investment has no long-run impact in the case of India. For Indonesia, only gross domestic investment has long-run relation with economic growth.

Liquidity commonality and total consumption expenditure have positive and significant, whereas the unemployment rate has a negative and significant long-run association with GDP growth for Malaysia. Gross domestic investment and total consumption expenditure have positive and significant, whereas liquidity commonality has a negative and significant long-run impact on economic growth in the case of Pakistan. Gross domestic investment, total consumption expenditure, and net trade have a positive and significant long-run association for both the Philippines and Thailand. The unemployment rate has a significant and negative impact only on Thailand. Liquidity commonality has no long-run association with economic growth for the Philippines and Thailand.

4.6. Error correction representation of ARDL model

The short-run association is examined by the ARDL error correction model. Estimates of the ECM representation are reported in Table 7. All error correction coefficients are negative as required and significant at 1% and 5% supporting adjustment towards the long run. The ECM coefficients suggest that the process of adjustment is quite fast ensuring the disequilibrium in economic growth from the previous period will be corrected in the current year.

Table 6: Long run results dependent variable GDPG

Countries	Independent Variables	Coefficient	S.E	t Statistics	P-value
China	γ	0.0215	0.0092	-2.1793	0.0812
	GDI	0.1522	0.0166	9.1464	0.0003
	TCE	0.4743	0.0423	11.2079	0.0001
	NT	0.0229	0.0019	12.2480	0.0001
	UR	-0.7059	0.2421	-2.9158	0.0332
	C	-0.7612	1.0456	-0.7280	0.4993
India	γ	-0.0115	0.0245	-2.1660	0.0495
	GDI	0.0433	0.0470	0.9211	0.3876
	TCE	0.4608	0.2320	1.9864	0.0873
	UR	1.8933	1.8745	1.0100	0.3461
	NT	-0.0206	0.0088	-2.3375	0.0520
	C	-6.8456	11.0068	-0.6219	0.5537
Indonesia	γ	0.4135	0.4210	0.9822	0.3711
	GDI	0.1665	0.0724	2.2995	0.0698
	TCE	-0.4313	0.3120	-1.3826	0.2254
	UR	0.1551	0.3369	0.4605	0.6645
	NT	0.0008	0.0018	0.4106	0.6983
	C	-4.8673	10.9697	-0.4437	0.6758
Malaysia	γ	0.0169	0.0110	2.1275	0.0548
	GDI	-0.2478	0.1429	-1.7348	0.1578
	TCE	0.5253	0.2260	2.3240	0.0808
	NT	-0.0001	0.0182	-0.0059	0.9956
	UR	-7.9044	3.0321	-2.6069	0.0596
	C	26.4573	8.2027	3.2255	0.0321

	γ	-0.0925	0.0360	-2.5717	0.0422
	GDI	0.1275	0.0315	4.0464	0.0068
Pakistan	TCE	0.2502	0.1117	2.2403	0.0663
	NT	-0.0011	0.0006	-1.6909	0.1418
	UR	-0.1475	0.0772	-1.9118	0.1044
	C	5.7024	1.0695	5.3320	0.0018
	γ	-0.0330	0.0211	-1.5655	0.1615
	GDI	0.4738	0.1670	2.8367	0.0252
Philippines	TCE	0.5397	0.1566	3.4464	0.0107
	UR	1.6273	1.1049	1.4728	0.1843
	NT	0.1617	0.0405	3.9919	0.0052
	C	3.9368	4.2316	0.9303	0.3832
	γ	-0.0157	0.0155	-1.0161	0.3670
	GDI	0.1869	0.0389	4.8040	0.0086
Thailand	TCE	0.3770	0.1376	2.7397	0.0519
	NT	0.0018	0.0008	2.3602	0.0776
	UR	-0.7779	0.2288	-3.4007	0.0273
	C	2.9341	2.1038	1.3946	0.2356

Total consumption expenditure has the strongest short-run effect on economic growth followed by liquidity commonality and gross domestic investment for China. Net trade and unemployment rate have no short-run impact. Only gross domestic investment has a short-run association with GDP growth in the case of India. Liquidity commonality has negative and significant, whereas gross domestic investment and net trade have a positive and significant short-run relationship with economic growth for Indonesia.

Liquidity commonality and unemployment rate have no short-run association with economic growth, whereas total consumption expenditure, gross domestic investment, and net trade have a positive and significant short-run relationship with economic growth for Malaysia. Liquidity commonality has a negative and significant, whereas total consumption expenditure, gross domestic investment, and net trade have a positive and significant short-run relationship with economic growth for Pakistan. Total consumption expenditure is the strongest predictor of economic growth in the short run for the Philippines followed by net trade. Liquidity commonality, gross domestic investment, and unemployment rate have no impact in the short-run. Liquidity commonality has negative and significant, whereas total consumption expenditure and gross domestic investment have a positive and significant short-run relationship with economic growth for Thailand.

Table 7: Error correction representation of ARDL model

Countries	Independent Variables	Coefficient	S.E	t Statistics	P-value
	Δ γ	0.1289	0.0319	4.0345	0.0012
	Δ TCE	0.2946	0.0611	4.8193	0.0003
	Δ GDI	0.1241	0.0394	3.1472	0.0071
	Δ NT	-0.0007	0.0036	-0.1995	0.8447
China	Δ UR	0.3208	0.8007	0.4007	0.6947
	ECT(-1)	-0.4375	0.2508	-5.7320	0.0001
	R-squared	0.8405			
	Adjusted R-squared	0.7835			
	Durbin-Watson stat	1.9825			
	Δ γ	0.0622	0.1293	0.4812	0.6378
	Δ TCE	0.2380	0.3243	0.7339	0.4751
	Δ GDI	0.1693	0.0706	2.3992	0.0309
	Δ NT	0.0037	0.0103	0.3578	0.7258
India	Δ UR	3.3738	5.8412	0.5776	0.5727
	ECT(-1)	-0.6434	0.4120	-2.2550	0.0406
	R-squared	0.4477			
	Adjusted R-squared	0.2504			
	Durbin-Watson stat	2.1787			
	Δ γ	-0.0996	0.0265	-3.7574	0.0021
	Δ TCE	-0.0606	0.1623	-0.3732	0.7146
	Δ GDI	0.1294	0.0187	6.9386	0.0000
	Δ NT	0.0036	0.0008	4.5955	0.0004
Indonesia	Δ UR	0.0706	0.3070	0.2300	0.8214
	ECT(-1)	-0.7846	0.3505	-2.2384	0.0420
	R-squared	0.9750			
	Adjusted R-squared	0.9661			
	Durbin-Watson stat	1.8736			
	Δ γ	-0.0339	0.0467	-0.7258	0.4808
	Δ TCE	0.2701	0.0940	2.8723	0.0131
	Δ GDI	0.2677	0.0419	6.3827	0.0000
	Δ NT	0.0588	0.0160	3.6658	0.0029
Malaysia	Δ UR	0.7419	1.9968	0.3716	0.7162
	ECT(-1)	-0.2348	1.5255	-2.1954	0.0502
	R-squared	0.8715			
	Adjusted R-squared	0.8221			
	Durbin-Watson stat	2.3932			
	Δ γ	-0.1440	0.0753	-1.9130	0.0764
Pakistan	Δ TCE	0.1866	0.0827	2.2549	0.0407
	Δ GDI	0.1279	0.0351	3.6449	0.0027

	Δ NT	-0.0019	0.0006	-3.3823	0.0045
	Δ UR	-0.3042	0.3793	-0.8020	0.4360
	ECT(-1)	-0.6146	0.3709	-4.3534	0.0007
	R-squared	0.6998			
	Adjusted R-squared	0.5926			
	Durbin-Watson stat	1.9791			
	Δ γ	0.0161	0.0350	0.4613	0.6517
	Δ TCE	0.9626	0.2282	4.2187	0.0009
	Δ GDI	0.1784	0.1411	1.2639	0.2269
	Δ NT	0.0689	0.0347	1.9834	0.0673
Philippines	Δ UR	0.9203	1.0720	0.8586	0.4050
	ECT(-1)	-0.8672	0.8284	-2.5622	0.0249
	R-squared	0.7077			
	Adjusted R-squared	0.6033			
	Durbin-Watson stat	2.2993			
	Δ γ	-0.1185	0.0414	-2.8635	0.0125
	Δ TCE	0.5536	0.2357	2.3488	0.0340
	Δ GDI	0.1915	0.0852	2.2464	0.0413
	Δ NT	0.0000	0.0000	0.8617	0.4034
Thailand	Δ UR	-0.5201	1.2202	-0.4263	0.6764
	ECT(-1)	-0.8965	0.2858	-3.1372	0.0073
	R-squared	0.9320			
	Adjusted R-squared	0.9078			
	Durbin-Watson stat	1.9707			

4.7. Stability of ARDL model

The stability of long-run and short-run coefficients in the ARDL error correction model is checked by applying the Cumulative Sum of Recursive Residuals (CUSUM). If the CUSUM plots of the estimated model stay within the critical bounds at a 5% level of significance, the null hypothesis of stability of all coefficients cannot be rejected. From the Figs. 1 to 7, we can see that CUSUM plots are within the critical bounds depicting that the coefficients are stable.

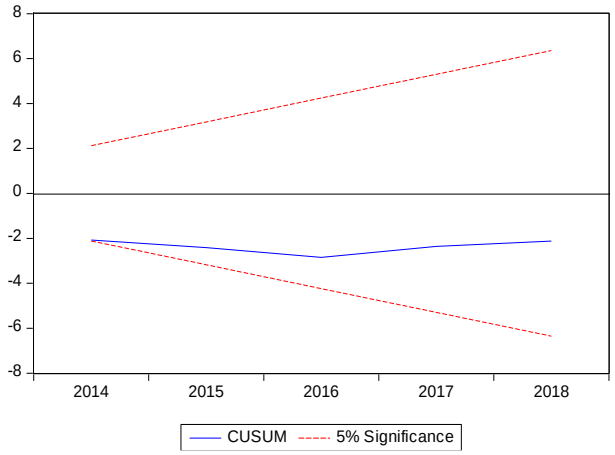

Fig. 1: Plot of cumulative sum of recursive residuals (China)

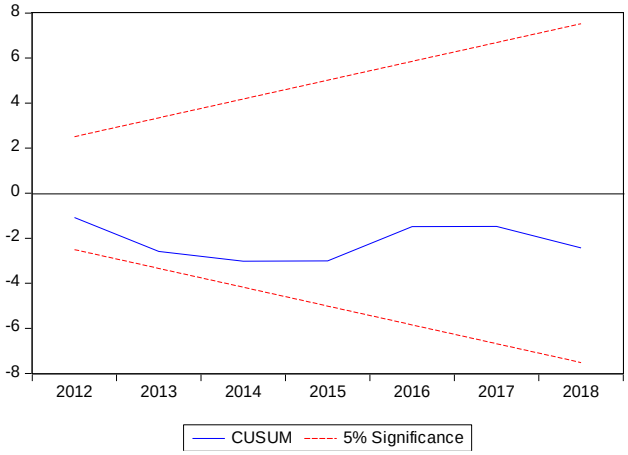

Fig. 2: Plot of cumulative sum of recursive residuals (India)

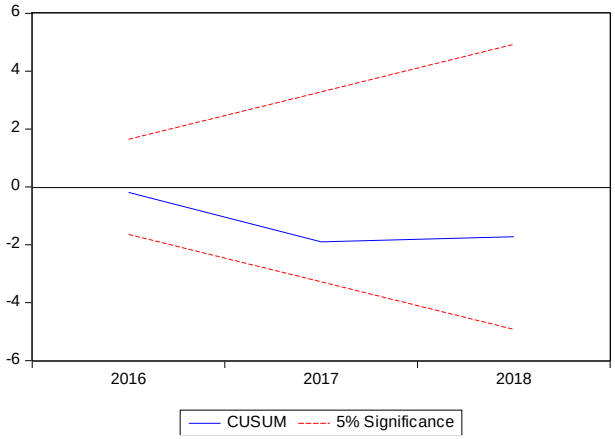

Fig. 3: Plot of cumulative sum of recursive residuals (Indonesia)

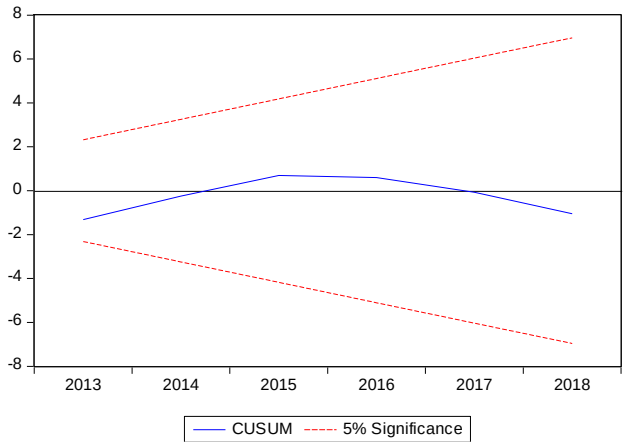

Fig. 4: Plot of cumulative sum of recursive residuals (Malaysia)

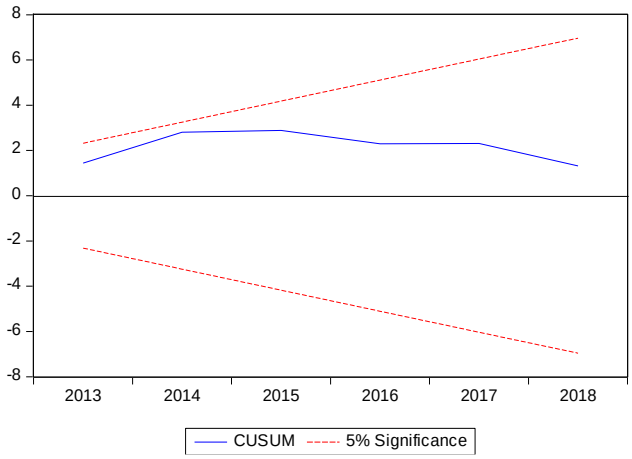

Fig. 5: Plot of cumulative sum of recursive residuals (Pakistan)

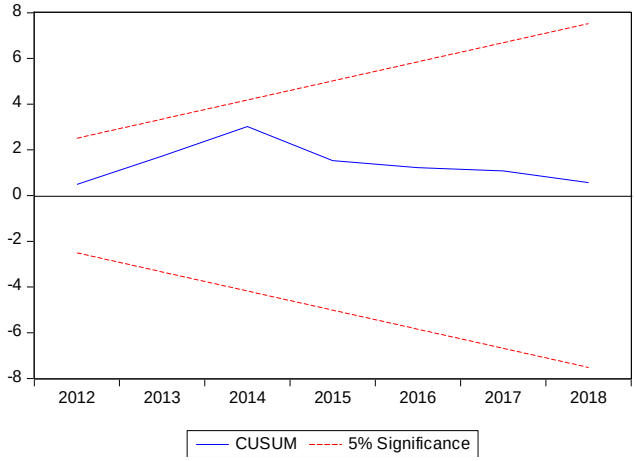

Fig. 6: Plot of cumulative sum of recursive residuals (Philippines)

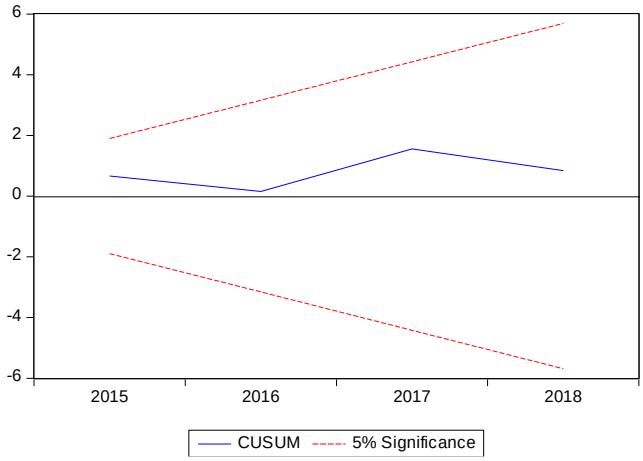

Fig. 7: Plot of cumulative sum of recursive residuals (Thailand)

5. Conclusion

This study attempted to examine the relationship between different factors and economic cycle with a special focus on liquidity commonality–economic cycle nexus for a sample of 7 emerging Asian economies over the period of 1997-2018, using the ARDL approach to cointegration. The study investigated both countries by country and panel estimates. Our country-wise findings suggest that there exists a significant relationship between economic growth and stock market liquidity commonality for large economies including China, India, Indonesia, and Malaysia. The results have confirmed that market-wide liquidity commonality contains significant information for the economic cycle; however, we found mixed evidence regarding the direction of relationship for different economies. The linkage is positive in the case of China and Malaysia, yet negative in the case of India and Indonesia. Similarly, the panel analysis revealed that liquidity commonality has a negative impact on economic growth in the long-run and positive associations in the short-run. As a non-diversifiable risk factor, liquidity co-movement spreads market-wide and upsets the overall functioning of the financial market. During market turmoil, liquidity decline may result in systemic consequences or market freeze and loss of investors' trust in the price discovery mechanism of the market. The uncertainty in stock markets motivates investors to move towards liquid assets–suggesting flight to liquidity phenomenon. The investors engage in panic selling and their perception of a decline in the market leads them in rebalancing their position in safe assets such as government bonds. Public debt has a positive growth effect in the short-run. However, it crowds out the private sector and eventually dampens economic performance in long run.

The macro variables are found to have a significant impact on economic growth. Gross domestic investment and total consumption expenditure have a positive and significant long-run relationship for most of the economies analyzed in the study, advocating the fact that an increase in investment boosts the capital formation and economic activities. Similarly, total consumption expenditure plays an essential role when it comes to supplying the economy with spending to generate growth. Conversely, the unemployment rate has a negative and significant long-run impact for China, Malaysia, and Thailand indicating low income and output level during times when the economy is operating below its full capacity. Mixed results are found for net trade; it has a positive and significant long-run association for China, the Philippines, and Thailand and a negative association with economic growth in the case of India.

The present study is carried out with some limitations. First, the empirical analysis is based on a small cross-section of economies and firms due to constraints with respect to data availability during the sample period. In an attempt to reduce the inference of biased conclusions, the time series observations have been increased. Second, the present study focused only on the liquidity of equity markets. Third, the price impact proxy is used in this study to measure stock liquidity. There are several other liquidity measures that may construct different conclusions.

With respect to future research, the empirical analysis of the study could be extended across different economies and across various asset markets like the bond market, commodity market, and foreign exchange market. Further research could be undertaken with some alternative methodology and different determinants. Liquidity estimated using high-frequency data provides more precise results. Addressing this caveat, future research could be conducted using intraday observations to measure liquidity. Further, different sectors of the economy can be analyzed to examine the impact of each sector on the economic cycle.

Appendix A: List of stock exchanges by country

Table A1 lists the stock exchanges and numbers of firms studied in this paper. Only the main benchmark stock exchange for each country is listed.

Table A1: List of stock exchanges by country

Country	Stock Exchange	Number of Firms
China	Shanghai Stock Exchange	393
India	Bombay Stock Exchange	397
Indonesia	Jakarta Stock Exchange	161
Malaysia	Kuala Lumpur Stock Exchange	315
Pakistan	Pakistan Stock Exchange	208
Philippines	Philippines Stock Exchange	128
Thailand	Stock Exchange of Thailand	258

Appendix B: Variable definitions and sources

Table B1 provides the list of variables used in this study with abbreviations, descriptions, and sources.

Table B1: Variable definitions and sources

Variable	Abbreviation	Description	Sources
Stock Market Variables			
Stock Prices	P	Daily closing price of stocks	Datastream
Trading Volume	Vol	Daily trading volume of shares	Datastream
Macroeconomic Variables			
GDP Growth	GDP	Annual percentage growth rate of GDP	World Development Indicators
Total Consumption Expenditure	TCE	Average annual growth of total consumption expenditure. Total consumption expenditure is the sum of household consumption expenditure and general government consumption expenditure	World Development Indicators
Gross Domestic Investment	GDI	Annual growth rate of gross domestic investment. Net acquisitions of valuables are considered as capital formation.	World Development Indicators
Net Trade	NT	Annual growth rate of net trade. Net trade in goods and services is the obtained by offsetting imports of goods and services against exports of goods and services.	World Development Indicators
Unemployment Rate	UR	Unemployment rate is the percentage share of labor force that is without work but available for and seeking employment.	World Development Indicators

Compliance with ethical standards

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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