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Article

Liquidity Synchronization, its Determinants and Outcomes under Economic Growth Volatility: Evidence from Emerging Asian Economies

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Abstract: This study investigates the country level determinants of liquidity synchronization and degrees of liquidity synchronization during economic growth volatility. As a non-diversifiable risk factor, liquidity co-movement shock spreads market wide and thus disrupts the overall functioning of the financial market. Firms in Asian markets operate in legal and regulatory environments distinct from those of firms analyzed in the previous literature. Comprehensive analyses of liquidity synchronicity in emerging markets are limited. A major knowledge gap pertaining to Asian emerging markets serves as the primary motivation for this study. Seven Asian emerging economies are selected from the MSCI emerging market index: Bangladesh, China, India, Indonesia, Malaysia, Pakistan and the Philippines for analysis from 2010 to 2019. The empirical findings show high levels of liquidity synchronicity in weaker economic and financial environments with low GDP growth, high inflation and interest rates and underdeveloped financial systems taking the form of low levels of private credit. Liquidity synchronicity is also affected by poor investor protection, political instability, weak rule of law and government ineffectiveness. Moreover, levels of liquidity synchronicity are higher in period of economic growth volatility.

Keywords: liquidity synchronization, liquidity risk, economic growth volatility, emerging Asian economies.

JEL Classification: F43; G11; G15

1. Introduction

Liquidity is a broad, yet elusive concept. In general, liquidity is defined as the capacity for a market to absorb significant transactions without much impact on pricing. Liquidity is associated with the functioning and operational efficiency of the market, which are necessary for the stabilization of a country's financial system. Liquidity is important for asset managers and active investors involved in portfolio management, who need to change their positions on a frequent basis to earn a profit from trading activities. It is generally believed that the measurement of liquidity should be executed across multiple assets at the portfolio level rather than at a single stock level. First, portfolio transactions involve the trading of multiple assets. Second, asset returns are correlated.

While liquidity is not an independent attribute of a specific security, the two share common components (Chordia et al. 2000; Hasbrouck and Seppi 2001; Rupeika-Apoga and Slovjova 2016; Huberman and Halka 2001). Liquidity has a spillover effect that affects the overall market. The liquidity of an individual stock co-moves with market wide liquidity. In other words, covariance exists between market and stock liquidity. This covariance plays a significant role in portfolio selection, resource allocation and asset pricing. Stock liquidity sensitivity to market liquidity is a serious concern when illiquidity arises at an inopportune time (Shyu 2017). When market liquidity declines, there is different downside pressure on different stocks. In particular, downside liquidity pressure is more intense for stocks, for which there is a strong correlation between market and

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stock liquidity. Liquidity synchronicity is stronger during periods of market volatility and low when the market is tranquil (Będowska-Sójka and Echaust 2019). Such fluctuations in stock trading stem from the political and economic affairs of a given country. The decisions of market players are directly or indirectly influenced by overall market conditions. Information and news about the current state of the economy are constantly processed by investors. This processing gives rise to a trade stimulus. Since trading volume is directly related to stock liquidity, aggregate market liquidity is likely to convey information about the real economy. In periods of market turmoil, there is an increase in liquidity demand because traders are focused on liquidating their positions across various securities, and the supply of liquidity decreases due to funding constraints imposed by liquidity suppliers (Karolyi et al. 2009). It is generally observed that stock market liquidity dries up during an economic downturn. Under difficult economic conditions, investors either shift their investments away from equity markets completely or allocate equity to safer securities that guarantee wealth safety (Switzer and Picard 2016).

Liquidity synchronization was not a widely discussed issue prior to the recent global financial crisis. Systematic liquidity risk is omitted in most financial models. However, the global financial crisis has brought this risk to the attention of relevant individuals. It has been revealed that risks of liquidity shortage can play a role in transmitting contagion through regional, national and global financial systems. The idea that asset illiquidity is caused by liquidity co-movement has gained much attention over the last two decades. How liquidity impacts investors and the underlying forces that drive liquidity synchronicity under different financial environments are major concerns of the finance literature. Researchers have offered several other propositions regarding co-movement in liquidity. Such propositions focus on effects of noise trading (Huberman and Halka 2001), asymmetric information and weak governance practices (Karolyi et al. 2012), market volatility (Hameed et al. 2010), macroeconomic announcements (Brockman et al. 2009), institutional investors (Chen et al. 2013), the role of financial intermediaries (Będowska-Sójka and Echaust 2019), and foreign institutional ownership (Deng et al. 2018). Due to the unique characteristics of each market, the relevance of each factor involved differs for different markets. Given the catalytic role of liquidity synchronicity, this study aims to investigate country specific determinants and degrees of liquidity synchronization in play under economic growth volatility in 7 emerging Asian stock markets, including those in China, India, Indonesia, Malaysia, the Philippines, Pakistan and Bangladesh.

The findings of this study offer several valuable insights. The extent to which liquidity synchronicity impacts market efficiency has long been of concern to investors, analysts, academicians and regulators. As a non-diversifiable risk factor, liquidity co-movement shock spreads market wide and thus disrupts the overall functioning of the financial market. Firms in Asian markets operate in legal and regulatory environments distinct from those of firms analyzed in the previous literature. Liquidity is one of the most significant hurdles to foreign investment in emerging Asian economies. However, the globalization of financial markets and major risks and uncertainties associated with developed markets has driven fund managers to expand their portfolios into emerging markets. As the liquidity of a single security is sensitive to market liquidity, an analysis of factors that affect the sensitivity of stock liquidity to overall market liquidity is much needed. Comprehensive analyses of liquidity synchronicity in emerging markets are limited 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 importance of liquidity synchronization, the current lack of research on various dimensions of liquidity synchronization and the unique market structures of emerging economies, a comprehensive analysis of this issue is much needed. A major knowledge gap pertaining to Asian emerging markets serves as the primary motivation for this study. First, we identify driving factors of liquidity synchronization at the country level. Specifically, we focus on financial environments and investor protection with an economy. Unlike the

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previous literature, we introduce new dimensions of investor protection, including regulatory quality, political stability, the rule of law, the control of corruption and government effectiveness. The presence of strong governance and rule of law, government effectiveness and political stability ensures strong investor protection in a country. Second, we investigate the impact of economic growth volatility on liquidity synchronicity.

The paper is organized as follows. A brief review of the previous 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

2.1. Liquidity Synchronization

Liquidity synchronization 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 recently argued that liquidity is not merely an attribute of a single security and it encompasses the entire market, which has been coined systematic or liquidity synchronicity (Chordia et al. 2000; Huberman and Halka 2001; Hasbrouck and Seppi 2001; Rupeika-Apoga and Nedovis 2016; Choe and Yang 2010). Several studies have documented the presence and dynamics of liquidity synchronicity. Within this context, Chordia et al. (2000) conducted the first study on liquidity synchronicity. Their analysis focuses on impacts of daily fluctuations in industry and market liquidity on the liquidity of a single stock. The results reveal a notable impact of industry and market wide liquidity on a single firm's liquidity. Similarly, Hasbrouck and Seppi (2001) investigated Dow 30 stock and found a single common component that drives liquidity. Huberman and Halka (2001) similarly selected 240 stocks of the NYSE at random from 254 observations to identify the presence of liquidity synchronicity. The author further investigated the role of asymmetric information and inventory risk in liquidity synchronicity. However, no evidence was provided on impacts of the selected variables on liquidity synchronicity. In a related study, Wang (2010) analyzed developed and emerging economies and found that a group of global and regional factors have more significant impacts on liquidity synchronicity than a single factor. The study shows that global factors affect liquidity synchronicity through shocks in volatility and returns while regional factors affect liquidity synchronicity through shocks in volatility and liquidity.

To gain insight into liquidity co-movement, Galariotis and Giouvris (2007) studied the co-movement of liquidity in the United Kingdom during different trade regimes. The London Stock Exchange changed its trade regime for FTSE250 stocks from a quote driven regime to a hybrid regime and that for FTSE100 stocks from a quote driven regime to an order driven regime in the period studied. The study shows that for FTSE250 stocks, liquidity synchronicity is strong for the portfolio level while for FTSE100 stocks, phenomena are strong not only at the portfolio level, but for individual stocks as well. However, overall synchronicity remained similar on average across different trading regimes irrespective of the type of liquidity provision involved. Huberman and Halka (2001) similarly identified liquidity synchronicity in NYSE quote driven markets. The authors conclude that liquidity emerges due to existence of noise traders in the market. In a related study, Kempf and Mayston (2008) analyzed liquidity synchronicity in the Frankfurt Stock Exchange. Since for medium and small trades, the inside spread shows only the systematic risk of liquidity, the authors expanded their study of liquidity synchronicity beyond best prices to identify high levels of trade systematic liquidity risk. They found large stocks portfolios to carry much higher levels of systematic liquidity risk than small stock portfolios. Further, systematic liquidity risk is high when markets are falling and in the morning. Similarly, Fabre and Frino (2004) studied the presence of liquidity synchronicity in the Australian Stock Exchange (ASX), which is a purely order driven market. In contrast to earlier research, some evidence of market wide liquidity

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synchronicity is found in ASX stock, though with less pervasiveness and significance as that found in other markets. These results conform to the fact that the ASX and other markets of the developed world have different structures. Likewise, Fernando and Herring (2003) showed that common shocks of liquidity caused by the recent financial crisis are long lasting and cannot be diversified. This is the case because for an order driven market, negative shocks render liquidity a scarce commodity, as more market players withdraw from the security market due to considerable order imbalances. Tayeh (2016), in investigating the Amman Stock Exchange, argued that due to differences in market structures, impacts of market wide liquidity on individual stock liquidity differ during the pre- and post-automation of a trading system. Generally, the results show varied levels of liquidity commonality on manual and automated trading platforms.

While the focus of the synchronicity literature has been on the equity market, empirical studies have also explored liquidity synchronicity in various other markets. For example, Friewald et al. (2013) explored synchronicity in liquidity in the bond market. Marshall et al. (2013) studied synchronicity in commodity markets. Corò et al. (2013) examined the synchronicity of liquidity in credit swap markets. Anthony et al. (2017) studied liquidity synchronicity in secondary corporate markets and found that liquidity synchronicity increases in varied ways during a global financial crisis. Mancini et al. (2013) conducted a first systematic study on liquidity synchronicity in foreign exchange markets.

2.2. Determinants of Liquidity Synchronization

Several empirical studies have been conducted across the globe to identify possible causes of liquidity synchronicity. For instance, Chordia et al. (2000) identified the cost of inventory and asymmetric information as possible causes of liquidity synchronicity. Coughenour and Saad (2004) studied co-variation in liquidity among securities traded by a single firm in the quote driven market. The authors found that shared information and capital among specialists within a firm result in co-movement in their liquidity provisions. Hameed et al. (2010) found that market fluctuations affect capacities to fund financial intermediaries and result in covariation in their liquidity provisions. Domowitz et al. (2005) found that in an order driven market, order type correlations act as an economic force that causes liquidity synchronicity.

To investigate which factors drive liquidity co-movement, Choe and Yang (2010) investigated the Korean Stock Exchange to determine causes of liquidity synchronicity. Inventory costs, investor sentiment, information asymmetry and volatility are studied as potential causes. The empirical analysis shows that higher levels of liquidity synchronicity are caused by information asymmetry, investor sentiments, volatility and style-based trading. However, inventory costs do not have significant effects on liquidity synchronicity. Further, more individual trading is related to more synchronicity in liquidity, which is a sign of strong investor sentiment in the Korean Stock Exchange. Hillier et al. (2007) similarly studied the relationship between firm size and liquidity synchronicity. The authors developed a model of spreads and information to provide insight into these factors. Their empirical evidence shows that the interval over which liquidity movements are measured has significant impacts on the presence and magnitude of common variability in liquidity. Such intervals form due to delays in information incorporation into bid and ask spreads. Similarly, Hameed et al. (2010) found that asset market values have an asymmetric impact on liquidity. In line with theoretical models, negative returns reduce liquidity much more than increases in liquidity due to positive returns. Thus, liquidity synchronicity and levels of liquidity are affected by market declines. It has also been found that within an industry, liquidity synchronicity increases to a formidable level when returns on other industries are negative and significant. Likewise, Brockman et al. (2009) studied liquidity synchronicity using data from 47 stock exchanges and intraday spreads. The authors found that exchange level changes across world stock exchanges greatly influence firm level changes in liquidity. The stock exchanges of emerging Asian economies exhibit more synchronicity than stock exchanges in Latin America. After exploring the role of liquidity synchronicity in individual stock exchanges, the researchers

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examined the phenomenon across exchanges and found that bid-ask depths and spreads affect global sources. Local sources contribute almost 39% of an individual firm's liquidity synchronicity while global sources contribute 19% to the overall synchronicity of the same firm. Sources of global synchronicity and exchange levels are also considered by the researchers. It is found that both U.S. macro-economic and domestic statements affect synchronicity. Brockman and Chung (2002) studied the Hong Kong Stock Exchange, which is one the world's largest order driven markets. They found that liquidity synchronicity includes components from both industries and markets. As opposed to what is found for quote driven markets, no positive relationship is found between a firm's size and its sensitivity to variations in market wide bid ask spreads. However, market stress has a stronger effect on the synchronicity of large firms than on that of smaller firms.

Liquidity synchronicity can be a result of both demand and supply side variables. Koch et al. (2016) postulated that interrelated trading done by investors for a single stock explains liquidity synchronicity across stocks. From data on stock liquidity and mutual fund ownership in AMEX and NYSE stocks for 1980 to 2008, the authors concluded that mutual funds play an important role in liquidity synchronicity. The results show a correlation between stocks owned by mutual funds experiencing liquidity shocks and stocks with high turnover. Both types of stocks exhibit higher levels of liquidity synchronicity. In a related study, Wang (2013) examined the effect of volatility and market returns on liquidity variations in 12 equity markets. The sample used includes both emerging and developed markets. The study shows that common factors significant impact liquidity variations in equity markets. Furthermore, volatility is found to be the least important factor in determining cross market average liquidity. Regional factors are found to have effects through volatility and liquidity shocks, and markets dynamics within the United Kingdom and United States are found to have few effects on emerging markets. Sensoy (2016) similarly studied Turkey's stock market to investigate the effects of macroeconomic and monetary policy statements on liquidity synchronicity. The study interestingly finds that only shifts in U.S. macroeconomic and monetary policy cause liquidity synchronicity in the market. Furthermore, there is a significant upward surge in liquidity synchronicity beyond best price quotes, showing that incorrect results on liquidity synchronicity can be obtained when researchers consider spreads at best prices. Corwin and Lipson (2011) studied the NYSE and found that liquidity synchronicity levels are relatively lower in large firms than in smaller firms. Kuo et al. (2017) explored the Taiwan Stock Exchange to study the tick size impact on liquidity synchronicity. Their results reveal that a small tick size can have a significant impact on market quality and liquidity risk.

Chen et al. (2013) empirically evaluated the Chinese Stock Market to identify sources of synchronicity that result in liquidity change. The authors studied the interdependence of changes in liquidity synchronicity and the involuntary trading behaviors of institutional investors. Their results show that the involuntary trading behaviors of investors of an open end fund have reasonable impacts on the liquidity synchronicity of China's Stock Exchange. Deng et al. (2018) also studied 39 stock markets of different countries for 2000 - 2014 to analyze the relationship between liquidity synchronicity and the institutional ownership of foreign investors. The results reveal an inverse relationship between global foreign institution ownership and the liquidity synchronicity of stocks. Foreign investors are in a better position to decrease liquidity synchronicity through corporate transparency. US based and independent foreign investors can exercise greater control over the liquidity synchronicity of a stock. Furthermore, there is a U-shaped relationship between the liquidity synchronicity of a stock and foreign institutional relationship. Thus, a foreign institutional investor can substitute a country's corporate governance level, minimize effects of local culture, and manage uncertainties of economic policy. The study also shows that liquidity synchronicity bridges the relationship between firm valuation and foreign institutional ownership. This ownership can increase firm valuation through stock liquidity and its liquidity synchronicity. Similarly, Gold et al. (2017) examined liquidity synchronicity in the Canadian Stock Market from 2008 to 2015. The

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authors found that changes in liquidity are common across the market and more significant in specific industries. They found that industry and market specific liquidity factors have major effects on individual asset liquidity. Thus, the liquidity of an individual asset is predominantly affected by industry and market wide liquidity. In a similar study, Narayan et al. (2015) evaluated four hypotheses on liquidity synchronicity in Chinese Stock Markets. The authors hypothesize that liquidity changes with firm size, that market wide liquidity directly affects individual stock liquidity, that there is an asymmetric effect on liquidity synchronicity and that individual stock liquidity is affected by related sector liquidity. Data on 48 million and 34 million transactions pertaining to the Shenzhen and Shanghai stock exchanges are analyzed. The results show that among the three key sectors studied, the liquidity of the industrial sector provides important evidence for explaining individual stock liquidities. The study also finds evidence of liquidity synchronicity and of strong impacts of industry wide liquidity on an individual stock's liquidity. The empirical evidence found does not support size or asymmetric effects of market liquidity on the liquidity of an individual stock. In a similar work by Barberis et al. (2005), it is shown that most investors categorize firms into different groups while trading resources are allocated among group of firms rather than to individual firms. The correlated trading behaviors of investors induce the liquidity and return co-movement of stocks. Pirinsky and Wang (2006) found a common tendency for investors to assign more weight to local firms while forming portfolios. Correlated trading resulting from this local bias induces liquidity co-movement in the same region.

Green and Hwang (2009) reported that stock categorization by investors is based on security returns. Price-based preferences encourage price-based synchronicity. The authors found strong patterns of co-movement in stocks with similar prices. Greenwood (2008) similarly found that stocks newly added to the index co-vary with increasing intensity relative to existing member stocks. Kamara et al. (2008) investigated the common shares of US firms to study liquidity synchronicity for 1963 through 2005. Their findings show that synchronicity significantly amplified for larger firms while for small firms the authors found a significant decline in liquidity synchronicity. Considering developments that affected US equity markets in the sampled period, the authors further studied data on the institutional ownership of common equity and found that an increase in institutional ownership is related to an increase in the sensitivity of stocks to systematic liquidity shocks. Index trading and institutional investing are more prevalent among large stocks than small stocks. It is also found that percentage differences in institutional ownership between large and small stocks can better explain variances in their respective liquidity betas. These results suggest that changes in the structures of stock markets cause an increase in large stocks' exposure to liquidity synchronicity.

Karolyi et al. (2012) studied behaviors of liquidity synchronicity across countries over time while considering demand determinants such as correlated the trading behaviors of institutional and international investors, investor sentiment, incentives available for investment in stocks and supply determinants such as liquidity available to financial intermediaries for funding. The study finds higher levels of liquidity synchronicity in countries with more market volatility, significant proportions of foreign investors and higher levels of correlated trading. Brunnermeier and Pedersen (2009) similarly found that high levels of market volatility and sharp declines in the market significantly impact liquidity available to financial intermediaries. As a result, liquidity in the market is reduced and synchronicity in liquidity is increased. Kamara et al. (2008) and Koch et al. (2016) found that the correlated trading behaviors of investors from institutions can increase liquidity synchronicity. Furthermore, liquidity synchronicity can arise when demand for liquidity across stocks is correlated. This happens when individual investors cannot identify better incentives to trade in individual stocks. Morck et al. (2000) found a correlation between such incentives and regulations on transparency and investor protection and showed that investor sentiment also affects liquidity synchronicity. Similarly, Bouchaddekh and Bouri (2015) studied the Tunisian financial market from 2011 to 2013. Variables empirically studied include the number of transactions, volatility, access to

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new information, trading volumes, etc. The researchers found that the return, volume and arrival of new information have strong effects on liquidity synchronicity.

Watanabe and Watanabe (2008) found that macroeconomic factors affect the liquidity of the stock market in times of volatility. Chordia et al. (2008) explained that in response to expansionary monetary policy, the liquidity of the stock market increases. It is further elaborated that macroeconomic shocks indirectly affect market returns, liquidity and turnover. Jensen and Moorman (2010) and Lu-Andrews and Glascock (2010) analyzed causes of time variations in liquidity premiums in the United States Stock Exchange. These studies reveal that expansionary monetary policy reduces the price of liquidity and that during an economic recession, investors demand a better return for holding illiquid stocks. Shyu (2017) examined whether marking to market disclosure affects synchronicity in liquidity in the Chinese Stock Market. The study explores the effect of fair value disclosure on the stock market and its relation to financial crisis. The author studied the relationship between liquidity synchronicity and fair value disclosure by examining how fair value measurement contributes to liquidity synchronicity in the Chinese stock market. Synchronicity in liquidity is a form of systematic risk for individual stocks. Therefore, unexpected liquidity demand will cause stock prices to drop rapidly while investors holding the same stocks must dispose of their security due to the same liquidity problem. As a result, there is a cyclical drop in market price and an overall decline in systematic liquidity in the financial system. Lin (2010) examined the impact of financial market liberalization on liquidity synchronicity in emerging economies. For a sample of 20 emerging economies covering a period of 20 years, it is found that opening local markets to foreign investors increases the liquidity of local markets by limiting asymmetric information. However, financial liberalization also introduces more liquidity risk in the form of liquidity synchronicity. A further investigation shows that higher levels of liquidity synchronicity arise from an increase in inventory risk due to financial liberalization.

Alhassan and Naka (2017), using daily and annual data for 1995 to 2015 for 50 countries in East Asia and the Pacific region, investigated how oil markets impact liquidity synchronicity. Two transmitting channels are found: oil price returns and volatility effects on liquidity synchronicity. The study reveals that oil volatility and returns explain liquidity synchronicity in countries where there is more integration with oil markets. The authors also found that the effect of oil volatility is more evident in oil exporting countries than in oil importing countries. Their findings suggest that oil price volatility in liquidity synchronicity is more substantial for oil sensitive countries than oil price returns except for five OPEC members, where synchronicity in liquidity is heavily affected by oil volatility along with returns. In a similar study, Tissaoui et al. (2017) explore synchronicity in liquidity using data from 105 stocks for 2008 to 2014 for the Saudi stock market. The analysis shows strong liquidity synchronicity in the Tadawul stock market and significant synchronicity in liquidity under normal conditions. The study documents that liquidity synchronicity in the Saudi stock market is stronger under different stock market conditions than under different oil market conditions. In exploring the magnitude of this impact, a time series analysis reveals that liquidity synchronicity is vital across all size-based quartiles, through the magnitude of corresponding impacts varies. Firms with less market capitalization are more vulnerable to synchronicity in liquidity while those with the considerable market capitalization are the least susceptible to synchronicity in liquidity. However, under boom and bust conditions of the oil market, the results are different, where the quartile of small market capitalization is generally the least sensitive to market wide liquidity while the second quartile is more susceptible to synchronicity in liquidity.

Pan et al. (2015) studied the Shanghai Stock Exchange to measure impacts of investors' trading activities on liquidity co-movements and common returns. The authors divided their population into retail and institutional investors. Their results reveal that retail traders contribute much less to synchronicity in liquidity than institutional traders. However, retail investors make more substantial contributions to return co-movements.

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Such contributions are more visible in firms with high levels of information asymmetry. In a related study, Dang et al. (2015) explored the impact of international cross listing on liquidity synchronicity. A large dataset covering more than 20,000 firms and 39 markets for 1996 to 2007 is studied. Their results suggest that the impact of aggregate liquidity shocks is reduced for stocks that have been cross listed. It is also found that for countries with poor institutional infrastructure, opaque information conditions and high levels of market segmentation, cross listing has a negative effect on home liquidity synchronicity. In another study, Isshaq and Faff (2016) investigated the relationship between liquidity synchronicity and uncertainty in firm fundamentals. Volatility in operating profits is used to measure fundamental uncertainty. The authors argue that liquidity synchronicity is stronger for firms with less volatility in profitability; supporting the prediction that liquidity synchronicity is negatively associated with operating profitability volatility.

2.3. Liquidity Synchronicity and Economic Growth

To gain insight into the empirical relation between stock market liquidity and business cycles, Næs et al. (2011) conducted a study on stock markets of the US and Norway. The authors found that stock market liquidity is a predictor of the future and current state of an economy. 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 fact that the liquidity of small firms is more reflective of economic conditions. In a related study, Switzer and Picard (2016) studied the association between market wide liquidity and business cycles in the NYSE. Weak evidence is found regarding the relationship between liquidity fundamentals and economic conditions.

3. Data and Methodology

3.1. Data Description

To investigate our research questions, a liquidity synchronicity measure is constructed from a dataset of financial information on 1,695 firms across 7 emerging Asian markets for a 10-year period running from January 4, 2010 to December 31, 2019. The following emerging economies are selected from the MSCI emerging market index: Bangladesh, China, India, Indonesia, Malaysia, Pakistan and the Philippines. 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.

Our variables are constructed from various sources. Data for stocks are obtained from Datastream and country level variables are acquired from the World Development Indicators, World Governance Indicators and Worldscope datasets. Sources and descriptions of the variables are provided in Appendix B.

3.2. Methodology

In order to check data stationarity Augmented Dickey-Fuller test is applied. All the variables are found stationary at level confirming no pattern in data series. The degree of association between the variables is analyzed by applying Pearson Correlation test. Ordinary Least Square technique is applied to investigate the liquidity synchronization for each stock. Fixed Effect Model of Panel Data Analysis is used to study the impact of country level determinants and economic growth volatility on liquidity synchronization.

3.2.1. Liquidity Synchronization

Liquidity synchronization 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; Rupeika-Apoga and Zaidi 2018; Anthony et al. 2017; Moshirian et al. 2017; Tissaoui et al. 2017). A market model is used by applying time series regression to investigate the liquidity synchronization of each stock in each year:

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

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

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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).

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). We use the liquidity measure because high-frequency data are not available for all firms of the selected countries for the sample period. Moreover, low-frequency proxies can effectively capture liquidity benchmarks (Fong et al. 2018). The ratio is measured as:

$$\text{Amihud ILLIQ}_t = |r_t|/P_t * Vol_t$$

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

$$r_t = [100 * (\ln(P_t) - \ln(P_t - 1))]$$

where P_t and P_{t-1} are the closing price on days t and t-1, respectively.

Vol_t is measured from the following formula:

$$Vol_t = [(\ln(N_t)]$$

where N_t is the number of stocks traded on day t. Daily data are used to measure the liquidity of stock *i*.

Equation (1) 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 (γ), the logarithmic transformation of R^2, to measure liquidity synchronicity so that the dependent variable can be used in our subsequent analysis.

$$\gamma = \log(R_i^2/(1-R_i^2))$$

The logarithmic transformation is the ratio of explained versus unexplained variance. Since R^2 is bound range between zero and one, liquidity synchronicity 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.

3.2.2. Country Level Determinants of Liquidity Synchronization

A panel regression is used to examine the country level factors that affect liquidity synchronization. Gamma (γ) is our dependent variable regressed on country specific variables to identify the determinants of liquidity synchronicity.

$$\gamma_{j,t} = \beta_o + \beta_1 GDP_{i,t} + \beta_2 PCG_{i,t} + \beta_3 MR_{i,t} + \beta_4 EX_{i,t} + \beta_5 INF_{i,t} + \beta_6 IR_{i,t} + \beta_7 PS_{i,t} + \beta_8 CC_{i,t} + \beta_9 RL_{i,t} + \beta_{10} GE_{i,t} + \beta_{11} RQ_{i,t} + \varepsilon_{i,t} \quad \text{Eq (2)}$$

3.2.3. Liquidity Synchronization under Economic Growth Volatility

Economic growth volatility refers to economic fluctuations that occur between stages of expansion and contraction. All countries experience variations in output growth. The incremental effect of economic growth volatility on liquidity synchronicity is tested by introducing GDP growth volatility as an interaction term of variation in market liquidity in equation (1).

$$\Delta L_{i,t} = \beta_o + \beta_1 \Delta L_{M,t} + \beta_2 \Delta L_{M,t+1} + \beta_3 \Delta L_{M,t-1} + \beta_4 (\Delta L_{M,t} * \sigma GDP) + \beta_5 (\Delta L_{M,t+1} * \sigma GDP) + \beta_6 (\Delta L_{M,t-1} * \sigma GDP) + \beta_7 R_{M,t} + \beta_8 R_{M,t+1} + \beta_9 R_{M,t-1} + \beta_{10} RV_{i,t} + \varepsilon_{i,t} \quad \text{Eq (3)}$$

4. Results and Discussion

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4.1. Liquidity Synchronization

Table 1 presents descriptive statistics for R^2 for the 7 emerging Asian economies studied. R^2 measures the proportional variation in stock liquidity explained by the proportional variation in market liquidity. A higher R^2 denotes a greater influence of market liquidity on individual stock liquidity.

Table 1. Results of Market Levels R^2.

Market	Mean	Standard Deviation	Min	Median	Max
Bangladesh	0.223	0.054	0.128	0.215	0.557
China	0.388	0.147	0.211	0.408	0.703
India	0.349	0.137	0.187	0.321	0.689
Indonesia	0.226	0.039	0.132	0.214	0.379
Malaysia	0.265	0.044	0.136	0.237	0.458
Pakistan	0.296	0.099	0.147	0.256	0.714
Philippines	0.256	0.049	0.113	0.238	0.383

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China shows the highest levels of liquidity synchronization in the sample period. On average, almost 39% of liquidity variation in individual stocks is associated with liquidity variations in the market. The lowest level of liquidity synchronicity is found in Bangladesh, where roughly 22.3% of variation in individual stock liquidity is explained by variations in market liquidity. The most volatility in liquidity synchronicity is found in China (a 14.7% standard deviation). On the other hand, Indonesia is the most stable with 3.9% volatility. The least synchronicity is found in the Philippines while the most is found in Pakistan's equity market (11.3% and 71.4%, respectively).

4.2. Country Level Determinants of Liquidity Synchronization

Correlation matrices for liquidity synchronization and its determinants are presented in Table 2. Real GDP growth and access to private credit is found to have negative association with liquidity synchronicity. This implies that the sensitivity of stock liquidity to market liquidity is higher under weak economic conditions and low financial inclusion. Market return is found to have positive linkage with liquidity synchronization, which confirms the notion that investors demand high compensation for holding stocks with high levels of liquidity sensitivity with market liquidity. A positive relation of liquidity synchronicity is found with inflation rate, interest rate and exchange rate. This supports the fact that economic instability in the form of high interest rate, high exchange rate and high inflation augment the stock market instability. We find a negative association between liquidity synchronicity and measures of government stability and investor protection. This reveals that an instable government with less investors' protection results in high systematic market risk in the form of liquidity synchronicity.

Table 2. Pearson's Correlation Matrix.

Variables	Gamma	GDPG	Credit	MR	INTR	INFR	EXR	PS	RQ	CC	RL	GE
Gamma	1.000											
GDPG	-0.076											

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		1.000										
Credit	-0.138	0.394	1.000									
MR	0.063	0.148	0.009	1.000								
INTR	0.097	-0.417	-0.427	0.076	1.000							
INFR	0.247	0.524	0.039	0.160	0.506	1.000						
EXR	0.159	-0.083	-0.066	-0.128	0.097	0.294	1.000					
PS	-0.311	0.041	0.047	0.358	-0.256	-0.214	-0.047	1.000				
RQ	-0.199	0.013	0.071	-0.058	0.0821	-0.176	0.026	0.563	1.000			
CC	-0.044	-0.056	0.080	0.140	-0.258	0.028	-0.096	0.179	0.173	1.000		
RL	-0.294	0.220	0.169	0.025	0.118	0.147	0.139	0.087	0.478	0.301	1.000	
GE	-0.137	0.157	-0.029	0.153	-0.157	-0.098	0.043	0.554	0.441	0.419	0.086	1.000

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For a preliminary investigation, we use various regression models to study the impact of each country specific determinant on liquidity synchronicity. The results are reported in Table 3. Most of the variables have significant impacts with the predicted signs. Liquidity synchronicity is found to be stronger under low country GDP growth, high interest rates, high inflation rates, low ratios of private credit to GDP, high levels of political instability, poor rule of law and government ineffectiveness.

Table 3. Cross-country regression for individual country level determinants of liquidity synchronicity.

Country Specific Variables	Predicted Sign	Coefficient	t-stat	R2 (%)	Adj. R2 (%)
Economic and Financial Conditions					
GDP Growth	-	-3.237	-2.017	4.3	1.9
Private Credit to GDP	-	-0.408	-2.861	11.1	8.6
Stock Market Returns	-	0.058	0.131	4.1	1.8
Interest Rate	+	0.036	2.423	5.5	3.1
Inflation Rate	+	0.025	2.681	8.4	5.8
Exchange Rate	+	0.001	0.076	4.4	2.1
Government Stability and Investor Protection					
Political Stability	-	-0.447	-3.762	6.6	4.4
Regulatory Quality	-	-0.143	-0.083	4.8	2.5
Rule of Law	-	-0.243	-2.278	8.4	5.9
Control of Corruption	-	-0.047	-1.306	5.3	3
Government Effectiveness	-	-0.089	-2.138	7.3	4.8
Control Variables					
Geographic Size		0.002	0.365	3.5	1.1
Per Capita GDP		-0.145	-2.963	8.6	6.9
Number of Stocks		0.061	1.589	4.8	2.4

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To analyze the incremental contributions of each determinant, we use a multiple regression. The results are reported in Table 4. Model (1) includes financial and economic environment determinants. We find high levels of liquidity synchronicity for economies

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exhibiting low GDP growth, high inflation rates and high interest rates with underdeveloped financial systems taking the form of low levels of private credit. Determinants related to investor protection are included in Model (2). Political stability, the rule of law and government effectiveness are found to show significant inverse relationships to liquidity synchronicity. Model (3) includes all of the variables of interest. The inflation rate is found to have a significant positive effect whereas GDP growth, financial system development, political stability, the rule of law and government effectiveness is significantly negatively related to liquidity synchronicity. Our findings are consistent with those of Koch et al. (2016), Næs et al. (2011) and Karolyi et al. (2012). We find that in markets with limited investor protection, levels of liquidity synchronicity are higher.

Table 4. Coefficient estimates of country level determinants of liquidity synchronicity.

Country Specific Variables	Predicted Sign	Model 1	Model 2	Model 3
GDP Growth	-	-2.357		-5.266
		(-2.183)		(-2.032)
Private Credit to GDP	-	-0.118		-0.214
		(-2.962		(-3.112)
Stock Market Returns	-	-0.021		-0.001
		(-1.094)		(-0.256)
Interest Rate	+	0.148		0.0095
		(1.981)		(1.348)
Inflation Rate	+	0.028		0.0563
		(2.151)		(1.983)
Exchange Rate	+	0.011		0.004
		(1.270)		(0.412)
Political Stability	-		-0.198	-0.081
			(-2.336)	(-2.658)
Regulatory Quality	-		0.153	0.002
			(1.127)	(1.203)
Rule of Law	-		-0.67	-1.076
			(-2.202)	(-2.852)
Control of Corruption	-		-0.001	-0.007
			(-1.202)	(-1.118)
Government Effectiveness	-		-0.056	-0.161
			(-1.993)	(-2.580)
Geographic Size		0.018	0.058	0.071
		(0.175)	(0.631)	(1.153)
Per Capita GDP		-0.112	-0.186	-0.148
		(-2.154)	(-2.482)	(-1.852)
Number of Stocks		-0.047	-0.023	-0.082
		(-0.721)	(-1.213)	(-1.373)
Adj.R2 (%)		17.4	12.6	23.1
F-Stat		4.32	3.25	9.66

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4.3. Impact of Economic Growth Volatility on Liquidity Synchronization

Liquidity synchronicity under economic growth volatility is presented in Table 5. The mean coefficient of concurrent market liquidity is positive and statistically significant. This coefficient is positive and significant for 54.51% of firms and negative and significant for 6.54% of firms. The findings reveal that on average, the liquidity of an individual stock is positively associated with market liquidity. In analyzing the impact of economic growth volatility, we find that the mean of the estimated coefficient increases from 0.235 to 0.586 with the interaction of growth volatility. Further, this coefficient is

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positive and significant for 56.87% of firms and negative and significant for 4.31% of firms. Thus, the sensitivity of individual stock liquidity to market liquidity increases in times of economic volatility. There is an increase in liquidity demand because traders are focused on liquidating their positions across various securities and on decreasing the supply of liquidity due to the funding constraints of liquidity suppliers.

Table 5. Impact of economic growth volatility on liquidity synchronicity.

	Normal Market								Economic Growth Volatility							
	Concur-rent		**Lead**		Lag		Sum		Concurrent		Lead		Lag		Sum	
	β1	**t-stats**	**β2**	**t-stats**	β3	t-stats	β1+β2+β3	t-stats	β4	t-stats	β5	t-stats	β6	t-stats	β4+β5+β6	t-stats
Mean of estimated coefficient	0.235	2.541	0.159	1.404	0.211	1.89	0.605	5.835	0.586	3.820	0.132	1.231	0.336	1.985	1.054	7.036
Number of firms with a positive coefficient (%)	1289		1050		1303				1353		1072		1368			
	(76.05)		(61.94)		(76.87)				(79.82)		(63.24)		(80.71)			
Number of firms with a positive coefficient and insignificant t-stats (%)	365		211		398				389		221		314			
	(21.53)		(12.44)		(23.48)				(22.94)		(13.03)		(18.52)			
Number of firms with a positive coefficient and significant t-stats (%)	924		839		905				964		851		1054			
	(54.51)		(49.50)		(53.39)				(56.87)		(50.21)		(62.18)			
Number of firms with a negative coefficient (%)	406		645		392				342		623		327			
	(23.95)		(38.05)		(23.13)				(20.18)		(36.76)		(19.29)			
Number of firms with a negative coefficient and insignificant t-stats (%)	295		423		256				269		451		236			
	(17.41)		(24.95)		(15.10)				(15.87)		(26.61)		(13.92)			
Number of firms with a negative coefficient and significant t-stats (%)	111		222		136				73		172		91			
	(6.54)		(13.09)		(8.02)				(4.31)		(10.14)		(5.36)			
Adj-R2 (%)							41.3									

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5. Conclusion and Implications

This study investigates the country level determinants of liquidity synchronicity and the impacts of economic growth volatility on liquidity synchronicity for 7 emerging Asian economies. Strong evidence of liquidity synchronization is found for these economies. Among the selected economies, China shows the highest and Bangladesh shows the lowest levels of liquidity synchronization. Two sets of country level variables are studied: the economic and financial environments of a country and government stability and investor protection. We find significant effects of country level variables on liquidity synchronicity. The results reveal that levels of liquidity synchronicity are higher under weak economic and financial conditions, political instability, government ineffectiveness and poor rule of law. The results show that economic growth volatility appears to have a significant effect on liquidity synchronicity. The market model is augmented with the interaction with economic growth volatility. The estimated coefficients of the augmented

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model reveal a significant increase in the impact of market liquidity on individual stock liquidity.

The current study has many important implications. Liquidity synchronicity is a systematic risk factor. Investors demand high compensation for stocks with high levels of liquidity sensitivity and market liquidity. The results of the present study can assist investors with appropriate portfolio formation by managing risks of liquidity synchronicity. Understanding liquidity synchronicity is essential for asset managers who use different trading strategies to diversify their investments. For regulators and policymakers and particularly for those in emerging economies, understanding liquidity and recognizing the dynamics and magnitude of liquidity synchronicity are important for policy coordination and market development. By focusing on the factors responsible for liquidity synchronicity, policymakers can reduce market susceptibility to liquidity decline in times of market stress. Further understanding of such phenomena can facilitate the formation of policies for preventing market turmoil due to liquidity shocks.

Author Contributions:

conceptualization: SHZ and RRA; methodology: SHZ and RRA; formal analysis: SHZ; investigation: SHZ and RRA; data curation: SHZ; writing–original draft preparation: SHZ; writing–review and editing: SHZ and RRA; visualization: SHZ. All authors have read and agreed to the final version of the manuscript.

Conflicts of Interest:

The authors declare no conflict of interest.

Appendix A. List of stock exchanges by country

Country	Stock Exchange	Number of Firms
Bangladesh	Dhaka Stock Exchange	93
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

Appendix B. Variable definitions and sources

Variable	Abbreviation	Description	Sources
Economic and Financial Environment of a Country			
GDP Growth	GDP	Annual GDP Growth in year t-1	World Development Indicators
GDP Growth Volatility	σGDP	Standard deviation of annual GDP growth for the past five years.	World Development Indicators
Private credit to GDP	PCG	Ratio of private credit to GDP	World Development Indicators
Market Returns	MR	Benchmark index of the relevant stock market	Datastream
Interest Rate	IR	Real interest rate is the lending interest rate of	World Develop-

		a country adjusted as inflation	ment Indicators
Inflation Rate	INF	Inflation measured by the consumer price index reflecting the annual percentage change in cost to the average consumer acquiring a basket of goods and services	World Development Indicators
Exchange Rate	EX	Exchange rate calculated as an annual average based on monthly averages (local currency units relative to the U.S. dollar)	World Development Indicators
Government Stability and Investor Protection			
Political Stability	PS	Annual political stability and absence of violence index of year t-1	World Governance Indicators
Regulatory Quality	RQ	Annual regulatory quality index of year t-1	World Governance Indicators
Rule of Law	RL	Annual rule of law index of year t-1	World Governance Indicators
Control of Corruption	CC	Annual control of corruption index of year t-1	World Governance Indicators
Government Effectiveness	GE	Annual government effectiveness index of year t-1	World Governance Indicators
Control Variables			
Geographic Size	GS	Log of a country's geographic size in square kilometers.	CIA World Factbook
Per capital GDP	PGDP	Log of per capita GDP measured in USD in year t-1	World Development Indicators
Number of Stocks	STK	Log of the number of registered firms in each stock exchange	Datastream

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