Market Liquidity Risk as an Indicator of Financial Stability:
The Case of Indonesia♠

by

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Abstract

Market liquidity, or liquidity in trading, has become an important aspect of financial stability. The measurement of market liquidity has been especially important for emerging markets as they are exposed to the flow of short term investment fund. We follow the liquidity measurement approach by Bervas (2006) and a combination of Value at Risk (VaR) and Liquidity-adjusted Value at Risk developed by Bangia, et al (1999) and produce the measurement of exogenous cost of liquidity (CoL) from the Indonesian stock market. The paper sheds light on the possibility of the use of this liquidity risk measure as part of the financial stability analysis. We also forecasted the value of CoL to see if it can be used as an early warning indicator. The results shows that especially for the series during the final quarter of 2008, the movement of the forecasted values can predict whether the liquidity risk will be worse. However, the magnitude of the forecasted increase of CoL undervalued the real increase of CoL. The forecast in the second semester of 2009 is roughly similar to the actual measurement as it is considered a more normal period. The methodology is deemed to be fairly simple and intuitive to help provide an objective assessment of the stock market liquidity condition.

JEL Classification Codes: G14, G15

Keywords: Market liquidity Risk, Value at Risk VaR, Liquidity-adjusted VaR,
Financial markets, Indonesia.

1. Introduction

To safeguard the financial stability financial system authorities rely on the assessment based on market indicators. If we assume that market always conveys the right information then financial stability can be measured using the information available in the market. Therefore, financial authorities collect different kinds of

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financial stability measures in order to make an objective and thorough assessment toward the financial market. One indicator that may have been deemed as less important thus far is market liquidity risk. Other things being equal, the performance of financial markets will always be measured by their composite indices representing the weighted average of the prices of assets traded in the markets. However, financial authorities have long realized this type of index is no longer enough to detect financial instability. The Value at Risk (VaR) is measured to represent the risk of loss on investment. The measure of the market liquidity risk may be less important than the indicators of transaction volume, composite index and VaR which represents the performance of the market. Nevertheless, illiquid markets are not favorable for investors especially during turbulence. The global market players have been reminded about this in the recent liquidity problem in the capital markets, especially in developed countries. This makes the indicator of market liquidity risk an important indicator in delivering a thorough assessment of the financial stability. A market has to continue showing that it is liquid in order to attract investors to maintain their fund within the market.

Indonesia currently has a traditional equity market. The impact of the subprime mortgage may not be felt directly in the first round; however, it was felt on the second round. The financial depth of the equity market will determine how much Indonesia can mitigate further shocks from the global markets. Shallow markets are characterized with less diversified investors and fewer choices of financial instruments. Investors have more disincentives to stay long term in shallow markets as they fear the markets are not able to facilitate risk management as well as the deeper financial markets. If foreign investors are dominant in the market, sudden reversal of capital flow is always a threat when the market risk increases. Therefore, shallow financial markets will propagate the crisis worse than the deeper markets because of the liquidity risk.

This paper is aimed to provide an additional financial stability indicator using the measurement of market liquidity risk. We measure the Indonesian equity market liquidity risk. The turbulence caused by the global liquidity problem that spilled over to Indonesian market related to the subprime mortgage crisis creates the dynamics that can be used to deliver the liquidity risk measurement in this case. We not only want to have an objective assessment of the liquidity of the stock market, but also a simple and transparent indicator that can intuitively reflect the dynamic of the market, thus is able to provide early warning indicators to support the task of safeguarding the financial stability. Therefore, the choice of data set is also of importance here. The empirical excercises show that although the financial market of Indonesia seems relatively resilient against the global financial turbulence, the financial market risk is indeed increasing. This prompts further consideration that the financial market may not be deep or diversified enough to weather the liquidity shock.

The rest of the paper is arranged as the following. Chapter 2 provides literature review, especially in relation with the market liquidity risk. Chapter 3 illustrates the stylized facts of the Indonesian stock market as the backdrop of the empirical work. Chapter 4 explains the methodologies used in for the arguments in the paper, which cover the measurements as well as the procedure to produce the forecast values. Chapter 5 describes the empirical work, including the results. Chapter 6 provides discussion on the use of the measurement, including the weaknesses and strengths. Finally, chapter 7 concludes.

2. Market Liquidity Risk

The liquidity risk can be divided into two categories: liquidity risk in trading and liquidity risk in funding. Funding liquidity risk is considered as a part of the asset liability management framework, which is related to the financial institution's balance sheet and the possibility that the financial institution (such as a bank) drains out its liquidity to repay the debt (Marrison 2002). The liquidity risk in trading is also known as "market liquidity risk". Different from the balance sheet liquidity, the liquidity risk in trading arises from the characteristics of the market, such as: atomicity of participants, free entry and exit at no cost, transparent information (Bervas 2006). A liquidity in trading is also called "asset liquidity", which is the asset's ability to be transformed into another asset without loss of value (Warsh 2007).

Kyle (1985) asses the degree of liquidity of the market based on these three aspects: 1) tightness; 2) depth; and 3) resilience. The tightness is measured with the bid-ask spread of assets, which is defined as the cost of a reversal of position (from short into long or vice versa) at a short notice. This is also a direct measure of transaction cost, excluding the operational cost. The market depth is measured with the size of transaction required to change the price of asset. The market resilience is the speed of the prices to return to their equilibrium after a shock in the market. Figure 1 illustrates the three aspects of the market liquidity. The second and third aspects are harder to measure as they require detailed information on every single transaction in the market which may not be available.

Figure 1. Aspects of Market Liquidity
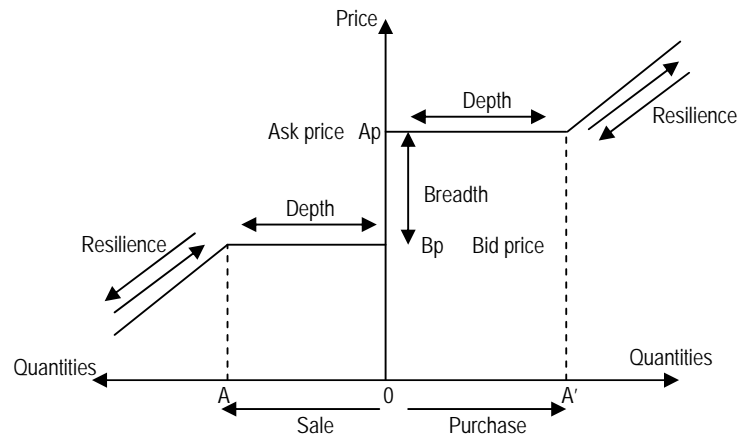
Source: Bervas (2006)

Note: Breadth represents the bid-ask spread. The smaller breadth (tighter bid-ask spread) is associated with a more liquid market.

This paper will only use the tightness aspect to measure the market liquidity following the approach by Bervas (2006). He incorporates the liquidity measure in the calculation of the *value at risk* (VaR)[1]. In the article, Bervas finds that the liquidity risk is accounted for 17% of the market risk of a long position on USD/Thai Baht and for only 1.5% for positions on USD/Yen since the market for the latter position is more liquid. The methodology for liquidity-adjusted VaR used for this paper will be explained in depth in Chapter 3.

Another approach to define liquidity risk is by starting from the market participant's point of view. Investors expect a financial asset to be liquid that is easily sold in large amount without losing the value when it was purchased. A liquid financial asset is characterized by having small transaction cost; easy trading and timely settlement; and large trades having only limited impact on the market price. Sarr and Lybek (2002) combine this starting point with the market characteristics during periods of stress and significantly changing fundamentals and come up with two additional characteristics along with the three aspects mentioned by Kyle (1985). They use the previous definition of "depth" for the characteristic "breadth", while they define "depth" as the existence of abundant orders, either actual or easily uncovered of potential buyers and sellers, both above and below the price at which a security now trades. They also added "immediacy" which defined as the speed with which orders can be executed, reflecting the efficiency of trading, clearing and settlement system[2]. The measurements to reflect these characteristics may be overlapping. Again, this paper will focus on the tightness of the market.

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[1] See Bangia,et.al.(1999), Hisata and Yamae (2000), and Bervas (2006) for detailed discussion.
[2] Sarr and Lybec (2002) order the characteristics as the following: 1) tightness; 2) immediacy; 3) depth; 4) breadth, and 5) resiliency.

The market liquidity risk is an important part in measuring risk, since when incorporated it can add significantly to the loss value of asset at the tail incidents. When the market is still shallow and has problems of asymmetric information, market liquidity becomes very important. Traders with different decisions over the underlying value of the asset will execute trade, and keep trading until more information is revealed.[3] The shallow market facilitates speculative transactions increasing the volatility of the asset prices. This is why shallow market is characterized with a more volatile price/return.

3. The Indonesian Capital Market: Stylized Facts

Indonesian stock market was initially established by the Dutch government in Jakarta by the end of 1912. It is followed by the establishment of the stock market in Semarang and Surabaya in 1925. The stock market had developed well until finally closed due to the World War II. As Indonesia gained its independency, the stock market was re-activated, marked by the issuance of Indonesia government bond in 1950. However, the development of the stock market was sluggish since then. That situation lasted up to the 1970s. Government then initiated the effort to revitalize the stock market by establishing a capital market supervisory agency on 10 August 1977, which turned to be BAPEPAM (*Badan Pengawas Pasar Modal*) or Capital Market Supervisory Agency in 1991. To integrate the supervisory functions of non-bank financial institutions, this agency currently has changed name into BapepamLK (Supervisory Agency for Capital Market and Financial Institution), which does not include the supervisory function over banks.

The macroeconomic factors play a significant role on the development of the Indonesian capital market, especially fund pooling activities through capital market. During the downturn of economic condition in the period of 1997-1998, the number of issuers in stock market grew by only 1% with the value of issues increased by 7.1%. The bond market was even worse. There was virtually no new issue during this period.

In 1999 the stock market condition was improved when corporations conducted restructuring process using the capital market. In that period, values of issuance increased by 172.2% or increased from Rp 75.9 trillion in 1998 to Rp 206.7 trillion in 1999. In the period of 2000 to 2007 the value of issuance grows at an annual rate of 6% and the number of issuers grows at an annual rate of 4.8%.

During 2008, the global stock market faced a lot of pressure due to negative sentiments surrounding the bankruptcy of top investment banks and increasing reports of losses posted by international financial institutions. The prospect of a

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[3] He and Wang (1995) develop a model of stock trading with differential information concerning the underlying value of the stock that illustrates this type of trading.

deteriorating global economy and the expectations of a recession in the U.S. as well as several countries in Europe had serious impact on the performance of Asian regional markets including Indonesian stock market. JCI plummeted 50.64% from 2,745.83 (December 2007) to 1,355.41 (December 2008), reaching its through at 1,111.39 on 28 October 2008.

Asian regional stock markets rebounded in 2009 led by Indonesia's. This was in particular due to positive sentiment stemming from improving global economic prospects. Furthermore, domestic indices rallied with the support of widespread buying by foreign investors, increasing share prices with the prospect of short term returns, particularly commodity-based stocks, such as mining and agriculture. The strong domestic market was also uplifted by the persistent short-term profit-taking behavior of foreign investors. The JCI (Indonesian stock market composite index) increased significantly to 2,534.36 (December 2009) or up by 86,98%.

During the period of 2000 to 2002, unstable macroeconomic condition contributed to the declining of market capitalization. However, 2003 marked the start of the stock market rebound. By the end of December 2007, total value of market capitalization reached Rp 1,988.326 trillion. As of 2007, the ratio of market capitalization to GDP stood at 50.24%, which is a new record. In 2008 the market capitalization slid sharply (-56.80%) as a result of the global economic crisis, while it rebounded 65.46% in 2009. The annual ratios of the market capitalization to GDP are displayed in figure 3.

Figure 2. Development of Issuers, Capitalization, Trading Value, and Issuance Value 1995-2009
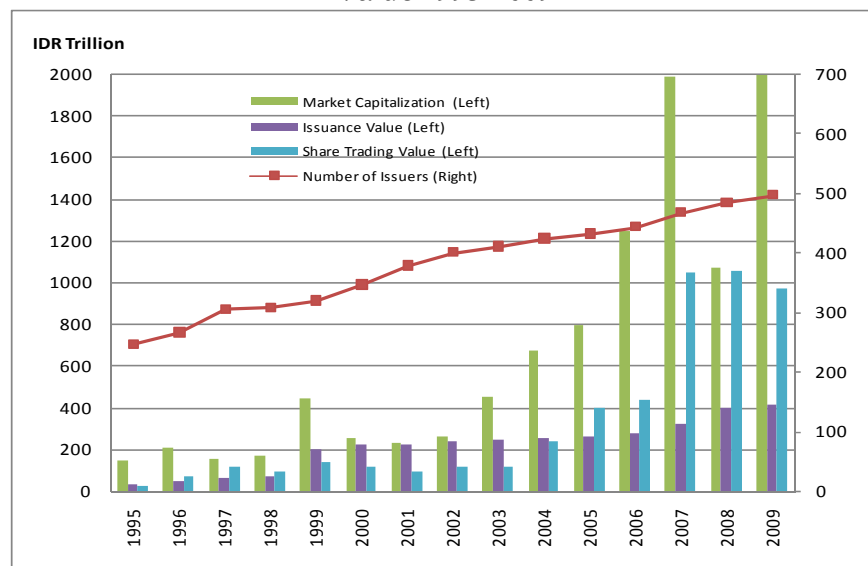
Source: BapepamLK

Figure 3. Ratio of Market Capitalization to GDP 1995-2007
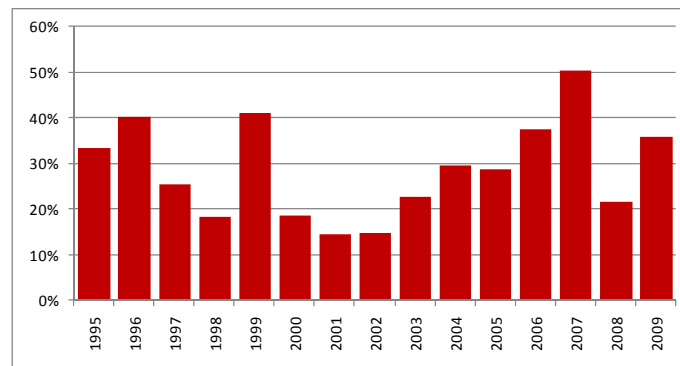
Source: BapepamLK & LPS

The trading activities in Indonesia Stock Exchange (BEI) were relatively active. The average value of daily transaction from 1999 to December 2009 was around Rp 4,05 billion with average daily volume of 6,09 billion share and frequency of around 87,12 thousand transactions per day.

Table 1. The Indonesia Stock Exchange (Average Trading)

| Indicator	Indices	Average Value of Daily trading (million Rp)	Average volume of daily trading (million shares)	Average Frequency of Daily Trading (thousand)
1995	513.847	131.50	43.28	2.48
1996	637.432	304.10	118.58	7.06
1997	401.712	489.40	311.38	12.08
1998	398.038	403.60	366.88	14.19
1999	676.919	598.70	722.58	18.42
2000	416.321	513.70	562.89	19.22
2001	392.036	396.40	603.18	14.72
2002	424.945	492.90	698.80	12.62
2003	691.895	518.30	967.07	12.20
2004	1000.233	1024.90	1708.58	15.45
2005	1162.635	1670.80	1653.78	16.51
2006	1805.523	1841.80	1805.52	19.85
2007	2745.826	4268.92	4225.78	48.21
2008	1355.41	4435.50	3282.40	55.90
2009	2534.36	4046.51	6093.97	87.12

Source: BapepamLK

Indonesia applies free capital mobility. Therefore, capital flows freely in and out of the financial markets. However, the country risk premium and the depth of the financial market also determine how the capital flow influence the price movement in

the market. Hence, we want to factor in the depth of the market to see how much the stock market can absorb the sudden inflow and outflow that can be perceived adding or draining the liquidity in the market or liquidity shock. The deeper market will absorb the liquidity risk much better than the shallower market. We use the liquidity-adjusted VaR (Value at Risk) methodology developed by Bangia et al (1999). The measurement of the liquidity-adjusted VaR should be able to show how the Indonesian stock market responds to the recent global crisis given the liquidity condition. First, if the volatility (or risk) in the local market is more pronounced than in the U.S. market, the local market shows the indication of the shallow stock market. Second, a shallow financial market may not be affected (the first round effect) directly by the declining value of a security product for reason of lack of product linkages with the underlying assets. However, a shallow financial market is sensitive toward a liquidity shock, thus it propagates the crisis in response to the global illiquidity problem (the second round effect). We want to illustrate that the shock may affect the financial markets in the emerging economies in worse way than we think.

Figure 4 illustrates the comparison of the movements of stock market indices (first column) and returns (second column) in the U.S. and Indonesia. The returns are represented in the same scale. The figure roughly shows that during normal period the Indonesian stock market returns are more volatile than those in the U.S. Figure 5 shows the daily volatility measured from the standard deviation calculated by taking the square root of the forecasted variance estimated using GARCH(1,1). We see that the volatility in Indonesia is roughly 3 to 4 times the U.S. volatility during normal period. However, while the U.S. market experienced a significant increase of volatility during stock market distress, the percentage increase of the volatility in Indonesian market – given the volatility during normal condition – is relatively smaller than that of the U.S. market. This may dampen the liquidity risk in the Indonesian stock market especially after 2008. While the volatility will influence the estimation of the VaR, the liquidity risk is another dimension to take into account when we want to make a thorough assessment on the financial stability. The measurement of liquidity risk by using the liquidity-adjusted VaR – or we can call it liquidity premium – is an additional loss that will be experienced in the tail events.

Figure 4. U.S. and Indonesia Stock Market Indices and Returns
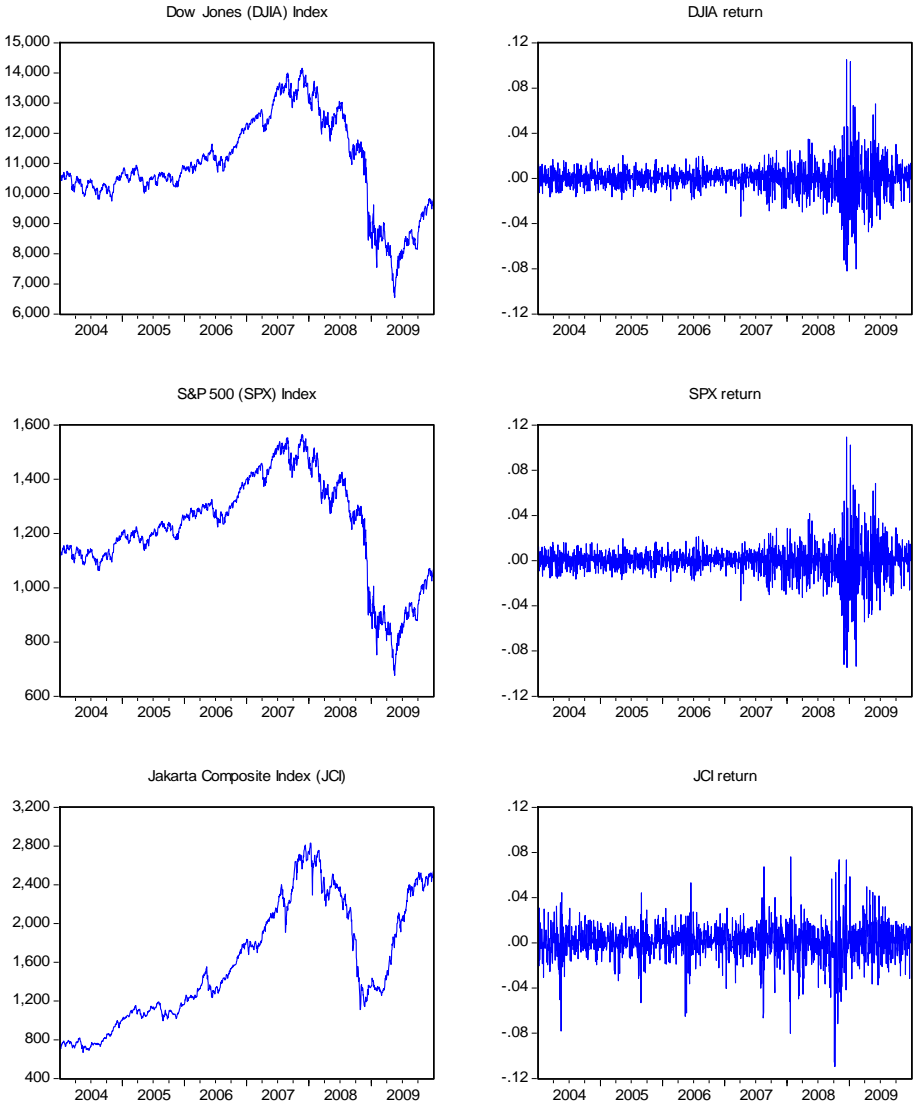
Source: Bloomberg

Figure 5. The Daily Volatility of Dow Jones, Standard & Poor's, and Jakarta
Composite Index
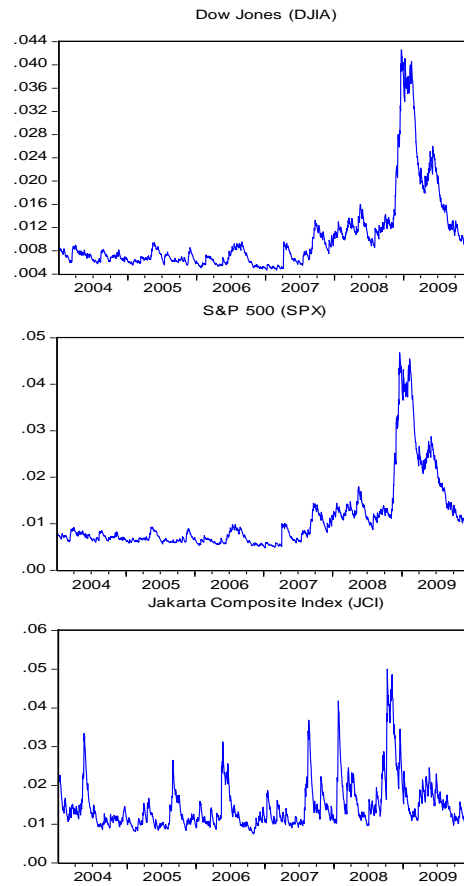
Source: Bloomberg, Authors' Calculation

4. Methodology: Value at Risk and Quantifying Liquidity Aspect

We use the Liquidity-Adjusted (L-VaR) methodology developed by Bangia, et al (1999). We define the value of return R_t as the log-difference of price of stock at time t while P_t is the stock price at time t. Therefore we can write the log difference of price as

$$R_t = \ln \frac{P_t^*}{P_t}$$

(1)

We assume the daily return process as a Gaussian process $R_t \sim N(\mu_t, \sigma_t^2)$, where μ_t and σ_t^2 are the first two moments of the distribution of the asset return. This process can be written as

$$\Pr\left(\frac{R_t - \mu_t}{\sigma_t} \le b\right) = 1 - \alpha \rightarrow \frac{R_t - \mu_t}{\sigma_t} \le b = \Phi^{-1}(1 - \alpha) \qquad (2)$$

We can solve this equation, so that we have R_t process as

$$R_t = \mu_t + \Phi^{-1}(1 - \alpha)\sigma_t \qquad (3)$$

Therefore, the lowest return expected at date t with the confidence threshold of $\alpha = 99\%$ is

$$P_t^* = P_t \exp(\mu_t - 2.33\sigma_t) \qquad (4)$$

The value at risk (VaR) at time t is the highest potential loss at confidence threshold $\alpha = 99\%$, or

$$VaR = P_t - P_t^* = P_t\left[1 - e^{(\mu_t - 2.33\sigma_t)}\right] \qquad (5)$$

Without loss of generality, we assume that the expected value of daily returns μ_t is zero, and variance is not constant but changing overtime. The standard parametric VaR is

$$VaR = P_t - P_t^* = P_t\left[1 - e^{(-2.33\sigma_t)}\right] \qquad (6)$$

In order to capture the dynamic volatility over time we use a different model. We can use exponentially weighted moving average (EWMA) or another method using Generalized Autoregressive Conditional Heteroskedasticiy (GARCH). In this case, we will use GARCH as it is more appropriate for high frequency data. If assets returns deviate significantly from its normality, the standard normal distribution assumption will lead to an underestimation of risk. This is why GARCH is more appropriate if we want to capture the extreme events. We need to apply a particular adjustment to maintain the standard normal distribution assumption. The potential loss with the adjustment can be written as

$$VaR = P_t\left[1 - e^{(\mu_t - 2.33\theta\sigma_t)}\right] \qquad (7)$$

This is an explicit relationship between kurtosis K and the correction factor is well captured by the relationship: $\theta = 1 + \phi\ln(K/3)$, where ϕ is a constant whose value depends on the tail of the probability. The value of ϕ is estimated by regressing the potential loss of the historical VaR. It is clearly that if the distribution of the return is normal, we will have $K = 3$ and $\theta = 1$.

Next, the exogenous cost of liquidity (CoL) is constructed based on the average relative spread. The relative spread is defined as

$$\text{Relative spread} = \frac{ask - bid}{mid} \tag{8}$$

The bid price is the highest price that the market maker is willing to pay at a given time to buy a certain share, while the ask price is the lowest price at which the market maker is willing to sell the share. We define P_t as the price, $\overline{S}$ as the average of relative spreads, $\tilde{\sigma}$ as the volatility of relative spread, and a as the scaling factor. If the distribution of relative spreads is far away from normality assumption we can not rely on Gaussian distribution theory for guidance on the value of the scaling factor. But if the spread is normal, the scaling factor a for 99% coverage probability is 2.33. For simplicity of the measurement, we will use this assumption.

In order to combine the risk from liquidity and market, we make a reasonable assumption that extreme events of the returns happen simultaneously with the extreme events of the relative spreads. Therefore, the worst case of price can be calculated by

$$P' = P_t e^{(\mu_t - 2.33\sigma_t)} - \frac{1}{2}\left[P_t\left(\overline{S} + a\tilde{\sigma}\right)\right] \tag{9}$$

The second part of the right hand equation is the exogenous cost of liquidity (CoL). It is constructed by assuming that the liquidity cost is equal to half the spread times the size of the position liquidated. Finally, we can write the equation to calculate the Liquidity-adjusted Value at Risk for this event by:

$$L - VaR = P_t - P' = P_t\left[1 - e^{(\mu_t - 2.33\sigma_t)}\right] + \frac{1}{2}\left[P_t\left(\overline{S} + a\tilde{\sigma}\right)\right] \tag{10}$$

or

$$L - VaR = VaR + CoL \tag{11}$$

Next, we design the steps to forecast the VaR and L-VaR to get the forecasted CoL using the baseline and extreme scenario. First, we forecast the returns and relative spreads by assuming time series models for returns and relative spreads. For simplicity, we can use the AR(1) process. We use the extreme values of the estimated errors to forecast the returns and spreads in extreme scenario, and use the median values of the estimated errors for forecasting the baseline scenario.[4] When the

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[4] One can define a percentage, say 10% or 20%, of the extreme values of the errors from the estimation for the extreme scenario and use the values of the rest of errors for the baseline scenario.

forecasted values are generated, using the rest of the procedure explained before, we can calculate the VaR, L-VaR, and CoL of the entire population.

5. Empirical Work and Results

Because the objective of the exercise is to construct a simple and transparent indicator, we choose a basket of shares that already have a good track record in the equity market. This is better known as the *blue chip* stocks. The advantage of choosing a blue chip stock for statistical exercise is that it has a long period of observations with high frequency of transactions, and therefore it provides us with larger number of observations to produce an objective indicator. And this is especially important in applying the L-VaR method, since the method will deliver the liquidity risk of the stock market. Therefore it is also best to use the most liquid stocks in the market since we will need the most objective bid-ask spread. The more frequently traded stocks will have the most reliable bid-ask spread. In the exercise, we constructed different indices to find the best index to use in the L-VaR method. We decided that the index that was constructed by taking the daily volume-weighted average of 16 most traded shares with the longest history is giving us the best outcome since it manages to deliver the dynamics of the market in facing of the liquidity shocks from the event analysis.[5] While L-VaR uses this basket of shares, the VaR is still calculated using the returns of JCI.

We illustrate the financial market depth in Indonesia by measuring the risk using the simple method of Value at Risk (VaR). In addition, we also want to incorporate the liquidity risk in the return measurement. The idea is that we want to show the liquidity condition of the Indonesian financial market compared to the advanced financial markets. Shallow financial markets are indicated by the illiquidity of the market and the fragility toward external shocks. We use the returns calculated from the times series of stock prices indices to measure the VaR and apply the basket explained before for the liquidity-adjusted VaR of Indonesia's market only. For this exercise we focus on the data set in the period of 2004 – 2009.[6]

Figures 6 to 8 illustrate the increase of the VaR during the subprime mortgage crisis in all markets using the shorter sample of 2004 to 2009. The U.S. markets are showing increase of VaR starting the second quarter of 2007 with steeper increase starting the fourth quarter of 2008 and finally gradually decreasing the values in 2009. Indonesia's VaR does not show persistent increase of level, but shows a mean

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[5] We also tried two other baskets: A) daily simple average prices of 29 most traded shares with the longest history; B) daily simple average of 16 most traded shares with the longest history.

[6] Because we updated the data set covering the year 2009, the VaR and L-VaR changes from the values in the previous version of the paper.

reversion pattern although with slightly higher mean. The highest peak was actually associated with the severe pressure in the global capital markets including the stock markets in Asia within January 2008, which was leading to a version of "Black Monday" on January 21, 2008. This shows that even when the Indonesian market is not highly exposed to the subprime mortgage products, the turmoil in the regional and U.S. market is still transmitted to Indonesia. Indonesian market in general exhibits more volatility compared to the U.S. markets along the sample. This happens not only during the period in review. The volatility of the market shows how easy the price changes in the stock market. This represents how difficult it is to price shares objectively given the informational problems in the market. In addition, there may not always be a buyer or seller of a particular share at any given time. In other words, there may not always be bid and ask prices for a particular share. A market player facing a buy or sell offer may have to refer to the historical prices. As a result, if pricing information is insufficient, players may refuse to trade. If they are willing to trade, they may require an arbitrary discount to buy or apply a premium to sell. Because of this arbitrary pricing mechanism, the prices in the less developed market are highly volatile. The lack of diversity in terms of the counterparties for trading partners exacerbates the problem. This is then known as the trading liquidity problem. The volatility showed in the Indonesian market fits this pattern considering the daily frequency of trading is still low (see again Table 1)[7].

Figure 6. (Parametric) VaR and Index of Dow Jones (U.S.) using Short Sample

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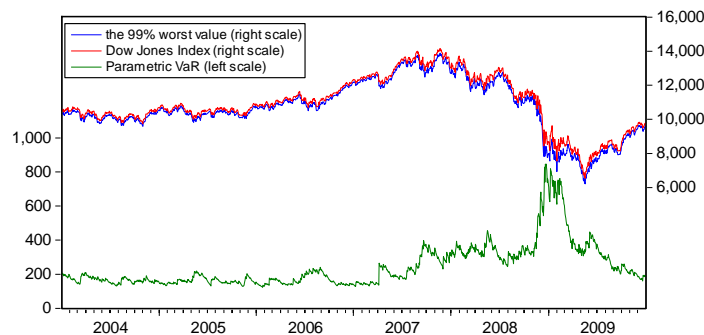
[7]Compare this with the application of *high-frequency trading* in the U.S. markets.

Figure 7. (Parametric) VaR and Index of S&P 500 (U.S.) using Short Sample
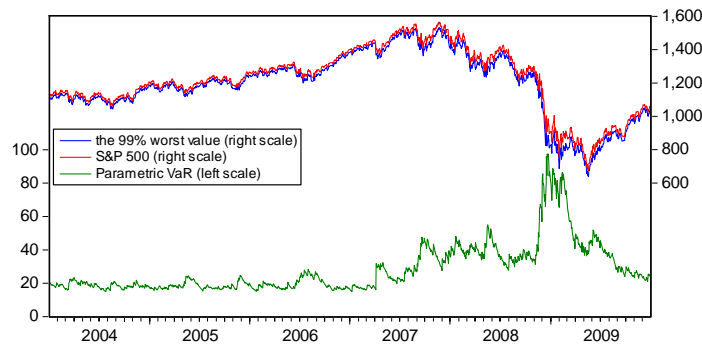

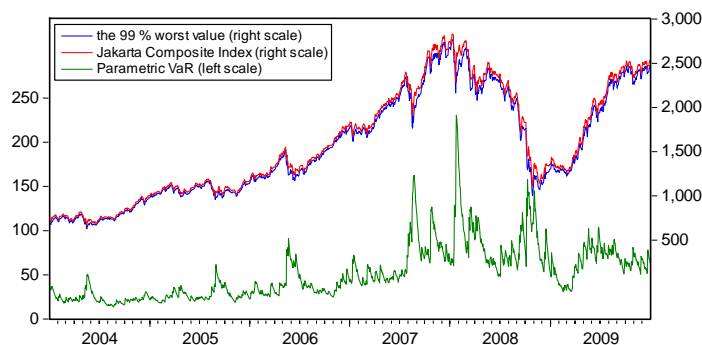Figure 8. (Parametric) VaR and Index of JCI (Indonesia) using Short Sample

Figure 9 shows the movement of the stock market index and exchange rate of Rupiah per USD in Indonesia, while figure 10 shows the portfolio investment movement of Indonesia's balance of payment. We think that the portfolio investment movement is important to explain the stock market index movement since 60% to 70% of the fund invested in the Indonesian stock market is originated from foreign sources. The exchange rate reflects the external vulnerabilities. The L-VaR, VaR and CoL of the Indonesian market are displayed in figure 11. Figure 12 plots the JCI and the CoL for better viewing. Although the series is shortened in the figures, the sample used for producing the measurement of L-VaR, VaR and CoL in figure 11 and 12 is from Desember 1993 to February 2010. The L-VaR in Indonesia is always higher than the VaR, causing persistent positive cost of liquidity. The spikes in the CoL measurements seems to be corresponding to the turnaround of the trend in the stock market, although the significant level of this claim is yet to be tested. For example, the spike in May 2008 indicating the long bearish trend of the stock market, in which the index was declining 55.74% from May 19, 2008 to reach the bottom on October 28, 2008. The next spike is in the fourth quarter of 2008 is also the beginning of the bullish trend of the stock market. This claim is justified since in order to influence the price of a security, active trading of the security is needed. When the market is not
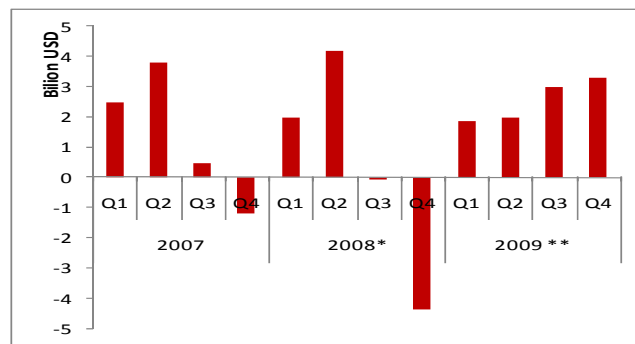
liquid enough, the active trading will influence the bid-ask spread that in turn will increase the measurement of CoL.

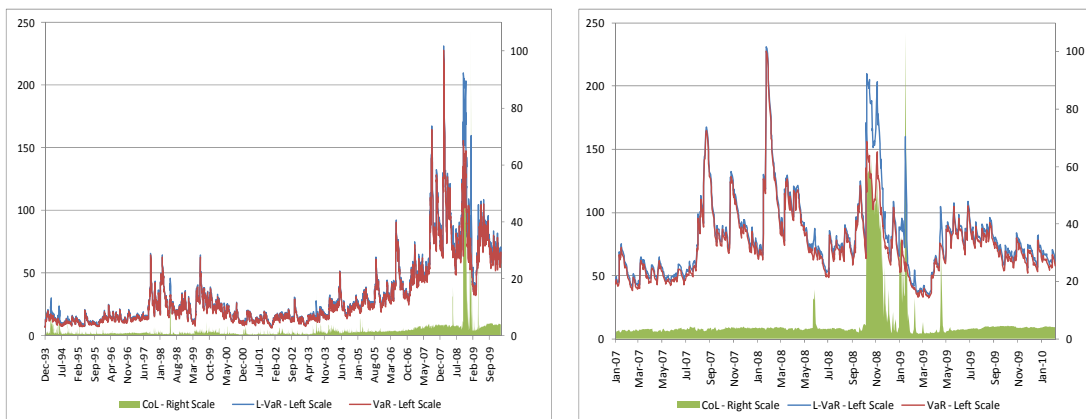Figure 9. Indonesian Stock Index (JCI) and Exchange Rate 2005 – 2009
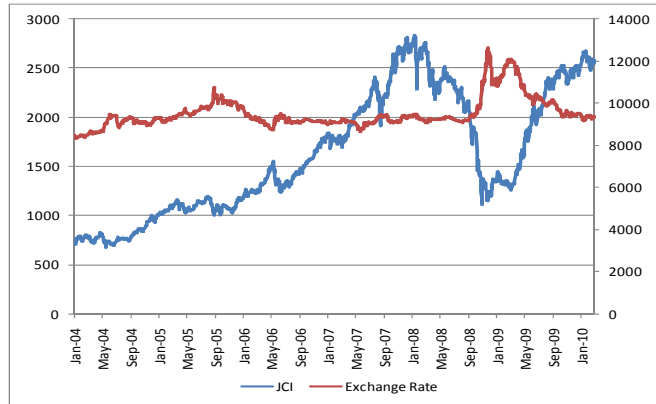
Source: Bloomberg

Figure 10. Portfolio Investment Movement of Indonesia

Source: Indonesian Balance of Payment

Figure 11. L-VaR, VaR and Cost of Liquidity of Indonesian Stock Market

Notes: Left panel covers the entire sample, right panel is zoomed within 2007 to 2009

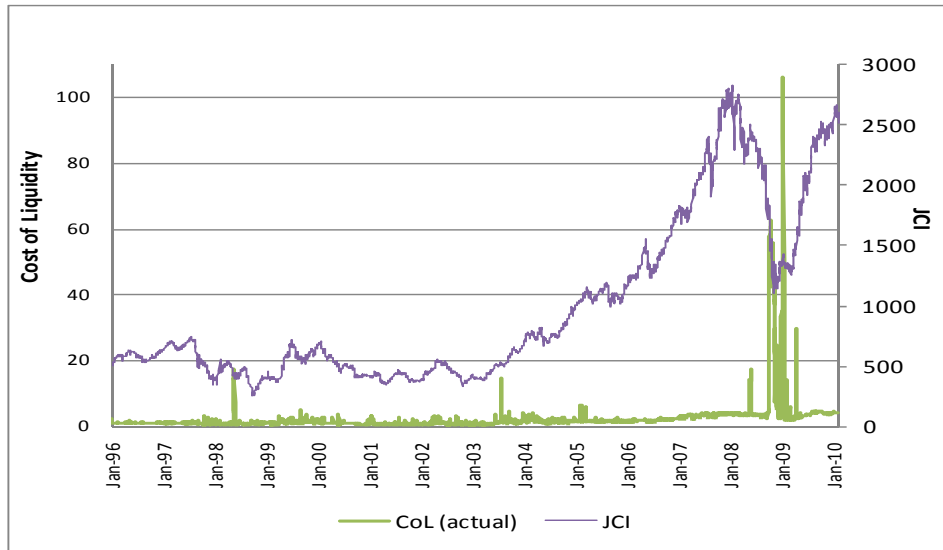Figure 12. Stock Index (JCI) and Cost of Liquidity 2004-2009

Table 2. Growth of Indices, Values at Risk, and JCI Cost of Liquidity

| Quarter	Index Growth			VaR Growth			JCI CoL
	Dow Jones	S&P 500	JCI	Dow Jones	S&P 500	JCI	Growth
2007Q1	3.52	4.13	1.41	0.96	5.80	-3.51	104.30
2007Q2	6.42	4.47	16.84	29.56	28.43	6.42	-12.98
2007Q3	-3.21	-5.07	10.28	102.17	106.29	48.23	-15.28
2007Q4	-0.60	0.56	16.39	-13.17	-18.13	0.50	23.27
2008Q1	-3.12	-5.01	-10.87	5.48	5.54	35.94	1.35
2008Q2	2.65	1.93	-4.01	-13.04	-10.86	-46.51	-4.18
2008Q3	-12.99	-11.26	-21.99	15.21	4.37	68.31	41.82
2008Q4	-22.98	-27.29	-26.04	112.52	119.23	-36.12	382.62
2009Q1	-8.54	-11.33	5.80	-52.28	-50.73	10.89	-91.19
2009Q2	-1.35	3.37	41.33	-0.72	1.02	51.76	69.28
2009Q3	6.60	8.82	21.75	-36.48	-35.89	-24.36	278.54
2009Q4	17.07	17.62	2.71	-15.64	-8.48	-8.01	-37.98

Source: Bloomberg and Authors' Calculations

Table 2 shows the dynamics of indices, values at risks and cost of liquidity in Indonesian stock market. The VaR of the U.S. markets are shown here to provide comparisons. This table also sheds lights to the added risk dimension in the market represented by the cost of liquidity or liquidity premium. In some quarters, VaR is actually improving (the growth is negative), the liquidity premium is increasing (CoL growth is positive), and vice versa. For example, the first quarter of 2007 shows the positive growth of indices in all markets. While VaR of the U.S. markets are increasing, Indonesia shows decreasing VaR. If we stop there, we observe that it is safer to invest in Indonesia's market. Supported with the lack of impact of the

subprime mortgage crisis on the Indonesian macroeconomic condition, the dynamics of VaR in Indonesia may be misleading in that period. The significant increase of the cost of liquidity shows a different dimension of the market risk. When the cost of liquidity increases, investors face an additional risk in a form of higher buying price or lower selling price because of the difficulties in finding the counterparties to do the transactions with. In the fourth quarter of 2007, JCI is increasing 16.39%, a much higher increase than those in the U.S. markets. This increase is accompanied with moderate volatility in the prices as reflected of an increase of only 0.50% VaR. However the 23.27% increase of the cost of liquidity is quite high after a negative growth of the cost in the previous quarter.

The liquidity risk is especially severe in the fourth quarter of 2008, around the same time of the liquidity pressure in the Indonesian financial market as a result of the global liquidity problem in the aftermath of Lehman Brothers bancruptcy. Although the VaR in the U.S. markets were increasing, the VaR in Indonesian market is actually decreasing. However, the cost of liquidity is increasing significantly. The increasing liquidity risk is also explained by the significant outflow in the form of portfolio investment. This shows that although investors were facing lowering risk of return on investment, they still need to consider the liquidity risk of trading in Indonesian market.

Recognizing the liquidity risk is important for financial stability analysis. To detect an emerging vulnerabilities and prescribe mitigating action in time we can use the forecasting procedure. Therefore, we also tested the ability of the methodology to deliver forecasted cost of liquidity. In this case, we pretended that we are in the mid year of 2009 and in need to check the liquidity risk within 6 months into the future. We used the procedure explained in the last paragraph of chapter 4. The results are displayed in figure 13 with the plot of the real cost of liquidity to compare the forecasted values with the values from the actual returns and actual relative spreads. The values of CoL generated from baseline scenario are in general slightly lower than the actual values. The values generated from the extreme scenario are much higher than the actual values. This is different from the forecasting exercise in the beginning of the liquidity problem in the fourth quarter 2008, which will be discussed later. The second semester of 2009 is considered tranquil period as the market is rebounding from the global shock in 2007-2008. The decision to sample the errors to 60% of median values for baseline scenario and 40% of the tails (20% for each tail) certainly play into the result of the forecast. Better calibration for the best distribution of errors for each scenario will improve the forecasted result.

Figure 13. Forecasting the Second Semester 2009
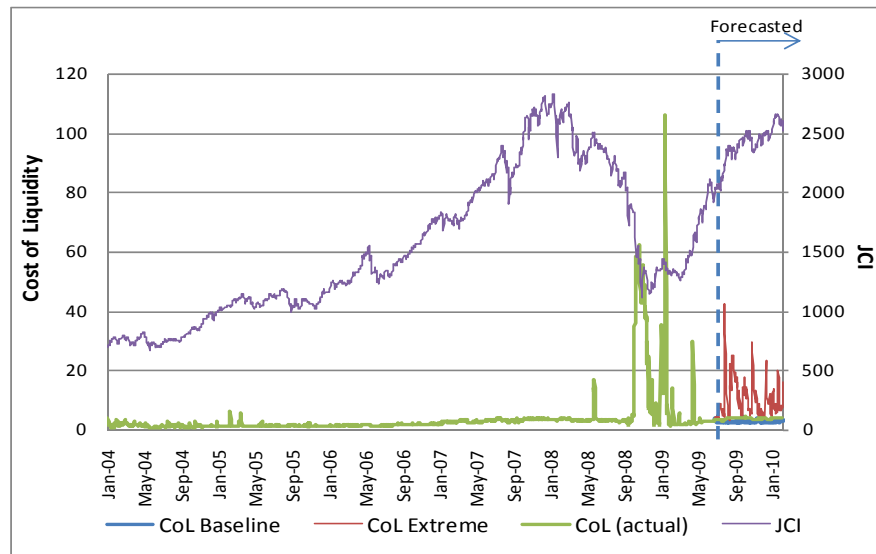
6. Discussion

The above exercise shows that the measurement of L-VaR can be used to scrutinize the dynamics of the stock market. Despite the weaknesses in the magnitude of the spikes, the CoL is quite sensitive in indicating the changes of the liquidity risk in the market. In general, we can only expect an early warning exercise to warn us about emerging vulnerabilties in the market. Even when there exist weaknesses in the early warning exercises, we just need to be aware of the weaknesses, and capture the dynamics in order to determine the vulnerabilities. In this case, the extreme shocks collected to forecast the extreme events may not be extreme enough. This is a common caveat in forecasting exercise with historical data that may not contain "enough" extreme events. This is also why the exercise will never predict the magnitude of the risk sufficiently.

The choice of time series models in estimating the variances, the forecasted returns and relative spreads may not be suitable for all markets. For example, when the same procedure is applied to the Indonesian government bond market, the result is not economically intuitive. The result is better when we change the methodology for producing the estimated variance using the more simple estimation using the moving average of the variance from Student-T distribution. The frequency of the data in the government bond market is much less than that in the stock market. This shows that the choice of distribution should be dependent on the data.

The sample used for the exercise is also important. In the midst of liquidity pressure in the fourth quarter of 2008, we ran the exercise to measure the cost of liquidity in the stock market (see figure 14). When we use the sample that only covers the period of 2004 to 2008, we found the liquidity shock in the fourth quarter of

2008 is more pronounced in the shorter sample compared to that in the longer sample. The longer sample includes the crisis of 1997-1998. This event undermines the liquidity shock in 2008. The lack of historical liquidity shock in the stock market also undermines the values of L-VaR in general. For example, we found some negative values in the measurement of CoL because of the calculation of L-VaR is lower than the VaR. The calculation using the events of liquidity problem in 2008 have produced all positive CoL values (revisit figure 12). This is an example of how careful we should be when interpreting the result since the historical data used in the sample also determines the result of the calculation. The severity of the liquidity problems showed by the measurement are relative to the severity of the problems included in the sample.

Figure 14. Cost of Liquidity and Stock Index with Different Samples
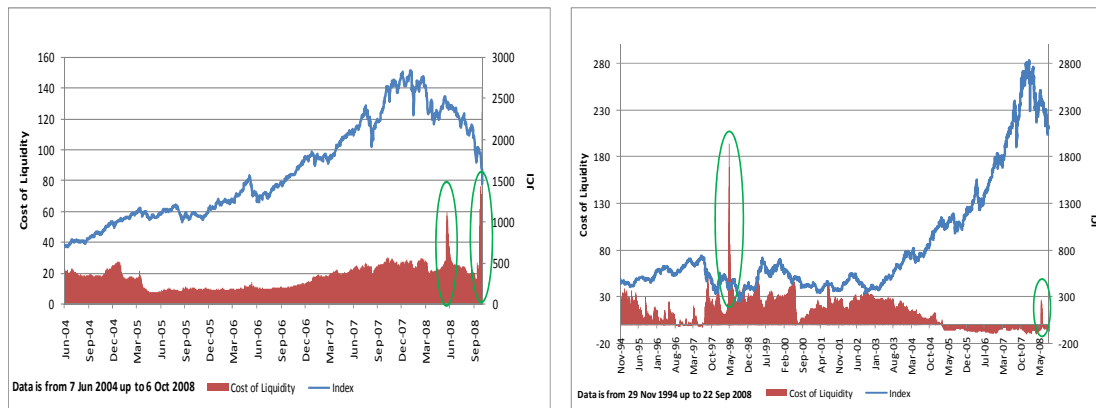

Note: Left Panel is shorter sample, right panel is longer sample. These figures are produced in October 2008.

Figure 15 showed the result of forecasting in outbreak of liquidity crisis in the fourth quarter of 2008. The choices of errors to forecast the returns (relative spreads) in the extreme scenario are determined from the sequence of returns (relative spreads) that delivers the highest volatility, while for the baseline scenario the choices of errors are taken from the sequence of returns (relative spreads) that delivers average volatility.[8] The result shows that even the values of CoL in the extreme scenario are still much lower than the actual values of CoL. This shows that the severity of the liquidity crisis in 2008 is new to the market experience. The result of the measurement that includes the crisis event shows that the other liquidity pressures in the past have relatively smaller spikes in the plot (figure 12). Nevertheless, the direction of the spike is already indicative to spot vulnerabilities in the market.

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[8] This is a different method to choose the errors. In this method, even in the extreme scenario errors that are considered as average errors may still be included. In the method used previously, extreme scenario only includes extreme errors.

Figure 15. Forecasting the Liquidity Crisis in the Fourth Quarter of 2008
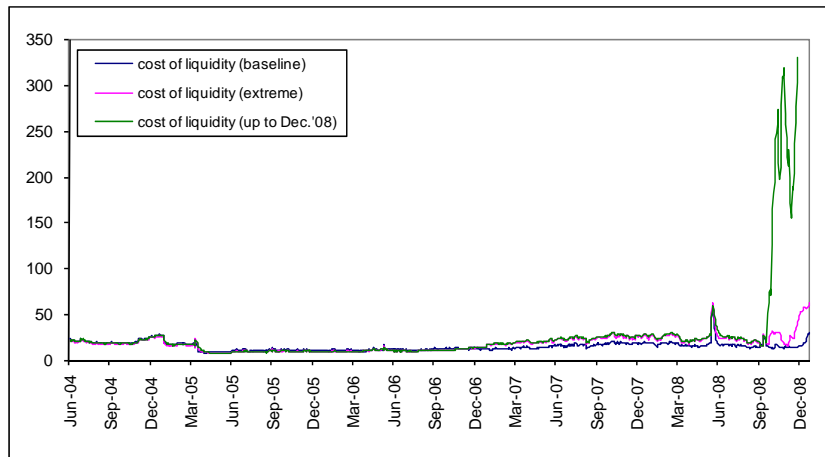
7. Conclusion

The less-developed markets are characterized with a relatively higher liquidity risk from that in the developed markets. Relying on the assessment of value at risk in the market may mislead the financial stability assessment. Vulnerabilities in the market can be detected from the measurement of the cost of liquidity. The exercise in the market shows that the movement of the cost of liquidity is able to indicate emerging vulnerabilities in market. The existence of the other characteristics of market liquidity (e.g. depth and resilience) opens a lot of opportunities to develop other measurements for liquidity risk. We aim and encourage others to explore the other measurements.

The calculation of the measurement has to consider the sample used to produce the estimation. The longer sample with more varieties of events in the market will deliver better result. The interpretation of the magnitude of the cost of liquidity has to consider the severity of the events happened in the past. In this case, markets that already experienced liquidity crises in the past can deliver the most objective outcome. Careful interpretation has to be applied to markets with lack of liquidity problems in the past.

The forecasting exercise shows that the measurement has the potential to become an indicator for early warning exercise. However, we cannot completely rely on the magnitude of the forecast cost of liquidity to predict the severity of the problem. The best way to use the indicator is to detect the movement and take the increase of cost of liquidity as a sign of emerging vulnerabilities in the market. The cost of liquidity rises as the market experiences jitters as investors are nervous about the information that they learn. As regulators who sometimes do not have direct access to the information, the cost of liquidity is useful to detect market jitters.

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