The liquidity impact on firm values: The evidence of Taiwan's banking industry

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1. Introduction

There are many risk factors that affect asset values and liquidity plays an important role in the valuation of financial assets. While there are many notions of liquidity, the liquidity in regard to asset valuation represents the degree to which an asset can be converted to cash which depends on the demand and supply of the asset. If the liquidity of an asset decreases in the market and investors want to sell the asset, then they might lower its price to execute the trade, which is known as liquidity discount. Therefore, the liquidity risk, which is the major cause of the financial crisis in 2007–2008, should be considered in the pricing process.

Taiwan's banking industry, after several decades of development and effort, has entered into a unique system, which is quite different from the ones adopted by the U.S., Japan or West European countries. Taiwan's banking system can be referred to as a “partial universal banking systems” (Shen (2005)) which falls in-between the “separated banking system” and “universal banking system” adopted by other countries.1 This unique system has contributed a lot to help Taiwan's financial institutions survive the Asian financial crisis in 1997. Hence, we are curious to know the liquidity impact on Taiwan's financial institutions during the global financial crisis period in 2007–2008.

In the financial crisis in 2007–2008, we witnessed that the values of financial institutions dropped dramatically and it mainly resulted from the lack of liquidity in their assets. For example, the market capitalization of the Taiwan stock market lost NT$9.72 trillion (roughly US$324 billion)2 from 1 month before to 1 month after the bankruptcy of Lehman Brothers. Most financial institutions hold a lot of assets vulnerable to liquidity risk, such as corporate debts and over the counter derivatives. By the same token, New Basel III regulatory framework highlights the importance of liquidity risk management implemented by financial institutions. In addition, updated International Financial Reporting Standards (IFRS) require the improvements about fair value measurements and reinforce existing principles for disclosures about the liquidity

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1 The “separated banking system”, which is adopted by the U.S., refers to the separation of commercial banks from investment banks. The “universal banking system”, which is adopted by most European countries (Germany as a notable example), allows banks to engage in the services of investment banks. According to Shen (2005), commercial banks in Taiwan were initially prohibited from engaging in commerce, securities and other financial-related businesses. These prohibitions were soon lifted as no investment banks existed during the early stage of economic development. To make a compromise, commercial banks were permitted to choose two of three ‘standard investment banking businesses’, that is, underwriting, proprietary trading and brokerage, to expedite stock market developments.

2 The exchange rate was around NT$ 30 dollars per US$ dollar in the Middle of 2014.
risk associated with financial instruments. Hence, it is crucial to estimate liquidity discounts of these assets and then provide proper valuation of financial institutions.

The existing literature of liquidity is voluminous. Yet it focuses mostly on microstructure measures, such as trading volume, bid-ask spread, or trading frequency which reflect the liquidity in market microstructure. Amihud (2002) used daily data on stock returns and dollar trading volume to measure stock illiquidity. However, we note that although the data required in the calculation of Amihud (2002) index are readily available in the developed markets, they are not rather incomplete in the emerging markets such as Taiwan. To overcome the problem of short time-series sample, Bekker et al. (2007) employed the percentage of observed zero daily returns averaged over the month to measure the liquidity for 19 emerging stock markets.

Pastor and Stambaugh (2003) measured liquidity by the price reversal coefficient due to the temporary price impact of signed order-flow transaction volume. This measure is based on the viewpoint that lower liquidity is followed by a higher volume-related return reversal. The measure proposed by Roll (1984) considered the subsequent prices as arising from the fact that prices bounce back and forth between the bid and the ask price. Hence, the auto-covariance in price changes provides a simple liquidity measure. Then, Bao et al. (2011) extracted an aggregate liquidity measure from investment grade bonds using the Roll measure and examine the pricing implications of illiquidity.

These proxies, however, cannot reflect the impact of the liquidity risk of asset values of a financial institution and a comprehensive pricing model with the consideration of liquidity risk is necessary. Moreover, credit risk and liquidity risk have been perceived as two major concerns for financial institutions. As Ericsson and Renault (2006) suggest that both risks are highly correlated, it would be more appropriate to employ a model which can provide interactions between liquidity and credit risks. The model proposed by Chen (2012) is an equilibrium model that is consistent with the Merton model widely used in modeling credit risk. Therefore, we fill in this gap caused by traditional liquidity measures and apply the liquidity discount model in Chen (2012) to evaluate the value of financial institutions in Taiwan. This is the major contribution of this paper.

In order to understand the contents of liquidity discounts suffered by financial institutions, we conduct an empirical study examining what factors affect firm-specific liquidity discounts for these institutions and conduct a sub-period analysis, which examines whether there is a significant change in liquidity discounts before and after the 2008 financial crisis. Each bank can also adopt our model to understand its own liquidity risk and adopt necessary steps to enhance their liquidity before it is too late. That is another contribution made by this paper.

There are two different sources of a firm’s default: (1) an economic default that is caused by insufficient revenues and (2) a liquidity default that is caused by lack of enough cash to pay for existing debt obligations. Economic default comes before the liquidity default during normal times when firms can liquidate their assets easily. On the other hand, under extreme market conditions, firms must sell their assets at large discounts as they need to pay for short-term liabilities. In such a situation, liquidity default may occur before economic default. This is what we observe in the financial crisis in 2007–2008, especially in banking industry around the world.

Based on Chen et al. (2012), we describe the capital structure of a firm and the economic and liquidity defaults by the model of Geske (1979) which is a multi-period extension of the Merton model (1974). Chen et al. (2014a) also adopts the Geske (1977) structural compound option model to examine Lehman Brothers in the midst of the 2008 Financial Crisis. To estimate the asset value of a financial institution, we combine the liquidity model by Chen (2012) with the Geske model. In the estimation, we calibrate the model with the financial institution’s market capitalization and its volatility. The sample used in the study includes 22 financial institutions: 10 banks and 12 financial holding companies, which consists of the entire financial industry in Taiwan with sufficient data.

Using the liquidity discount model, we empirically classify Taiwan’s financial institutions into three liquidity categories: safe, crisis contagious and vulnerable. In addition, we investigate what factors affect firm-specific liquidity discounts for these institutions and conduct a sub-period analysis, which examines whether there is significant liquidity discounts changes before and after the 2008 financial crisis. We find that liquidity discounts change substantially during the financial crisis. Furthermore, we find that liquidity discounts can be attributed to some firm-specific performance.

Therefore, based on our empirical findings, we suggest that regulatory authorities and financial institutions use the model to monitor the liquidity condition of the financial industry. In other words, our findings can serve as an early warning signal for liquidity calamity for the financial industry in Taiwan.

This paper is organized as follows. We describe the combined model used for banks’ assets in Section 2. In Section 3, we summarize the empirical data and introduce the banking industry in Taiwan. The empirical work is in Section 4 and the paper concludes in Section 5.

2. Theoretical model

We utilize the model in Chen (2012) to evaluate a bank’s asset value with the consideration of liquidity risk. As mentioned earlier that this model is a combination of the liquidity discount model by Chen (2012) and a capital structure model by Geske (1979). To combine both models smoothly, we make the same assumptions as both models. Under these assumptions, we introduce how we combine both models as follows.

2.1. The liquidity discount model when the market is illiquid

According to the points stated in Chen (2012), the relationship between the asset value \( V \) and the fundamental economy \( Y \) must be convex in order for the liquidity discount to exist. Therefore, we specify a call payoff to capture such convexity. That is, we specify that \( V_T = \text{max}(Y_T - K, 0) \) represents the convexity of the call’s payoff, where \( K \) is the strike price of the call. The underlying state variable for the economy, \( Y_T \), is assumed to follow a log normal distribution with mean \( \mu_Y \) and variance \( \sigma_Y^2 \).

Chen (2012) also argues that the liquidity discount increases with the convexity, which is affected by the strike price. Therefore, at the extreme value where \( K = 0 \), liquidity has no effect on the asset value. Based on Chen (2012)’s argument, when the market is extremely illiquid, there is no trading permitted for the asset. Then the illiquid price of the assets \( \left( V^* \right) \) can be computed by the following equation:

\[
V^*_T = \frac{1}{R(t, T)} \left( E[Y_T] - 0.5 \{ E[Y_T] - R(t, T)Y_T \} \right),
\]

where \( R(t, T) = e^{(T-t)} \) is the risk-free compound interest rate, and \( \beta = \frac{Cov[Y_T, Y_T]}{Var(Y_T)} \) represents the dollar beta. We can compute the illiquid asset value \( V^*_T \) numerically by Eq. (1) and it is valid under the condition that there is no trading allowed for the asset.

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3 Chen (2012) mentions that any convex function is good enough to generate a liquidity discount.
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