ASSESSING THE DEMAND AND SUPPLY OF LIQUIDITY IN ISLAMIC BANKING (The Case of Indonesia)

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Abstract

This paper attempts to assess the demand and supply of liquidity in Islamic banks and to check the resilience of the industry to liquidity pressure. Firstly, it identifies the sources of short-term demand and supply of liquidity. Secondly, it assesses the historical performance of banks to manage liquidity. Thirdly, this paper predicts the short-term future performance and investigates the resiliency of the industry against any liquidity pressure by using ARIMA models and Bayesian technique. The paper finds that the industry has historically managed liquidity very well. Nevertheless, the resiliency against liquidity pressures is not strong enough because it does not perform well when irregular demand of liquidity or a liquidity run occur. As such, this paper suggests to Islamic banks that they intensify education of the public on Islamic banking principles, improve banking facilities, products and services, and optimize bank financing.

Keywords – ARIMA, *Waḍīʿah*, *Muḍārabah*, Cash reserve, Bayesian.

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I. BACKGROUND

Assessing the demand and supply of liquidity is very important for banks in order to conduct robust banking operations. The demand for liquidity from depositors has to match with the supply of liquidity from the banks' investment activities. Any liquidity mismatch can create a liquidity problem and interrupt the optimal results of banking operations (Bank for International Settlement, 2008, pp. 6-7). In fact, one of the causes of the failures of banks during the global financial crisis of 2008-2009 was imprudent banking liquidity management that led to a liquidity problem (Chapra, 2008, p. 1). As such, to create robust liquidity management, banks have to assess both potential short-term demand for liquidity on the liability side and the short-term supply of liquidity on the asset side.

Furthermore, besides benefiting the banks in the arrangement of optimal liquidity, assessing the demand for liquidity and its supply can test the resilience of the industry to liquidity pressure (Hoggarth, Glenn, Reidhill, Jack, Sinclair, Peter, 2004, pp. 10-14). The resilience can be observed from (at the least): (i) the position of the available short-term supply of liquidity to meet the short-term demand for it; (ii) the performance of the suppliers of liquidity to mitigate sudden demand for liquidity; (iii) the critical level of liquidity withdrawals from depositors which could cause the industry to fail to meet its obligations; and (iv) the probability of occurrence of the unexpected liquidity withdrawal conditions.

This paper attempts to assess the demand and supply of liquidity in Islamic banks in the case of the Indonesian Islamic banking industry. Islamic banks in Indonesia have some specific banking operations related to the demand for and supply of liquidity; for instance:

1. Indonesia has adopted a dual banking system (conventional and Islamic banking systems), with only 2.5% of market share held by Islamic banks. As such, the Islamic banking industry is very sensitive to the impact of the conventional banking operations.
2. Islamic banks apply a revenue-sharing scheme rather than a profit-and-loss-sharing (PLS) scheme on the liability side. They use a PLS scheme on the asset side.
3. In general, there are three types of Islamic banking deposits, namely *Waḍīʿah* demand deposits, *Muḍārabah* saving deposits

and *Muḍārabah* time deposits. On the other hand, there are two types of financing: operational financing, which is mostly comprised of *Murābaḥah* and *Muḍārabah* financing; and non-operational financing, which is dominated by *Ijārah* financing.

4. Besides extending funds to operational financing and non-operational financing, Islamic banks locate some liquidity in the central bank, the Islamic money market (PUAS), inter-bank placement and Bank Indonesia Sharia Certificates (SBIS) for the sake of liquidity management.

In the following parts, this paper attempts to assess demand and supply of liquidity in the Indonesian Islamic banking industry. Firstly, it starts by identifying the sources of short-term demand and supply of liquidity. Secondly, it examines the historical performance of the banks in managing demand and supply of liquidity. Thirdly, it predicts the short-term future performance of liquidity management and investigates the resiliency of the industry against liquidity pressure. For this purpose, Autoregressive Integrated Moving Average (ARIMA) and Bayesian technique with binomial distribution are used to: (i) model the historical Islamic banking data from December 2000 to August 2009; (ii) generate the estimated numbers from September 2009 to December 2011; and (iii) assess the future performance and the resiliency of the industry under certain scenarios of irregular liquidity withdrawals and liquidity run. Finally, findings are presented and suggestions are given to maintain the future performance of the industry.

II. SHORT TERM DEMAND FOR LIQUIDITY

As mentioned before, there are three main sources of funds in the Indonesian Islamic banking industry namely: (1) *Waḍīʿah* demand deposits; (2) *Muḍārabah* saving deposits; and, (3) *Muḍārabah* time deposits. With demand deposits, Islamic banks obtain an explicit or implicit authorisation to use them for whatever purpose permitted by the Sharīʿah, but do not guarantee returns or profits to investors (Obaidullah, 2005, p. 49). Meanwhile, with *Muḍārabah* saving deposits and *Muḍārabah* time deposits, Islamic banks can actively use them and share risks with the investors without any voting rights (Grais & Pellegrini, 2006, p. 1). Therefore, with respect to managing liquidity, Islamic banks need to maintain a certain level of adequate liquidity reserves to anticipate any liquidity withdrawal from these three deposits.

The short-term demand for liquidity may come from *Waḍīʿah* demand deposits. The nature of the demand-deposit contract makes demand-deposit accounts the most unpredictable deposit account, since depositors may take out their money at any time without prior notice to the banks. In this sense, it is advisable for an Islamic bank to know how much the potential regular liquidity withdrawals are. Historically, based on data from December 2000 to August 2009, the average depositors' withdrawals are 8.89% per month. All Islamic banks in Indonesia usually employ the funds from *Waḍīʿah* demand deposits for short-term financing, but only some of them give a bonus to the holders of these accounts, as it is not obligatory (Ismal, 2010a, p. 10-20).

The second short-term demand for liquidity may come from *Muḍārabah* saving deposits. This deposit is unpredictable as well, because there is also no requirement for depositors to give the bank advance notice before withdrawing cash. Data shows an average of 5.39% withdrawals per month on these deposits, slightly lower than that from *Waḍīʿah* demand deposits. In fact, this is good because all Islamic banks finance both short-term and long-term projects by using funds from *Muḍārabah* saving deposits, and they certainly give return sharing to the holders of the accounts (Ismal, 2010a, pp. 10-20).

Finally, the last demand for short-term liquidity may appear from the short-term maturity of *Muḍārabah* time deposits. Nonetheless, unlike the previous two, the *Muḍārabah* time deposits are the most predictable account for banks because they know exactly the demand for short-term liquidity from the tenors and maturity dates of these accounts. The most important one is the 1-month tenor of *Muḍārabah* time deposits, which capture 19.53% of the total deposits. Nonetheless, this tenor is mostly automatically rolled over (ARO) and the historical data only recognizes 11.84% termination of this tenor, with the rest always being rolled over (Ismal, 2009, p. 7). As such, Islamic banks are temporarily safe in utilizing the funds, but they have to be aware of the potential of time deposit terminations every month.

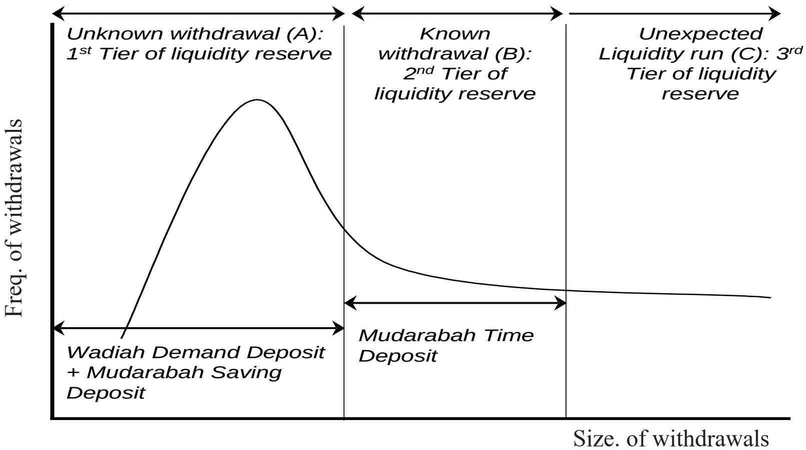
The identification of the sources of short-term demand for liquidity is the basis to compute both historical and future demand for liquidity in the following sections. The former will explain the performance of Islamic banks in managing liquidity. The latter, with ARIMA models and Bayesian technique, will look at the outlook for liquidity demand and will identify the potential and the probability of liquidity pressure as a result of greater demand for liquidity from depositors than the available liquidity held by the banks.

III. SHORT-TERM SUPPLIERS OF LIQUIDITY

Following the three sources of short-term demands for liquidity, there are sets of short-term suppliers of liquidity to fulfill any regular or irregular demand for liquidity. For simplicity, such suppliers are grouped into 1st, 2nd and 3rd tier liquid instruments based on their functions (see Figure 1). Firstly, any unpredictable liquidity withdrawals from *Waḍīʿah* demand deposits and *Muḍārabah* saving deposits are served by the 1st tier liquid instruments which are: (a) cash reserves; (b) placement of funds in Bank Indonesia (BI); and, (c) borrowing from the Islamic money market (PUAS).

Then, combining the liquid instruments in the 1st tier with the other three instruments creates the 2nd tier liquid instruments prepared to tackle any demand for liquidity from the termination of 1-month *Muḍārabah* time deposits. These three liquid instruments are: (i) withdrawing the inter-bank placement; (ii) repurchasing Bank Indonesia Sharia Certificates or SBIS (formerly known as BI Wadiah Certificates or SWBI) to BI; and, (iii) withdrawing the equity participation. Finally, in the case of a liquidity run, the 1st and 2nd tiers above are coupled with the 3rd tier liquidity suppliers containing (a) Central bank's intra day emergency funds (FLI/FPJP); (b) the Deposit Guarantee Institution (LPS); and (c) banks' capital. All of this is illustrated in areas A, B and C of Figure 1.

Figure 1. Short Term Liquid Instruments



Source: taken from Arani (2006), Promoting Islamic Financial Stability Through Risk Management Techniques in IFS. Presentation in The 2nd SEACEN-IRTI Course on Regulation and Supervision of Islamic Banks, Jogjakarta

A. Suppliers of Liquidity for Withdrawals in Waḍīʿah Demand Deposits and Muḍārabah Saving Deposits

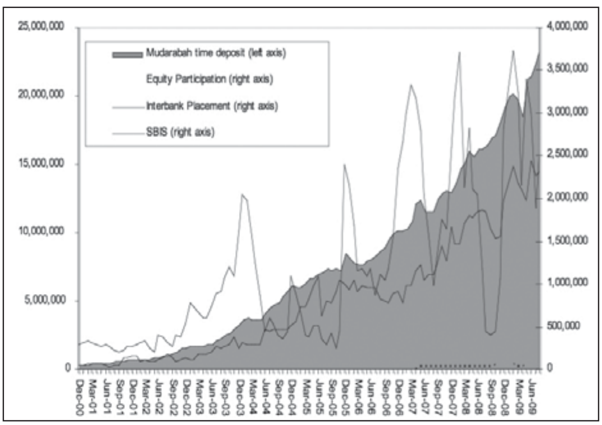
The first instrument used by Islamic banks to serve regular and short-term liquidity withdrawals from both *Waḍīʿah* demand deposits and *Muḍārabah* saving deposits is cash reserves. Islamic banks have reserved 1.98% of their total deposits in this instrument (average data from December 2000 to August 2009). If the demand exceeds stock of cash reserves, banks will use the second instrument, namely placement of funds in BI which consists of reserve requirement and excess reserves. Islamic banks allocate 19.13% of total deposits to these two liquid instruments.

If demand for liquidity still goes beyond cash reserves and placement of funds in BI, borrowing funds from PUAS by using the IMA instrument is the next alternative. This is a tradable instrument and the quickest way of getting instant liquidity although it needs strong cooperation among Islamic banks. Further, its amount is counted at 2.57% of total deposits. As displayed in Figure 2, the 1st tier liquid instruments have settled down any withdrawal from both accounts.

B. Supplier of Liquidity for Withdrawals
in Muḍārabah Time Deposits

If liquidity demand is added to the withdrawals from *Muḍārabah* time deposits, the 2nd tier liquidity reserves are available to provide extra liquidity. Besides instruments in the 1st tier, withdrawing the inter-bank placement supplies additional liquidity. This is actually a short-term allocation of the Islamic bank's funds to other banks, ready to be taken when needed. Its amount is recorded at 5.80% on average of total deposits. If this is still not enough, alternatively, Islamic banks may repurchase their funds in SBIS to BI. SBIS actually functions as an Islamic monetary instrument to absorb short-term excess liquidity in the industry. Thus, SBIS gives direct return to banks. Not only that, SBIS also functions as a liquid instrument to fill out liquidity needs by repurchasing it to BI. SBIS only represents 12.98% of total deposits.

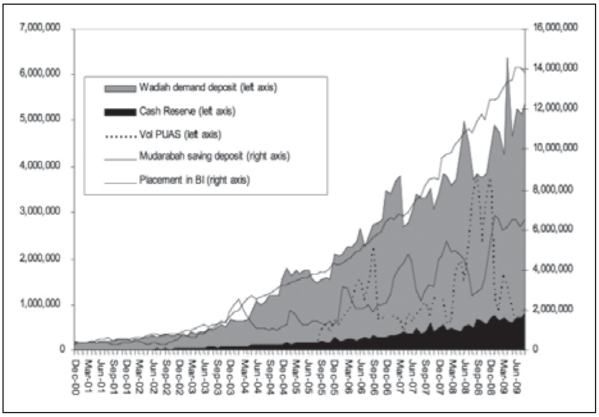
Figure 2: The 1st Tier Liquid Instruments



Source: Bank Indonesia (www.bi.go.id/statistics)

Finally, a small portion of another supplier of liquidity, namely equity participation, can be executed to strengthen the role of the 2nd tier of liquid instruments when needed. This instrument records 0.10% of total deposits. As such, the 2nd tier liquid instruments offer liquidity equivalent to 42.57% of total deposits (see Figure 3).

Figure 3: The 2nd Tier Liquid Instruments



Source: Bank Indonesia (www.bi.go.id/statistics)

1. Suppliers of Liquidity in Liquidity Distress

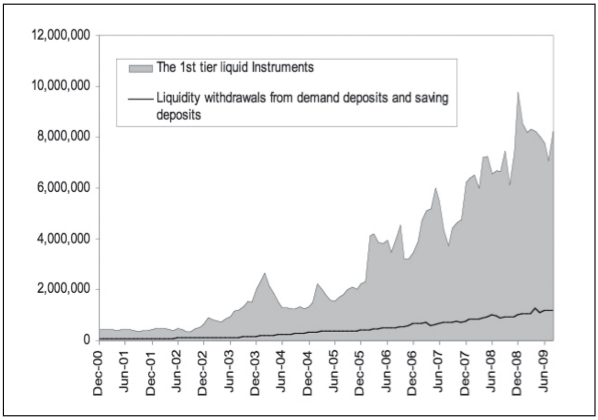
When the needs for short-term liquidity still surpass liquidity discussed above, Islamic banks can use the last option which is the 3rd tier liquid instruments. Firstly, by using FLI/FPJP. Although this requires some specific pre-requisite from the monetary authority, this is the instant way to gain on-the-spot liquidity. Secondly, Islamic banks can also use their capital as long as it does not violate the capital adequacy ratio (CAR) requirement. Finally, contacting government institutions (LPS) may guarantee depositors' funds in the banks.

Fortunately, Islamic banks rarely use the 3rd tier liquid instruments because they have successfully balanced the growing trend of deposits and high demand of financing from the real sector. Moreover, the market share is around 2% of the total banking industry and its interactions, operations, etc are not as complicated as the conventional counterparty. Islamic depositors on the other hand also show strong motivation and religious intention to deal with the banks and seem far away from rushing the banks for some unrealistic and non-Islamic motivations such as foreign exchange speculation, gambling and interest-rate speculation.

IV. HISTORICAL PERFORMANCE OF THE SHORT-TERM LIQUIDITY MANAGEMENT

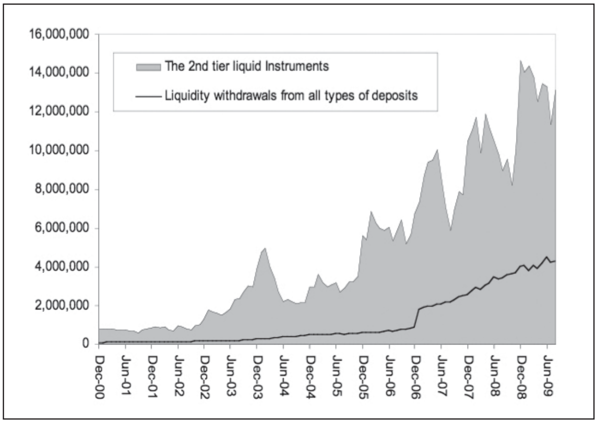
The historical performance (December 2000–Aug 2009) of the 1st and 2nd tiers to provide the required liquidity to depositors has been quite successful. The total amount of short-term liquid instruments stands above the demand for liquidity. Figures 4 and 5 below prove this point.

Figure 4: The 1st Tier and Liquidity Demanded



Source: Bank Indonesia (www.bi.go.id/statistics)

Figure 5: The 2nd Tier and Liquid Demanded



Source: Bank Indonesia (www.bi.go.id/statistics)

Nonetheless, this performance may not possibly apply if (Ismal, 2010b, p. 9):

a) Economic pressures hit the country followed by a very tight monetary policy like the one that occurred in 1997/1998. When the interest rate is high, some Islamic banking depositors tend to switch their deposits to the conventional banks for a higher interest rate return.
b) Islamic banks are proven to be un-Islamic and do not have either proper banking facilities or services. Up to now, the Council of Indonesian Sharīʿah Scholars (Majelis Ulama Indonesia/ MUI) has strictly guided the operation of Islamic banking to prevent it from non-compliant activities. Further, there is mutual cooperation between Islamic windows and their parent banks to arrange office channeling (using the parent bank's networks in all provinces) to reach more depositors.
c) Islamic banks do not implement short-term financing orientation. Due to the characteristics of the deposits and depositors (short-term, continuous and positive expectation of profit), Islamic banks play safe by advancing most of the funds in the short-term, safe, liquid and pre-determined financing instruments.

The next part of this paper will investigate the future trend of short-term liquidity demand. Technically, every liquid instrument and deposit will be modelled and forecast with the ARIMA model. Then, Bayesian technique with binomial distribution is used to show the probability of occurrence of irregular liquidity withdrawals and liquidity run. Finally, the future performance of short-term liquidity management will be checked and analysed, particularly for the next two years.

V. FUTURE PERFORMANCE OF SHORT-TERM LIQUIDITY MANAGEMENT

A. Autoregressive Integrated Moving Average (ARIMA)

In order to assess the future performance of liquidity management and analyse the resiliency of the industry, the estimated numbers are generated with the ARIMA model. ARIMA was firstly developed by Box and Jenkins in 1976. Unlike structural models which are composed of some independent variables, ARIMA employs autoregressive (AR) and moving average (MA) plus integration order term. AR(*p*) describes the dependent variable (Y_t) based on its past (lag) value (of order *p*) or the same as the dynamic model. AR is also commonly known as the one that uses lag value of the residual of the regression.

On the other hand, MA(*q*) explains the dependent variable (Y_t) based on past value of the error terms (ε_t) which are the moving average of past error terms of order *q* added into the mean value of Y_t. MA is also commonly known to be the one that occupies lag value of forecast error to improve current forecast. The general equation of ARIMA is:

$$Y_t = \beta_0 + \theta_1 Y_{t-1} + \theta_2 Y_{t-2} + \ldots + \theta_p Y_{t-p} + \varepsilon_t + \Phi_1 \varepsilon_{t-1} + \Phi_2 \varepsilon_{t-2} + \ldots. + \Phi_q \varepsilon_{t-q} \quad (1)$$

The process of modelling with the ARIMA approach follows four steps (Firdaus, 2006, p.19): (i) identification of variables: (ii) estimation of model: (iii) model evaluation: and, (iv) model forecasting.

In *identification*, a series is investigated on whether it has a seasonal pattern or not; is stationary or non-stationary; and, pattern of auto correlation function (ACF) and partial auto correlation function (PACF) such that:

$$Z_t = \mu + \theta_1 Z_{t-1} + \theta_2 Z_{t-2} + \ldots + \theta_p Z_{t-p} + \varepsilon_t - \Phi_1 \varepsilon_{t-1} - \Phi_2 \varepsilon_{t-2} - \ldots. - \Phi_q \varepsilon_{t-q} \quad (2)$$

From (2) Z_t is said to be stationary, if the following conditions are met: (a) constant mean for all investigation periods or $E(Z_t) = \mu$ for all t; (b) constant variance or $Var(Z_t) = E[(Z_t - \mu)^2] = \sigma^2_x$ for all t; and, (c) constant covariance or $Cov(Z_t, Z_{t-k}) = E[(Z_t - \mu)(Z_{t-k} - \mu)] = \gamma_k$ for all t.

Next, the *estimation* step will find the most robust estimated model combining AR and MA or both of them. Model *evaluation* will conduct several diagnostic tests to check the accuracy of the estimated model and the actual ones such as residual test, coefficient of variables, etc. Finally, *forecasting* will produce future data of every model under two assumptions: (a) linear forecasting; and, (b) selected model with the most efficient variables.

The ARIMA process in the subsequent section involves nine variables and is grouped into two: (i) liquidity demanders: *Waḍīʿah* demand deposit (WD), *Muḍārabah* saving deposit (MS) and 1-month *Muḍārabah* time deposit (MT1); and, (ii) liquidity suppliers: cash reserves (CR), placement of funds in BI (PB), inter-bank placement (IP), BI Sharia Certificate (SB), equity participation (EP), and borrowing funds from Islamic money market (PS). Lastly, the group of liquidity suppliers will be regrouped as the 1st tier and the 2nd tier liquid instruments to serve liquidity demand from *Waḍīʿah* demand deposits and *Muḍārabah* saving deposits (the 1st tier) and *Muḍārabah* time deposits (the 2nd tier).

1. Identification of variables

First of all, statistical summaries of variables of liquidity demanders and suppliers are given by Tables 1 and 2 respectively. From the standard deviation value, all of the variables have indications of upward trends as previously illustrated in Figures 2 and 3. In fact, this is one of the causes of the non-stationarity. Thus, every variable needs to be tested for stationarity.

Table 1. Statistical Summary (million Rp)

Vriable	Mean	Median	Std Deviation
Cash Reserve (CR)	256,042	183,344	222,778
Placement of Funds in BI (PB)	2,190,674	1,454,641	1,835,653
Inter Bank Placement (IP)	795,092	734,125	678,324
Equity Participation (EP)	16,920	5,660	24,353
Islamic Money Market (PS)	578,256	84,000	847,278
BI Sharia Certificate (SB)	1,207,924	882,000	993,8585

Table 2. Statistical Summary (million Rp)

Vriable	Mean	Median	Std Deviation
Wadiah Deman Deposit (WD)	1,692,825	1,403,000	141,947
Mudarabah Saving Deposit (MS)	4,705,904	3,545,000	4,154,258
Mudarabah Time Deposit (MT1)	8,783,393	7,259,519	7,822,117

In this case, unit root tests were carried out to check stationarity of every variable which can be explained by taking a simple AR (1) process:

$$Y_t = a_0 + a_1 Y_{t-1} + \varepsilon_t \tag{3}$$

where Y_{t-1} is lag of an independent variable which might contain a constant and trend; a is a constant; and, ε is assumed to be white noise (Enders, 1995: 70). If $|a_1| \geq 1$, if Y_t is a non-stationary series, it has a trend, does not have a constant mean, and has a time variant of variance. Therefore, the stationarity can be evaluated by testing whether the absolute value of a_1 is strictly less than one.

Two widely used tests are Augmented Dickey-Fuller (ADF) (1979) and Phillips and Perron (PP) (1988). ADF re-estimates (3) by subtracting Y_{t-1} such that (Lutkepohl & Kratzig, 2004, p. 54):

$$\Delta Y_t = \alpha Y_{t-1} + \sum_{j=1}^{p=1} a^*_j \Delta Y_{t-j} + \varepsilon_t \tag{4}$$

The process is integrated when a(1) = 1- a(1) -…- a_p = 0 where α = -a(1) and a_j^* = -(a_{j+1}+…+a_p). Null and alternative hypothesis are H_0: $\alpha = 0$ and H_1: $\alpha < 0$; with $t_\alpha < \alpha/(se(\alpha))$. The basic idea of ADF is to correct high order serial correlation by adding lagged difference terms in the right-hand side of the equation.

Meanwhile, Phillips and Perron (PP) use nonparametric statistical methods to take care of the serial correlation in the error terms without adding lagged difference terms (Gujarati, 2004, p. 818). Tables 3 and 4 provide the results for the ADF and PP tests (105 frequencies of data) which include intercept and use 12 lags based on Schwarz info criterion.

Table 3. Stationary Test of Liquidity Suppliers

Variable Name	Augmented Dickey-Fuller		Phillip and Perron	
	Level	1st Difference	Level	1st Difference
CR	2.8039*	-16.9189***	0.7722	-21.6681***
PB	-1.0213	-7.2559***	-0.2546	-6.8677***
IP	0.5743	-12.8870***	1.8091	-14.6011***
EP	-0.4352	-9.4668***	0.5506	-11.4327***
PS	-1.5714	-12.2915***	-2.7211*	-12.0391***
SB	-2.4629	-9.2767***	-2.6883*	-9.6712***

Note: ***,**,* refers to stastical significance of 1%, 5% and 10%

Table 4. Stationary Test of Liquidity Demanders

Variable Name	Augmented Dickey-Fuller		Phillip and Perron	
	Level	1st Difference	Level	1st Difference
WD	0.0282	-15.2957***	0.3817	-22.1848***
MS	5.6345	-3.5843***	5.1519	-10.9070
MT1	3.4664**	-14.5310***	4.1683	-14.8723***

Note: ***,**,* refers to stastical significance of 1%, 5% and 10%

Tables 3 and 4 reveal that all variables of liquidity suppliers and demanders are stationary (1% statistical significance) in 1^{st} difference (integrated in order 1). Therefore, the estimated ARIMA models will integrate all variables with order *p* for AR, order *q* for MA or *(p,d,q)*. The next identification process is checking the pattern of AR and MA through a correlogram test for behaviour patterns of ACF and PACF. There are at least three patterns commonly found in the ARIMA model: (i) correlogram test which produces zero value in all periods of auto correlation function (ACF = 0) namely the white noise ACF function; (ii) correlogram test which shows cut off ACF pattern (usually) between the first period of auto correlation function and the second or third one: and, (iii) correlogram test with decreasing pattern of ACF from the beginning of the period until the end of the period, namely dying down pattern.

In modelling ARIMA, when ACF shows a dying down pattern and PACF indicates a cut off pattern, the pure auto regressive (AR) model should be employed with the formula of:

$$Z_t = \delta + \theta_1 Z_{t-1} + \theta_2 Z_{t-2} + ... + \varepsilon_t \quad (5)$$

where Z_t and Z_{t-q} are the current and prior values of the stationary series; δ and θ are the values of parameters (coefficient and constant values); and, ε_t is the residual with expected value of zero.

Table 5. Correlogram of ACF and PACF

Period	EP		CR		PB		IP		SB		PS		WD		MS		MT1	
	ACF	PACF	ACF	PACF	ACF	PACF	ACF	PACF	ACF	PACF	ACF	PACF	ACF	PACF	ACF	PACF	ACF	PACF
1	-0.015	-0.015	-0.474	-0.474	0.311	0.311	-0.244	-0.244	0.072	0.072	-0.135	-0.135	-0.397	-0.397	-0.053	-0.053	-0.353	-0.353
2	-0.281	-0.281	-0.231	-0.587	-0.04	-0.152	0.027	-0.034	0.006	0.001	-0.43	-0.456	0.031	-0.15	0.027	0.024	0.005	-0.136
3	-0.01	-0.021	0.57	0.232	-0.161	-0.112	-0.168	-0.18	-0.047	-0.048	0.289	0.184	-0.061	-0.129	0.398	0.402	0.14	0.109
4	-0.005	-0.092	-0.375	-0.019	-0.112	-0.03	-0.119	-0.224	-0.149	-0.143	0.228	0.14	-0.018	-0.113	0.065	0.131	-0.161	-0.08
5	-0.255	-0.292	-0.13	-0.161	-0.325	-0.345	0.052	-0.056	-0.19	-0.174	-0.155	0.116	-0.051	-0.142	0.084	0.087	0.199	0.146
6	-0.004	-0.064	0.408	-0.014	-0.3	-0.159	0.102	0.066	-0.206	-0.198	-0.191	-0.158	0.032	-0.079	0.273	0.149	0.116	0.253
7	0.258	0.108	-0.296	-0.026	-0.094	-0.037	-0.08	-0.109	-0.225	-0.251	-0.024	-0.253	0.028	-0.015	0.006	-0.035	0.037	0.264
8	-0.009	-0.046	-0.026	0.02	-0.012	-0.161	0.177	0.131	-0.038	-0.103	0.155	-0.032	-0.102	-0.141	0.211	0.162	-0.075	0
9	-0.008	0.078	0.324	0.138	-0.055	-0.17	-0.14	-0.026	-0.098	-0.236	-0.171	-0.189	-0.001	-0.15	0.178	0.065	0.168	0.174
10	-0.011	-0.074	-0.376	-0.158	-0.014	-0.147	0.139	0.126	0.01	-0.188	-0.172	-0.04	0.085	-0.009	-0.015	-0.035	-0.145	-0.076
11	-0.006	0.019	0.164	0.091	0.192	0.023	-0.118	-0.032	0.207	-0.015	0.124	-0.033	0.081	0.121	0.235	0.098	0.187	0.098
12	-0.007	0.086	0.209	0.152	0.402	0.266	0.053	0.055	0.279	0.099	0.1	0.085	0.015	0.134	0.12	0.009	-0.006	-0.067
13	-0.007	-0.005	-0.27	0.258	0.207	-0.011	-0.051	-0.014	0.233	0.115	-0.101	0.026	-0.157	-0.109	0.134	0.168	-0.014	0.012
14	-0.01	-0.009	0.098	0.038	0.074	0.072	0.031	0.006	0.023	-0.057	-0.078	-0.071	-0.031	-0.166	0.125	-0.023	0.093	-0.02
15	-0.007	-0.014	0.177	0.104	-0.036	0.012	0.103	0.146	-0.039	-0.048	0.07	-0.106	0.093	0.035	0.134	0.062	-0.127	-0.099
16	-0.004	-0.037	-0.238	0.123	-0.091	0.015	-0.043	-0.031	0.036	0.11	0.093	-0.079	0.041	0.125	0.038	-0.091	0.138	-0.007
17	0.223	0.308	0.062	0.071	-0.434	-0.273	-0.083	-0.059	-0.145	0.007	-0.081	-0.047	-0.028	0.024	0.144	-0.004	-0.063	-0.061
18	-0.007	-0.009	0.13	0.006	-0.241	0.101	0.112	0.089	-0.26	-0.127	-0.115	-0.101	0.07	0.077	0.092	0.024	-0.007	-0.115
19	-0.007	0.139	-0.158	0.069	0.002	0.052	-0.233	-0.162	-0.227	-0.173	0.079	-0.031	-0.049	0.087	-0.03	-0.156	-0.015	-0.114
20	-0.006	0.047	0.038	-0.043	0.097	-0.003	0.108	-0.082	-0.043	0.008	0.002	-0.125	-0.025	0.059	0.036	-0.111	0.104	0.077
21	-0.007	0.052	0.023	-0.145	-0.03	-0.054	-0.051	-0.05	-0.075	-0.095	-0.08	-0.031	0.001	-0.036	0.155	0.027	-0.061	0.033
22	-0.239	-0.127	0.07	0.204	0.123	0.082	0.075	0.014	0.092	0.018	-0.061	-0.139	0.008	-0.082	0.007	0.023	0.027	0.052
23	-0.002	0.021	-0.133	-0.1	0.11	-0.165	0.074	0.02	0.088	-0.1	0.076	-0.007	0.005	0.04	-0.03	-0.068	-0.067	-0.088
24	0.242	0.066	0.141	0.08	0.142	0.082	-0.103	-0.088	0.245	0.005	0.124	0.087	-0.133	-0.053	0.076	-0.085	-0.041	0.013
25	-0.008	0.012	-0.024	-0.103	0.026	-0.075	0.075	0.114	0.112	-0.079	-0.137	-0.088	0.173	0.115	-0.02	-0.068	0.168	0.107
26	-0.008	0.022	-0.085	0.006	0.097	0.056	0.038	0.1	0.081	-0.015	-0.032	-0.013	0.014	0.109	-0.001	-0.068	-0.087	0.082
27	-0.008	-0.072	0.099	-0.075	0.059	0.035	-0.107	-0.017	-0.117	-0.242	0.342	0.186	-0.069	-0.082	0.052	0.039	0.105	0.121
28	-0.003	-0.009	-0.033	-0.042	-0.025	0.051	0.085	0.039	0.031	-0.084	-0.087	-0.065	0.086	0.046	-0.013	0.003	-0.136	-0.029
29	-0.004	0.142	-0.06	-0.065	-0.155	0.134	-0.175	-0.077	-0.014	0.023	-0.16	0.013	-0.078	0.003	-0.007	-0.028	-0.093	-0.165
30	0.018	0.002	0.114	0.024	-0.131	0.037	0.085	-0.022	-0.046	0.133	0.113	-0.124	0.047	0.059	0.102	0.094	0.137	-0.006
31	-0.025	-0.034	-0.035	-0.014	-0.062	-0.004	0.071	0.09	-0.139	0.024	0.084	-0.024	-0.027	0.068	0.001	0.112	-0.039	-0.053
32	0.018	-0.014	-0.12	0.02	-0.102	-0.128	-0.012	-0.003	-0.134	-0.126	-0.065	-0.001	0.051	0.089	-0.068	-0.029	-0.004	-0.097
33	-0.004	-0.055	0.188	-0.068	-0.064	0.029	-0.053	-0.147	-0.07	-0.102	-0.011	0.19	-0.124	-0.076	0.059	0.006	0.008	-0.089
34	-0.004	0.032	-0.091	0.008	0.169	0.064	0.072	0.155	-0.071	-0.138	-0.069	-0.024	0.069	-0.019	0.02	0.031	-0.015	0.043
35	-0.004	-0.017	-0.05	0.048	0.115	-0.046	-0.079	-0.013	0.046	-0.073	0.045	-0.024	-0.059	-0.093	-0.053	-0.002	-0.013	0.135
36	-0.004	-0.143	0.107	-0.08	0.015	-0.018	-0.04	-0.22	0.234	0.03	0.027	-0.005	0.036	-0.076	-0.02	-0.036	0.029	0.003

However, when ACF shows a cut off pattern while PACF is dying down, the pure moving average (MA) model should be employed with the formula of:

$$Z\tau = \mu + \varepsilon_t - \Phi_1\varepsilon_{t-1} - \Phi_1\varepsilon_{t-2} - .... - \Phi_q\varepsilon_{t-q} \quad (6)$$

where Z_t is the current value of stationary series; ε_t and ε_{t-q} are a white noise residual and historical residual; and, Φ_1 and μ are values of a constant and coefficient of variables. Finally, when both ACF and PACF depict a dying down pattern, a combination of AR and MA is used with the formula written in equation (2). In fact, if computation of ACF and PACF finds dying down patterns of all variables (see Table 5), then the combination of AR and MA is confirmed.

2. Estimation of models

Estimation of nine models has fitted the ARIMA regression requirements and every estimated model below is presented with values of coefficients, t-statistics (in brackets), r-squared and LM test.

$$\Delta CR_t = \mu + \theta_1 AR_{t-1} + \theta_2 AR_{t-3} + \theta_3 AR_{t-4} + \varepsilon_t - \Phi_1 MA_{t-2} - \Phi_2 MA_{t-3} - \Phi_3 MA_{t-5} - \Phi_4 MA_{t-9} \quad (7)$$

11243 –0.729 0.891 0.544 –0.656 –0.689 0.366 0.232

[2.949] [7.207] [11.079] [4.653] [-6.719] [-6.457] [2.849] [3.756]

R-squared 0.5612 AIC 24.019 LM test 0.8278

$$\Delta EP_t = \mu + \theta_1 AR_{t-7} + \varepsilon_t - \Phi_1 MA_{t-2} - \Phi_2 MA_{t-5} \quad (8)$$

1011.3 0.664 -0.216 -0.503

[1.549] [5.120] [-2.158] [-5.397]

R-squared 0.283 AIC 20.452 LM test 0.6317

$$\Delta PB_t = \mu + \theta_1 AR_{t-3} + \varepsilon_t - \Phi_1 MA_{t-1} - \Phi_2 MA_{t-5} - \Phi_3 MA_{t-6} \quad (9)$$

57886 -0.257 0.248 -0.393 -0.374

[3.455] [-2.515] [2.599] [-4.072] [-3.767]

R-squared 0.242 AIC 28.643 LM test 0.111

$$\Delta IP_t = \mu + \theta_1 AR_{t-1} + \theta_2 AR_{t-3} + \theta_3 AR_{t-4} + \varepsilon_t - \Phi_1 MA_{t-1} - \Phi_2 MA_{t-3} - \Phi_3 MA_{t-4} \quad (10)$$

24196 0.396 0.565 -0.706 -0.739 -0.682 0.916

[3.082] [4.921] [5.653] [-8259] [-20.917] [-14.435] [22.371]

R-squared 0.147 AIC 26.257 LM test 0.3361

$$\Delta PS_t = \mu + \theta_1 AR_{t-1} + \theta_2 AR_{t-2} + \varepsilon_t - \Phi_1 MA_{t-3} - \Phi_2 MA_{t-4} \quad (11)$$

3029 -0.170 -0.334 0.453 0.298

[0.070] [-1.715] [-3.308] [4.664] [3.060]

R-squared 0.308 AIC 28.563 LM test 0.8758

$$\Delta SB_t = \mu + \theta_1 AR_{t-6} + \varepsilon_t - \Phi_1 MA_{t-6} - \Phi_2 MA_{t-7} \quad (12)$$

46693.44 -1.139 1.035 -0.082

[1.434] [-22.381] [15.832] [-1.835]

R-squared 0.234 AIC 28.854 LM test 0.1220

$$\Delta WD_t = \mu + \theta_1 AR_{t-1} + \theta_2 AR_{t-2} + \varepsilon_t - \Phi_1 MA_{t-2} - \Phi_1 MA_{t-3} - \Phi_1 MA_{t-5} \quad (13)$$

42129.81 -0.521 -0.818 0.665 -0.497 -0.354

[3.736] [-5.568] [-4.518] [3.807] [-3.438] [-3.210]

R-squared 0.204 AIC 28.237 LM test 0.148

$$
\begin{array}{llllllll}
\Delta MS_t = & \mu & + & \theta_1 AR_{t-3} + \varepsilon_t & - & \Phi_1 MA_{t-3} & - & \Phi_1 MA_{t-8} \\
 & 192047 & & 0.929 & & -0.684 & & 0.287 \\
 & [1.162] & & [11.900] & & [7.347] & & [3.877] \\
 & \text{R-squared } 0.273 & & & & \text{AIC } 27.016 & & \text{LM test } 0.3177
\end{array}
\quad (14)
$$

$$
\begin{array}{llllllllll}
\Delta MT1_t = & \mu & + & \theta_1 AR_{t-1} & + & \theta_2 AR_{t-3} & + & \theta_2 AR_{t-4} & + \varepsilon_t - & \Phi_1 MA_{t-1} - \Phi_1 MA_{t-3} \\
 & 161711 & & -0.334 & & 0.953 & & 0.309 & & -0.060 \quad -1.245 \\
 & [1.186] & & [-3.445] & & [13.866] & & [2.665] & & [-3.049] \quad [-50.980] \\
 & \text{R-squared } 0.3824 & & \text{AIC } 29.0983 & & \text{LM test } 0.1761 & & & &
\end{array}
\quad (15)
$$

Every equation has found the robust past (lag) value(s) of dependent variable (Y_t) or AR(*p*) and the error terms (ε_t) or MA(*q*) that explain the dependent variable. Further, these models are utilised to produce estimated numbers, which is the purpose of this subsection, to assess the future performance of the demand and supply of liquidity and the resiliency of the industry.

3. Forecasting of the models

The nine ARIMA models generate estimated values (in series) from September 2009 to December 2011. The decision to choose this extended period arose because of three reasons (Ismal, 2010b, p. 17). Firstly, the accuracy of the model is believed to be strong in the short-term rather than the long-term. Secondly, using it for more than three years ahead can lead to a biased forecast because of the dynamic progress of this industry. In the near future, new Islamic banks and Islamic banking units might join the industry, new banking regulations might come into effect to strengthen and support the development of Islamic banks. Moreover, the issuance of *sukuk* might give another stimulus to this industry.

Thirdly, the purpose of this paper is to generate ideas to Islamic banks and regulators on how to manage demand and supply of liquidity through liquidity withdrawal scenarios. The first scenario is regular liquidity withdrawals, which is the current management of liquidity. The second one is irregular liquidity withdrawals where the demand for liquidity rises above the former scenario. This scenario is possible when depositors want to hold more cash due to unstable economic conditions. Lastly, is a liquidity run when Islamic banks lose the trust of depositors, and bank rushes and bank crises occur, like the one that occurred in 1997/1998.

B. Bayesian Technique and Binomial Experiment

The statistical analysis in general can be grouped into two philosophies: (a) the frequentist and ARIMA, which are examples from one group and; (b) the Bayesian. Unlike the former, which treat the statistical phenomena based on their historical frequency, the latter views them based on a subjective interpretation of probability. Moreover, the former considers the source of uncertainty to be the randomness inherent in the realization of random variables while the latter considers it subject to modification if new information becomes available (Rachev, Svetlozar T, Hsu, John S. J, Bagasheva, Biliana S, Fabozzi, Frank J., 2008, p. 2).

Hence, in the Bayesian technique there is a prior probability and posterior probability in every statistical case, and its process goes through at least two steps: (i) formulating the prior probability to reflect the existing information and; (ii) constructing the quantitative model to incorporate uncertainty intrinsic in model assumptions. The basic formula of the Bayesian technique refers to the discrete Bayes theorem, which is (Koop, 2003, p. 1):

$$P(B|A) = \frac{P(A|B)\,P(B)}{P(A)} \tag{16}$$

Where B is the information prior to observing the data so that the belief that B will occur is expressed as the probability of B or P(B). P(B|A) is the conditional probability of the data given the truth of prior information B. Finally, after observing the data (A), such belief in B changes to be P(B|A) as written in equation (16).

In the Bayesian technique, it is common to use the symbol α to denote the constant term with respect to random variables being dropped from its density function, such that:

$$p(x)\alpha x \quad \text{or} \quad \log(p(x)) = const + \log(s) \quad \text{or} \quad \text{simply } \log(p(x))\alpha \log(x) \tag{17}$$

The technique involves an educated guess as to how a statistical phenomenon is generated. For example, there is a statistical distribution of a statistical case called Y, noted as: $p(y|\theta)$, where y is the realization of a random variable Y and θ is the parameter of the p distribution. Then, with n observations, such that y_1, y_2, y_3,…y_n, the joint density function of Y for a given value of θ is:

$$f(y_1, y_2, \ldots, y_n | \theta) \quad (18)$$

Equation (18) can also be treated as a function of an unknown parameter θ, namely, a likelihood function, such that:

$$L(\theta | y_1, y_2, \ldots, y_n) = f(y_1, y_2, \ldots, y_n | \theta) \quad (19)$$

One of the purposes of Bayesian technique is to know the probability value of θ, which explains the probability of an event occurring; i.e, it is a measure of the degree of belief regarding the occurrence of an uncertain event. Hence, using Bayesian technique to support the output of ARIMA is reasonable and beneficial.

However, a binomial experiment is conducted under the assumption that the source of randomness is binary (i.e., it only takes two alternative modes/states) and the probability of both states is constant (Rachev, et al., 2008, p. 16). Particularly, the binomial random variable is the number of occurrences of the state of interest. For example, with a state of interest X, the probability of X under the certain condition of θ is formulated in binomial function as:

$$P(X = x | \theta) = \binom{n}{x} \theta^x (1-\theta)^{n-x} \quad \text{with } x = 0,1,2,3 \ldots,n \quad (20)$$

n is the sample size whilst $\binom{n}{x} = \frac{n!}{x!(n-x)!}$. Further, in order to cover prior information, the binomial function is modified by including a beta function to replace $\binom{n}{x}$, such that (Rachev, et al., 2008, p. 17):

$$\pi(\theta | \alpha, \beta) = \frac{1}{B(\alpha, \beta)} \theta^{\alpha} (1-\theta)^{\beta - 1} \quad \text{where } 0 \le \theta \le 1 \quad (21)$$

Then, the posterior probability has a function of: $P(\theta | x) = \frac{L(\theta | x)\pi(\theta)}{f(x)}$ (22)

where $f(x) = \int L(\theta | x) \pi(x) d(\theta)$ (23)

and is assumed to be constant (Congdon, 2005, p. 2), so that the posterior probability becomes $P(\theta | x) \alpha L(\theta | x) \pi(\theta)$ with α representing equation (23). After attaching the beta function in the posterior probability function, $P(\theta|x)\alpha L(\theta|x)\pi(\theta)$ now becomes $\alpha\theta^{x}(1-\theta)^{n-x}\theta^{\alpha^{*}-1}(1-\theta)^{\beta-1}$ and the value of the posterior probability is computed as the value of $\frac{\alpha^{*}}{(\alpha^{*}+\beta)}$ (Rachev, et al., 2008, p. 20). α^* is used to differentiate it from α, which is the constant term in the Bayesian equation.

The Bayesian technique under binomial experiment is employed in this paper in order to strengthen and complete the findings from the ARIMA models. Especially, Bayesian technique computes the probability of occurrence of irregular liquidity withdrawal and liquidity run, which it is very essential to identify, after generating the estimated numbers of the demand for liquidity and supply of liquidity from ARIMA. The combination of ARIMA and Bayesian can hopefully complete the future assessment of the demand for and supply of liquidity in the Indonesian Islamic banking industry.

C. Result of the Bayesian Technique and Binomial Experiment

Applying the two states, as stated before for the case of irregular liquidity withdrawals, it is assumed that the increasing trend of the demand for liquidity withdrawals is coded as X and its probability of occurrence is θ. Based on historical and estimated data from December 2000 – December 2011, x happens 112 times or x = 112 out of the total 133 observations, or n = 133. Thus, the binomial function is formulated as:

$$P(X=112|\theta)=\binom{133}{112}\theta^{112}(1-\theta)^{133-112} \qquad (24)$$

The prior information, which is a subjective opinion, is named as $\pi(\theta)$ and is assumed to be represented by the total 100 points of α and β. The 100 points of α and β are broken down based on the subjective belief that the increasing trend of the demand for liquidity will be likely to happen in $\alpha = 8$ where $0 \leq \alpha \leq 10$, leaving the value of $\beta = 92$, coming from $100 - \alpha$.

At last, the posterior probability, i.e., the prior probability updated with the historical data, is computed as:

$$\alpha\theta^{112}(1-\theta)^{21}\theta^{8-1}(1-\theta)^{92-1} \text{ such that:} \qquad (25)$$

$$\alpha\theta^{120-1}(1-\theta)^{113-1} \tag{26}$$

and this equation (26) resembles $\alpha\theta^{\alpha-1}(1-\theta)^{\beta-1}$, meaning that the value of α = 120, β = 113, and the value of posterior probability is $\frac{\alpha}{(\alpha+\beta)}$ = 0.5150 or 51.50%. This figure implies that the probability of occurrence of irregular liquidity withdrawals is moderate, which is 51.50%.

For the case of a liquidity run, the increasing trend of demand for liquidity leading to a liquidity run records the same number as that in irregular demand for liquidity withdrawals, which is 112 or x = 112, out of the total 133 observations, or n = 133. Thus, the binomial function is formulated as:

$$P(X=112|\theta)=\binom{133}{112}\theta^{112}(1-\theta)^{133-112} \tag{27}$$

The prior information is assumed to be α = 4 where 0 ≤ α ≤ 10, leaving the value of β = 96 because a liquidity run has never happened in the industry so far. Then, the posterior probability (i.e., the prior probability updated with the historical data) is computed as:

$$\alpha\theta^{112}(1-\theta)^{21}\theta^{4-1}(1-\theta)^{96-1} \text{ such that,} \tag{28}$$

$$\alpha\theta^{116-1}(1-\theta)^{117-1} \tag{29}$$

and this equation (29) resembles $\alpha\theta^{\alpha-1}(1-\theta)^{\beta-1}$, meaning that the value of α = 116, β = 117 and the value of posterior probability is $\frac{a}{(a+b)}$ = 0.4978 or 49.78%. The same as the probability of occurrence of irregular liquidity withdrawal, the probability of occurrence of a liquidity run is also moderate: 49.78%.

D. Resiliency of the Islamic Banking Industry

1. Resiliency of the 1st tier liquid instruments

In order to examine the resiliency of the 1st tier liquid instruments, three scenarios of liquidity withdrawals from both *Waḍīʿah* demand deposits and *Muḍārabah* saving deposits are determined. The first scenario is regular liquidity withdrawals where the future demand for liquidity is computed based on the historical pattern of liquidity withdrawals. The average monthly liquidity withdrawals of *Waḍīʿah* demand deposits and *Muḍārabah* saving deposits are found to be 8.85% and 5.39% of each monthly balance. Based on this regular pattern and the output of ARIMA forecasting of liquidity demanders and suppliers, the resiliency of the 1st tier liquid instruments against regular liquidity withdrawals is drawn in the thick line in Figure 6.

Figure 6. Resiliency of the 1st Tier

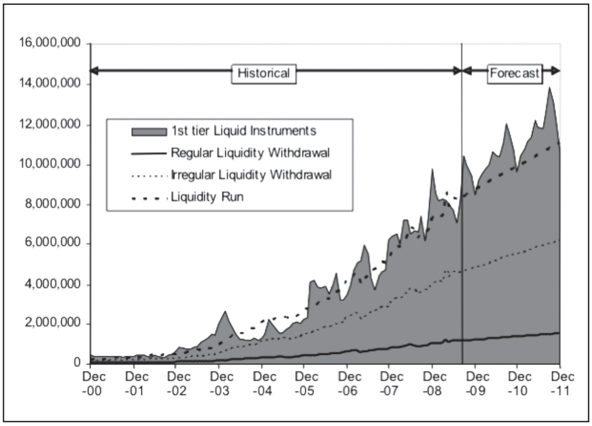
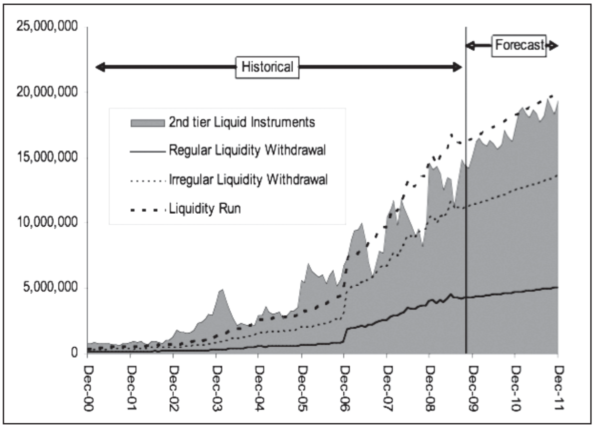


Figure 7. Resiliency of the 2nd Tier



The second scenario is the irregular liquidity withdrawal. It is assumed when liquidity withdrawals from both accounts increase up to a quarter (25%) of each monthly balance. As such, the resiliency of the 1st tier liquid instruments against irregular liquidity withdrawal is drawn in the thin dotted line in Figure 6. The last scenario is a liquidity run with the assumption that 45% of each monthly balance is gone. A severe scenario of a liquidity run (i.e. more than 45%) is not considered because the 45% assumption should have given a strong signal to take emergency actions to avoid a further worsening scenario. The resiliency of the 1st tier liquid instruments against a liquidity run is drawn in the thick dotted line in Figure 6.

2. Resiliency of the 2nd tier liquid instruments

The existence of the 2nd tier should strengthen the supply of liquidity to handle the additional demand for liquidity from 1-month *Muḍārabah* time deposits besides the two previous accounts. The first scenario is regular liquidity withdrawal. Historical data shows that the average monthly liquidity terminations of 1-month *Muḍārabah* time deposits are 11.84% of each monthly balance. This fact together with ARIMA's output test the ability of the 2nd tier to settle down such a scenario. The thick line in Figure 7 depicts the result of this scenario.

The second scenario is the irregular liquidity withdrawal. It is when the terminations of 1-month *Muḍārabah* time deposits reach

25% of each monthly balance. This assumption and the supply of liquidity from the 2nd tier liquid instruments are illustrated in the thin dotted line in Figure 7. Finally, the harshest condition occurs in the third scenario when a liquidity run occurs. This is if the terminations of 1-month *Muḍārabah* time deposits occur at 30% of each monthly balance and is explained by the thick dotted line in Figure 7.

However, based on the result of the Bayesian technique, the probability of occurrence of irregular liquidity withdrawal and of a liquidity run are very moderate. Fortunately, it might be because the performance of Islamic banks has been satisfactory so far and the public is still confident about depositing money in Islamic banks. However, considering that Islamic banks exist in the same level playing field with conventional banks, the possibility of negative impacts from conventional banking operations should be taken into account, and this is not captured in the Bayesian computation in this paper.

VI. FINDINGS AND SUGGESTIONS

The overall analysis of the demand and supply of liquidity in the Indonesian Islamic banking industry gives rise to some important findings:

a) Historically, the 1st and 2nd tier liquid instruments perform well to supply and match short-term demand for liquidity during regular and even irregular liquidity withdrawal conditions. This is clearly seen in the historical performance of the 1st and 2nd tier liquid instruments to serve monthly liquidity withdrawals from *Waḍīʿah* demand deposits and *Muḍārabah* saving deposits (1st tier) and 1-month *Muḍārabah* time deposits (2nd tier).

b) However, in the future, the potential of liquidity mismatch may occur. In the irregular liquidity withdrawals, the 2nd tier faces liquidity mismatch in the last quarter of 2008 as seen in the grey line in Figure 8.

c) Unfortunately, both 1st and 2nd tiers fail to mitigate a liquidity run condition. The 1st tier liquid instruments cannot continuously serve the depositors' demand for liquidity, for example between May 2004 – February 2006; October 2006 – February 2007; and, July – December 2007 (see Figure 9). The 2nd tier, on the other hand, begins to lose its function from July 2007 to December 2011 (see Figure 8).

Figure 8. Performance of the 2nd Tier

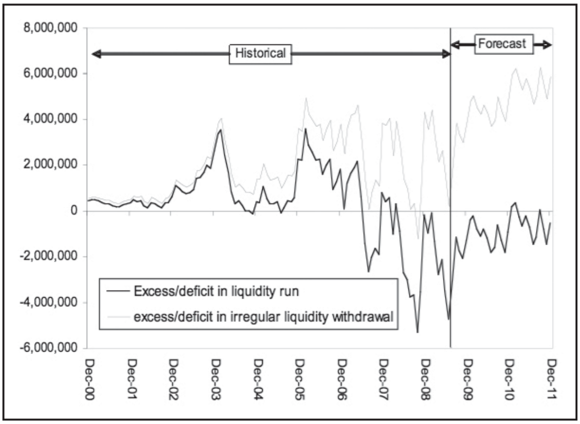
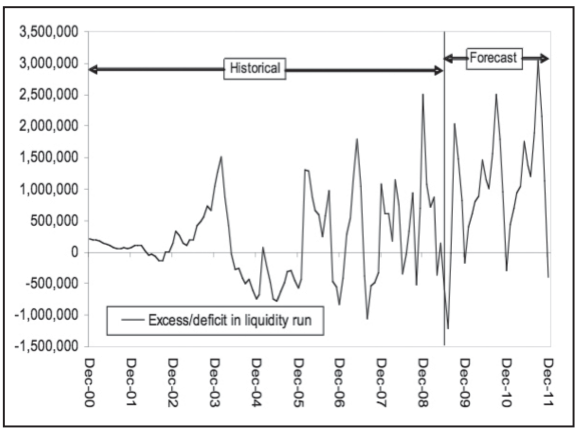


Figure 9. Performance of the 1st Tier



d) Particularly, based on the liquidity run scenarios, the 1st tier fails to handle a liquidity run when deposit withdrawals reach 45% of total deposits and the 2nd tier fails to survive in a liquidity run when the withdrawals reach 30% of total deposits. It does not have to be 50% deposit withdrawals to end the function of these two tiers.

e) The percentage assumption of a liquidity run delivers the important message that the failure of Islamic banks to manage liquidity may begin from this percentage of liquidity withdrawals. There are a number of things that all market players and banking regulators can do to maintain the sound condition of Islamic banking industry and prevent liquidity runs. They include: intensifying the education of depositors and the public by involving the government, banking regulators and Islamic scholars; improving banking facilities, products and services; and, optimising bank financing in order to be able to gain and pay competitive returns to depositors and stakeholders.

f) It is realised that there is still another tier, the 3rd tier, to finally solve the liquidity problem. Nonetheless, using this tier brings many negative consequences, such as negative perception in the market and among depositors which may potentially impact the whole banking system; negative image of the quality of liquidity management of a needy Islamic bank; and, sanctions from banking regulators.

g) Fortunately, the probability of occurrence of both irregular liquidity withdrawal and liquidity run are very moderate. It is because Islamic banks have successfully maintained robust performance. Moreover, the unfavorable liquidity problems have not hit the industry yet, but the current global financial crisis, following some internal and external Islamic banking problems (lack of infrastructure, human resources and banking facilities, less competitive Islamic returns, the existence of rational depositors) can make such irregular and liquidity run scenarios possible.

VII. CLOSING REMARKS

The Islamic banking industry in Indonesia faces remarkable growth and performance. With respect to liquidity management, there are three sources of short-term demand for liquidity and the 1st, 2nd and 3rd tiers of short-term liquid instruments as suppliers of short-term liquidity. In fact, Islamic banks have shown good short-term liquidity management under the assumptions of regular liquidity withdrawal, an immature but growing industry, and high interest of the public.

Even during irregular demand for liquidity, the 1st and 2nd tier liquid instruments are still able to mitigate the situation.

Nevertheless, when unfavorable conditions occur, such as macroeconomic turbulence or unstable non-economic factors (social and political unrest), leading to a liquidity run, the performance of the industry is highly impacted. This paper finds that the industry is too fragile to suitably manage its liquidity, although the probability of occurrence of irregular liquidity withdrawal and a liquidity run are very moderate. In the end, more efforts have to be taken in order to establish a better liquidity management system to guard this industry and optimize its development.

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