The Transmission of Liquidity Shock across International Markets during the 2007-08 Financial Crisis

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Abstract

This article investigates the determinants of liquidity and the transmission of liquidity shocks across 52 stock markets during the period 2005-2009. Constructing Amihud (2002) liquidity measure, we finda positive linkage between liquidity and volatility. Moreover, the Granger causality analysis provide evidence of bi-directional relationship between stock market return and its illiquidity shock, through a. Also, the results support the presence of USA illiquidity shock spillover to others markets during the financial crisis of 2007-08. Moreover, both USA return and illiquidity shock have a strong effect on the illiquidity shock of the others markets. Finally, the impact of the USA market through its return or illiquidity shock is the same during normal and crisis period.

1 Introduction

The financial and economic World were marked by a several dramatic financial crises (the 1990s: the Exchange Rate Mechanism (ERM) currency attacks in 1992–1993, the Tequila crisis in 1994–1995, the East Asian crises in 1997, the Russian default in 1998 and the Brazilian devaluation in 1999). The last one happened in 2007 and it's known by the subprime crisis. This crisis leads to financial crisis in 2008.

Most of these crises, especially the subprime crisis, channels financial crises spread on the globe and affect the financial markets. This phenomenon has pressed researchers to study

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and to explain contagion. This phenomenon has been increased by the globalization and the integration of financial markets.

One channel through which financial crisis and contagion are caused is the lack of liquidity of market. The crisis-contingent theories (Forbes and Rigobon 2002) assume that the transmission mechanisms change during a crisis, and therefore market co-movements increase after a shock. Not surprisingly, international investors could find it rational to suddenly withdraw their capital from a country if they fear on the empirical side, to be otherwise left with no claim on a limited pool of foreign exchange reserves. Formal models of contagion with multiple equilibria have been developed, among others, by Masson (1999). An example of crisis-contingent theories in which the transmission mechanism is based on liquidity shocks is due to Goldfajn and Valdes (1997). According to these authors, liquidity constraints can induce agents to sell securities of emerging markets once they have incurred losses due to currency and equity depreciations in the crisis country.

Furthermore, many authors including Cifuentes et al. (2005), Schnabel and Shin (2004) and Plantin et al. (2005), Brunnermeier and Pederson 2009 argue that the funding liquidity problem could lead banking or financial crisis and contagion. However, less attention has been focused on the detection of the liquidity spillover among international financial markets.

The main purpose of this study is to investigate the liquidity spillover effects across international financial markets in two steps. In the first step, we study the liquidity of 52 stock markets and the possible factors affecting market liquidity. More precisely, we examine the causality linkage between stock market return and stock market liquidity across international financial markets. In the second step, we used a dummy regression model in order to examine if liquidity could have been linked to financial crisis and contagion. In others words, we analyze the illiquidity spillover across international financial market.

Our findings pointed out a positive correlation between liquidity and volatility but a negative impact of return in the illiquidity shock. Furthermore, our results support the presence of USA illiquidity shock spillover to others markets during the crisis. Moreover, both USA return and illiquidity shock have a strong effect on the illiquidity shock of the others markets. Also, the impact of the USA market through its return or illiquidity shock is the same for the two periods.

This paper is organized as follows. Section 2 reviews empirical studies on liquidity and the relationship between liquidity and financial crisis. Section 3 describes the measure of liquidity. The section 4 discusses the methodology and data summary and section 5 reports the empirical results. Finally, section 6 concludes the study.

2 Literature Review

The empirical studies devoted to liquidity can be classified in two tendencies: the analysis of the determinant of liquidity and the relationship between the liquidity and crisis.

For the first field, the authors focus on one specific market or between different markets on one specific country. They investigate the relationship between liquidity and the others variables of markets, such as return, volatility and trading activity.

In this context, Odean (1999) finds that the return and volatility of equity affect the trading behavior and in turns the liquidity trough the psychological bias of loss aversion. Therefore, a return-dependent investing behavior and a wave of trading activity in one direction and affects the price change and therefore decrease the liquidity (a higher bid-ask spread). In

other hand, the liquidity affects the stock return by the means trading cost (Amihud and Mendelson, 1986) or by the order imbalances (Chorida et al. (2002)). Accordingly, an increasing of liquidity makes the asset more attractive and increases the demand of the asset. In turn the liquidity affects the order imbalance. This later affects the return via the overreaction of investor and market maker inventory. Chorida et al. (2001) reveal that the liquidity is impacted by macroeconomic variables, such as short and long interest rate, default spread and market spread.

Focusing on bond market, and using intraday data trading volume and bid-ask spread as a measures of liquidity, Fleming and Remolona (1999), Balduzzi et al. (2001) conclude that the announcement of macroeconomic lead to increase the trading volume and wide quickly the bid-ask spread. Fleming (2003) studies the liquidity of the U.S treasury market using several different measures He finds that it is difficult to compare among the different measures. Hameed et al. (2010) investigate the relationship between liquidity of individual stock and the NYSE market index return. They confirm the hypothesis of asymmetric reaction: the individual stock liquidity is more affected by the negative stock return than positive one.

More recently the empirical studies of liquidity are focused on the transmission of liquidity among different sectors or between different markets. Chordia et al. (2011) research the liquidity spillover among different sectors and find that the liquidity of large-cap sectors can affect the liquidity of small-cap sectors by the imbalance spillover. The return of higher volume or liquidity leads returns of low volume or illiquidity because of the speed of adjustment to market wide information. Chordia et al. (2005) examine the liquidity spillover between U.S equity and bond markets and show that the two markets are linked by the volatility which can affect the liquidity via the inventory risk. An innovation of stock market volatility forecasts an increase in bond spread and reduces liquidity. A negative information shock in stock can cause 'flight to quality' (Chordia et al. (2005) and Beber et al. (2006)). The investor seeks for a safe stock (Treasury bond). So, the trading activity of one market leads and lags the trading activity of the other market. This leads to a pressure on the price of the safe stock and therefore the liquidity.

The second field of research investigates the liquidity and financial crisis. Bernard and Whelch (2004) argue that the financial crisis is due to the fear of future market liquidity shock rather than the liquidity shocks themselves. However, this study was unable to explain how this fear could spread to contagion across financial markets or institutions. Brunnermeier and Pederson (2009) relate the bank crisis and financial market by the link between asset market liquidity and trader's funding liquidity.

Another strand of the pertinent literature is concerned with the relation between financial contagion and liquidity. In other words, the financial contagion could be due to liquidity. In fact, due to the mark-to-market rules, institutions try to sell their assets to meet their internal capital requirement because of the devaluation of their asset due to the downturn of market. However, if these institutions are not able to sell their assets in local market, because of the problem of liquidity, they try to sell them in foreign market. Such behavior would cause a pressure on foreign market and therefore a liquidity problem and cause financial contagion. This hypothesis is supported by Boyer et al. (2006). They argue that the contagion of Asian financial crisis is induced by international investor and not fundamental. And subsequently, the financial market contagion is due to the problem of liquidity.

These studies show the importance of liquidity to explain financial contagion, his dependence to stock return or volatility but they are unable to study the liquidity problem

directly. In this area, Chen and Poon (2007) examine the transmission of liquidity between 37 stock markets. They find that the illiquidity is driven by the volatility. The illiquidity shock is negatively linked to the market return. More importantly, they find that the illiquidity is caused by local stock market. Similar relationships were recorded during the Asian Financial crisis of 1997. Hong Kong illiquidity shocks have propagated to the other countries around the world except the Latin American stock markets.

3 Measure of Liquidity

The question related to the measure of liquidity remains unsolved as it is hard to define the liquidity. However, many authors such as [Harris (1990), O'hara (1995)] try to identify several dimension of liquidity. Harris (1990) distinguishes four dimensions. The first one is width which is related to transaction costs such as commission or bid-ask spread. Secondly, depth which is considered as one of basic liquidity measure and refers to the number of shared that can be traded as a given bid-ask spread. Immediacy, the third dimension, refers to the speed with which order can be executed. The last one is resiliency which refers how new orders flow quickly to correct order imbalances. All these measures require high-frequency transactions and quote data which is not available for all markets. To overcome this problem, various studies have proposed low-frequency liquidity proxies including Pastor and Stambaugh (2003), Liu (2006) and Amihud (2002).

As we examine the liquidity of international stock market liquidity patterns and their relationships with stock market returns, the choice must satisfied the two criteria. First, the data needed to measure the liquidity must be available for all markets. Hence, the bid-ask spread or the order depth cannot used in our study because it's not available for all individual stocks. Second, we need data at high frequency liquidity because financial crisis spread quickly and allows us to examine the duration the liquidity shock is transmitted. Therefore, the liquidity measure at low frequency proposed by Pastor and Stambaugh (2003) and Liu (2006) cannot be used for our sample. These authors employ order flow data to approximate the liquidity which is not available for our data set.

For these two reasons, the most common liquidity measure is Amihud (2002) illiquidity measure which it has been widely used in the liquidity literature.

According to Amihud (2002), the illiquidity measure of an individual stock is defined as the average ratio of the daily absolute return to the trading volume on that day.

$$Il_{it} = \frac{|R_{it}|}{vol_{it}} \qquad (1)$$

Where Il_{it} is the Amihud illiquidity measure of the stock i on day t. R_{it} and Vol_{it} are respectively the absolute return and the total value traded for stock i on day t and measured in local currency. The return is computed as follow:

$$R_{it} = 100 Ln(\frac{P_{it}}{P_{it-1}}) \qquad (2)$$

Where P_i is the price of stock i measured in local currency.

To determine the market illiquidity measure, we aggregate the individual liquidity measure to obtain a market level measure $IL_{m,t}$ estimated as the equally weighed average of individual stock illiquidity measures:

$$Il_{mt} = \frac{1}{M_t}\sum_{i=1}^{M_t} IL_{it} \tag{3}$$

In the above equation M_t denotes the number of stocks available in a particular market on day t. The value of M_t could be different from day to day because the creation of new stock or death of old stocks.

4 Econometric Methodology

In this paper we examines first the direction causality between stock market return and stock market illiquidity across international financial market, while for the second purpose, we examine spillover across international financial market.

4.1 The Causality Direction between Illiquidity and Stock Market

The causality between stock market returns and the illiquidity shock is examined by the Granger causality using a VAR framework. But before, we need to estimate the illiquidity shock which is derived from Amihud (2002) illiquidity measure. More precisely, the illiquidity shock is calculated through the following procedure.
First, as mentioned in the literature revue, the stock market liquidity is highly correlated with volatility. Stressed in previous work (e.g. Chorida et al. (2005)), we de-seasonalised the daily liquidity measure and remove the volatility effect from the illiquidity as follows:

$$Il_{mt} = \alpha + \sum_{k=1}^{4}\beta_k day_k + \sum_{j=1}^{11}\gamma_j Month_j + \theta\sigma_{mt} + adj_{mt} \tag{4}$$

This equation allows us to disentangle the relationship between return, liquidity and volatility. The day_k is the dummy variable for 4 days from Tuesday to Friday, $Month_j$ represents the dummy variable for 11 months from January to November and adj_{mt} is the country's daily filtered illiquidity measure. The market volatility $\sigma_{m,t}$ is derived from AR(p)-GARCH(p,q).
In second step, we scale the daily adj_t using the residual terms of the equation (4) and as follow

$$adj_{t,scaled} = \frac{adj_t - mean(adj_t)}{stdev(adj_t)} \tag{5}$$

Where mean and stdevare respectively the average value and standard deviation of adj_t.To avoid the non-synchronous due to the difference time zones among different markets, we are going to use the weekly data. So, the parameter ($adj_{t,scaled}$) is averaged through the week in order to have a weekly market illiquidity level "adj_{mt}".
In the third step, we estimate the weekly illiquidity shock measure ($\varphi_{t,shock}$) from an AR(p) of the illiquidity level "adj_{mt}"using the following equation:

$$adj_{mt} = \alpha + \beta \, adj_{mt-1} + \varphi_{t,shock} \tag{6}$$

4.2 Illiquidity Spillover across International Financial Market

As previously noted, the financial contagion could be due to liquidity, so we seek to examine the impact of US financial illiquidity shock on the illiquidity shock of the others countries. For that, we follow Forbes and Rigobon (2002) and use the financial crisis of 2008 to check whether the USA return and illiquidity shocks have caused illiquidity for the others markets. We consider the USA stock as a proxy of the financial crisis because the crisis was starting in this market.

The impact of USA return and illiquidity shocks on the illiquidity shock of the others markets is investigated through the following model:

$$\varphi_{t,shock} = \alpha + \beta R_{mt} + \gamma D_{normal} R_{USA,t} + \theta D_{crisis} R_{USA,t} + \varepsilon_t \tag{7}$$
$$\varphi_{t,shock} = \alpha + \beta R_{m,t} + \gamma D_{normal} \varphi_{USA,t} + \theta D_{crisis} \varphi_{USA,t} + \varepsilon_t \tag{8}$$

Where R_{mt} and $\varphi_{t,shock}$ are respectively the weekly local stock market return and shock illiquidity. $R_{USA,t}$ and $\varphi_{USA,t}$ are respectively the weekly return of USA and its shock illiquidity. D_{normal} is the dummy variable for the normal period and D_{crisis} is the dummy variable of the financial. The crisis period displays from July 01, 2007 to February 28, 2009. The dummy variable D_{crisis} is equal to 1 for the crisis period and 0 otherwise.

The dummy variable of normal period D_{normal} is equal to 1 during the pre-crisis period (January 03, 2005 to June 30, 2007) and recovery crisis period (March, 1st 2009 to October 2, 2009)

The two equations examine respectively the impact of USA stock return and its illiquidity shock on the illiquidity shock of the others markets during the normal and crisis periods.

Table 1: List of countries and number of stocks

Country	Number of stock	Country	Number of stock	Country	Number of stock	Country	Number of stock
Argentina	88	Estonia	17	Japan	1540	Portugal	69
Australia	111	Finland	128	Korea	224	Russia	275
Austria	1782	France	1191	Luxumburg	172	Singapore	774
Belgium	194	Germany	1339	Malta	19	Slovenia	112
Brazil	382	Greece	285	Malysia	979	South Africa	371
Canada	3518	Holland	156	Mexico	130	Spain	159
Chile	174	Hong Kong	1133	Morocco	76	Sri lanka	233
China	1629	Hungry	43	New Zeland	150	Switzerland	388
Colombia	74	Iceland	10	Norway	237	Taiwan	1064
Czech	20	India	1137	Pakistan	239	Thailand	542
Denmark	197	Indonesia	392	Peru	166	Turkey	317
Egypt	144	Irelande	179	Philippine	229	UK	2052

Equator	35	Italy	205	Poland	350	USA	11061

Table 2a: Summary statistics of stock market return

Country	Mean(%)	Std.Dev(%)	Skewness	Kurtosis	JB	LB(10)	ARCH-LM	ADF test
Argentina	0.0588	2.4	-0.691	7.725	3179.579	18.184	53.44	-19.603
Australia	0.0133	1.3	-0.388	4.742	1192.114	22.95	70.829	-22.435
Austria	-0.0299	2	-0.161	6.777	2376.236	13.54	101.143	-20.553
Belgium	-0.0429	1.6	-1.29	13.855	10253.624	38.337	42.03	-20.229
Brazil	0.0699	2.1	-0.015	5.635	1639.366	13.061	71.02	-22.641
Canada	0.0187	1.5	-0.666	8.469	3794.707	55.708	68.075	-21.184
Chile	0.0462	1.3	0.357	15.396	12262.999	36.443	30.885	-20.47
China	0.0665	2.2	-0.017	5.811	1743.251	12.736	95.182	-20.923
Colombia	0.0798	1.7	-0.059	12.785	8439.565	40.502	100.912	-20.721
Czech	0.033	1.9	-0.576	13.174	9028.79	25.916	76.446	-22.189
Denmark	0.0242	1.5	-0.327	7.657	3048.93	33.037	70.409	-20.812
Egypt	0.0755	1.9	-0.842	7.851	3328.744	43.067	8.655	-17.392
Equator	-0.0031	1.2	-0.504	96.321	4790.173	71.77	68.627	-25.928
Estonia	-0.0454	1.7	0.151	7.504	2911.904	24.728	19.038	-18.723
Finland	-0.0087	1.8	0.03	4.366	984.192	17.254	19.981	-22.038
France	-0.0028	1.5	0.043	8.654	3866.984	50.262	55.163	-23.286
Germany	0.0044	1.5	0.194	9.061	4245.825	27.047	42.139	-21.731
Greece	-0.0098	1.8	-0.245	5.491	1569.005	25.629	56.144	-19.792
Holland	-0.0013	1.5	-0.198	8.463	3705.93	31.245	82.087	-22.157
Hong Kong	0.0182	1.6	-0.16	7.645	3022.649	6.564	93.482	-20.596
Hungry	0.0069	2.1	-0.072	6.496	2179.26	72.46	66.069	-21.026
Iceland	-0.1521	3.5	-25.204	760.424	2998.302	21.017	0.001	-19.995
India	0.0725	2	0.008	6.561	2222.237	29.006	14.725	-20.583
Indonesia	0.08	1.9	-0.283	4.744	1178.555	32.042	39.365	-19.559
Irelande	-0.0984	2.2	-0.599	9.198	4441.997	23.213	58.749	-20.976
Italy	-0.0284	1.5	0.033	9.278	4444.242	67.756	64.555	-22.179
Japan	-0.0207	1.6	-0.275	7.775	3136.296	22.954	174.836	-22.723
Korea	0.0464	1.7	-0.399	6.814	2430.014	2.773	63.588	-20.337
Luxumburg	0.0093	2.4	0.354	48.331	1206.165	34.06	156.466	-23.492
Malta	0.0033	0.8	0.101	5.663	1657.732	128.894	44.462	-19.579
Malysia	0.0233	0.9	-1.337	14.424	1110.919	31.406	14.181	-18.201
Mexico	0.0561	1.7	0.203	4.296	961.074	15.604	35.064	-21.435
Morocco	0.0584	1.1	-0.454	3.532	686.553	95.843	50.502	-19.023
New Zeland	-0.0289	1.1	-0.164	2.985	465.556	36.051	115.684	-21.071
Norway	0.0078	2.1	-0.563	5.321	1527.314	17.62	97.966	-21.241
Pakistan	0.0221	2	-0.455	2.614	395.502	58.059	63.615	-17.428
Peru	0.0973	2.4	-0.27	4.879	1243.925	18.526	37.287	-19.356
Philippine	0.0309	1.6	-0.562	6.844	2483.277	29.74	26.154	-20.249
Poland	0.0017	1.8	-0.196	2.258	271.172	15.168	29.853	-20.311
Portugal	-0.004	1.2	-0.136	14.114	1028.794	38.299	27.869	-20.183
Russia	0.0251	2.9	-0.505	15.676	1273.833	43.408	37.213	-20.688
Singapore	0.0189	1.5	-0.18	4.843	1217.65	10.614	98.164	-20.599

Slovenia	0.0124	1.4	-0.178	8.645	3865.261	39.242	83.297	-19.807
South Africa	0.0497	1.5	-0.247	2.523	341.176	20.608	48.707	-21.825
Spain	0.0167	1.5	-0.08	8.878	4070.361	38.364	59.363	-22.062
Sri lanka	0.0432	1.4	1.621	18.778	18745.891	107.039	61.764	-16.066
Switzerland	0.0103	1.7	0.144	4.54	1068.168	16.642	40.513	-21.905
Taiwan	0.0042	1.5	-0.271	2.703	392.407	20.139	27.477	-19.385
Thailand	0.0112	1.8	-1.141	15.939	13385.05	22.659	39.281	-19.044
Turkey	0.0376	2.1	-0.034	2.555	337.239	16.229	17.807	-20.303
UK	0.0018	1.4	-0.119	8.876	4069.949	65.303	71.38	-23.893
USA	-0.0117	1.5	-0.251	10.505	5709.548	50.453	70.366	-21.626

Notes: Std.Dev is the standard deviation; JB is the Jarqu3-Bera normality test; LB is the Ljung-Box test for autocorrelation of order 10; ARCH-LM is the statistics test for conditional heteroskedasticity of order 2; ADF is the statistics test for unit root.

5 Data and Summary Statistics

The used data are collected from DataStream, and cover the period from January 03, 2005 to October 2, 2009. The sample comprises 36491 stocks of 52 countries in America, Europe, Asia, Australia and Africa.

The data includes both dead and live stocks. For the computation of the liquidity ratio, we collect for each stock, its closing price and its number of traded shares. The price is indicated in local currency because we are working on liquidity and not price. Also, we collect from DataStream, the daily local price index of each stock market.

Table 2b: Summary statistics of illiquidity measure

Country	Mean	Std.Dev	Country	Mean	Std.Dev
Argentina	3.65E-06	2.77E-06	Japan	1.60E-07	2.30E-07
Australia	1.25E-04	5.34E-04	Korea	2.00E-08	2.00E-08
Austria	2.82E-05	1.60E-04	Luxumburg	3.17E-05	8.31E-05
Belgium	5.77E-05	9.36E-05	Malta	2.87E-05	1.02E-04
Brazil	3.09E-05	1.36E-04	Malysia	6.64E-05	1.33E-04
Canada	5.65E-02	3.48E-01	Mexico	1.22E-04	4.23E-03
Chile	1.01E-05	1.00E-08	Morocco	3.25E-06	2.69E-06
China	4.80E-07	4.77E-06	New Zeland	7.37E-05	2.49E-04
Colombia	5.99E-04	2.00E-08	Norway	1.05E-03	3.55E-02
Czech	8.23E-06	3.43E-05	Pakistan	1.11E-05	5.56E-05
Denmark	2.49E-04	2.42E-03	Peru	1.15E-06	1.61E-06
Egypt	1.09E-05	3.07E-05	Philippine	1.12E-06	9.86E-06
Equator	1.23E-06	4.34E-06	Poland	2.50E-05	1.75E-04
Estonia	1.82E-04	3.95E-04	Portugal	8.62E-05	2.36E-04
Finland	5.71E-05	2.82E-04	Russia	2.55E-05	2.79E-04
France	1.09E-04	1.93E-04	Singapore	3.36E-05	4.60E-05
Germany	9.63E-03	6.16E-02	Slovenia	2.55E-04	8.35E-04
Greece	1.82E-02	4.78E-01	South Africa	2.47E-05	9.22E-05
Holland	3.85E-02	1.31E+00	Spain	6.90E-07	8.00E-07
Hong Kong	1.90E-07	1.45E-06	Sri lanka	1.10E-05	1.45E-05
Hungry	2.02E-05	2.63E-04	Switzerland	2.99E-04	1.95E-03
Iceland	1.10E-07	2.17E-06	Taiwan	2.30E-07	2.00E-07

India	1.74E-06	1.78E-06	Thailand	1.44E-06	2.02E-06
Indonesia	2.20E-07	3.11E-06	Turkey	1.00E-08	1.00E-08
Irelande	1.50E-05	8.05E-05	UK	7.46E-04	6.98E-03
Italy	1.03E-06	1.56E-06	USA	3.31E-01	4.01E-01

Table 2a summarizes the descriptive statistics for the daily stock market return. The return of all countries is near zero. We find that Peru market (0.0973%) gives the greatest average return relative while Iceland market has the lowest return (-0.1521). This finding can be explained by the financial crisis of 2007 where Iceland was in bankruptcy. Moreover, 15 of 52 countries have a negative return while the rest exhibit a positive return. US market has a negative return. In terms of risk, Iceland market has the highest risk while Malta market has the lowest risk. The non commensurate between return and risk in Iceland can also be explained by the crisis. Otherwise, 40 of 52 countries are leptokurtic and skewed to the left, while the kurtosis statistics suggest the presence of asymmetry in all return series. As a consequence, the Jarque-Bera statistics reject the null hypothesis of normal distribution for all return under consideration. Furthermore, based on the Ljung-Box (LB) statistic of order 10, we can also reject the null hypothesis of white noise and assert that all series are autocorrelated. Additionally, the results of the Augmented Dickey Fuller (ADF) test reject the null hypothesis of a unit root for all daily return index at the 1% significance level. As result, we can conclude that all return time series are stationary.

The table 2b reports the descriptive statistics of illiquidity measure. We note that the illiquidity is low for the most market. Nevertheless, the comparison among market is not allowed as each market's illiquidity is measured on its own currency.

6 Empirical Results and Discussion

The analysis of the empirical findings on the international liquidity and financial crisis will be structured in two main parts. First, we examine the direction causality between stock market return and stock market illiquidity shock across international financial market, while in second step; we test the illiquidity spillover across international financial market during the financial crisis of 2007-08.

6.1. Causality between Stock Market Return and Stock Market Illiquidity Shock

The causality between stock market return and stock market illiquidity tested through three steps. In the first step, we remove the volatility effect from illiquidity measure according to the equation (4). In the second step, we calculate the weekly illiquidity level derived from the residual terms of the equation (4) and we estimate the illiquidity shock via the equation (5). In third step, we examine the causality between weekly return market and illiquidity shock. Using Granger causality test, we test the following null hypotheses:

H^1_0: weekly illiquidity shock market does not Granger cause weekly market return.
H^2_0: weekly market return does not Granger cause weekly illiquidity shock.

6.1.1 Deseasonality of illiquidity measure

We, first, estimate the equation 4 in order to remove the volatility effect from illiquidity measure. The estimating results as reported in table 3. As we can see from the table, the

weekday and months, generally, do not affect the illiquidity measure. In fact, 33 countries exhibit no day seasonality while 4 countries display the all days of the week effects. For the month effect, 48 countries have at least one month significant seasonality. And 3 countries including USA among them, have all month effects. In addition, the relationship between the illiquidity and volatility is in the most positive and significant. In fact, from the table 3, we find that the volatility of 37 out of 52 markets is positively correlated to the illiquidity. While the volatility of 8 markets affect negatively its illiquidity (Brazil, Chili, Holland, Hong Kong, Mexico, Norway, Singapore and Slovenia). The positive correlation between volatility and illiquidity corroborated the hypothesis that during the volatile period, the market becomes illiquid because the reluctance of investors to transact.

Once, the volatility effect was removed from the illiquidity measure, and in order to examine the causality between return market and illiquidity, we compute for each country its weekly market illiquidity measure (adj_{mt}), as described in methodology section. This measure allows the estimation of the illiquidity shock.

6.1.2 Estimation of the illiquidity shock

The illiquidity shock is estimated through the equation 6 where it approximates by the residual of the equation.The estimated results of AR (1) and ARMA (1,1) model[3]are reported in the table 4. The obtained results show that 21 cases where the coefficients of AR (1) are positively and statistically significant. Additionally, we find that the 30 cases of 52 are described by ARMA (1,1). Only 1 case (South Africa) has neither AR nor ARMA process. The coefficient β of AR (1) is positive for 41 markets but is statistically significant for 34 cases. So, in 34 markets, a higher market liquidity of today will be followed by a high liquid market for the next day, while for only 8 market, the high liquid market for a day followed by a low liquid the next day.

6.1.3 The impact of the local return on the shock

Once estimated the illiquidity shock, we test the impact of the stock market return on illiquidity shock through the following equation:

$$\varphi_{t,shock} = \alpha + \beta R_{m,t} + \varepsilon_t \tag{9}$$

The results are reported in table 5 and they reveal that the stock returns of 33 markets have a negative effect on the illiquidity shock. However, only 19 have significant negative coefficients: 5 coefficients are significant at level 5% and 4 at the 10% level. For the rest (19cases), the impact of the return is positive on the illiquidity shock but non-significant. Hence, a higher stock return market will decrease the illiquidity shock and generate a lower illiquidity in the market and therefore increases the liquidity of the market.

Our results are partially coherent with the theoretical and empirical literature where the relationship between return and liquidity is negative.

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[3]The optimal lag length for the AR and ARMA model was determined by using the AIC criteria.

Table 3: Illiquidity measure 's seasonality and volatility filtering results

Country	Weekday	Months	Volatility	Country	Weekday	Months	Volatility
Argentina	0	2	7.62E-08*	Japan	0	1	1.45E-08*
Australia	0	4	1.28E-05*	Korea	0	2	1.32E-09*
Austria	1	9	1.38E-06*	Luxumburg	0	3	9.15E-07*
Belgium	0	1	2.80E-06*	Malta	0	2	1.33E-06
Brazil	1	1	-1.93E-06*	Malysia	2	2	5.25E-06*
Canada	1	2	2.97E-04	Mexico	1	1	-2.33E-05
Chile	4	1	-4.22E-11	Morocco	4	11	9.16E-08*
China	0	11	4.52E-08*	New Zeland	0	5	2.71E-06***
Colombia	0	1	6.55E-11	Norway	0	1	-2.11E-05
Czech	0	1	3.16E-07*	Pakistan	0	1	5.26E-07*
Denmark	0	1	4.33E-06	Peru	1	1	3.12E-08*
Egypt	0	1	3.33E-07*	Philippine	0	1	3.45E-08
Equator	1	0	5.07E-08***	Poland	0	3	3.37E-07
Estonia	0	3	1.01E-05*	Portugal	1	5	1.93E-06**
Finland	0	0	6.95E-06*	Russia	0	0	2.11E-07
France	1	2	6.85E-06*	Singapore	0	1	-2.84E-07***
Germany	0	0	6.97E-04*	Slovenia	0	3	-6.77E-06***
Greece	1	1	1.32E-03	South Africa	1	1	6.60E-07**
Holland	1	1	-3.84E-03	Spain	0	7	3.29E-08*
Hong Kong	1	1	-6.43E-10	Sri lanka	4	9	2.52E-07*
Hungry	0	1	2.46E-06*	Switzerland	0	5	1.89E-05*
Iceland	0	1	2.84E-08*	Taiwan	1	5	3.11E-09*
India	1	1	6.74E-08*	Thailand	0	3	1.73E-07*
Indonesia	0	1	7.92E-09	Turkey	4	6	1.19E-09*
Irelande	0	1	8.24E-07*	UK	0	1	7.75E-05*
Italy	0	3	9.24E-08*	USA	0	11	3.42E-03*

Notes: *, ** and *** denote rejection of the null hypothesis at 1%. 5% and 10% levels, respectively

The weakness of our results for the impact of return on illiquidity shock can be explained by cross-effect and bi-directional causality. This latter is examined by the Granger causality.

6.2 Cross-effect between Return and Illiquidity Shock

Table 6 reports the results of no Granger causality test. The optimal lag order selected by using AIC information criteria vary from 1 to 20 weeks. This means that the illiquidity shock and return impact on each for a duration varying between one to 20 weeks. The results show that 28 out of 52 cases, the stock return does not cause illiquidity shock and 24 cases where the stock return causes the shock. However, 30 and out of 52 cases, the illiquidity shock does not cause stock return and 22 cases the illiquidity shock have an impact on the return. Furthermore, there are 15 markets where the causality is bidirectional. In others words, the return and illiquidity shock cause each other. While, only for 21 countries, there is no causality between stock return and illiquidity shock. This results mean that either stock return or shock illiquidity affect each others. Finally, we find for 16 countries the relation between return and illiquidity shock is unidirectional. In fact, for 9 countries the stock return impacts the illiquidity shock while the illiquidity shock of 7 markets affects the stock return.

The result shows that there is a cross-effect and bi-directional relationship between stock market return and its illiquidity shock. Subsequently, we conclude that the stock market return may influence future trading behavior, which in turn affect the illiquidity. While the illiquidity may impact the stock return through the trading cost (Amihud and Mendelson 1986).

Table 4: Estimation result of the AR(1) and ARMA(1,1) model

Country	AR	Std.Dev	MA	Std.Dev	Country	AR	Std.Dev	MA	Std.Dev
Argentina	0.27*	0.06	-	-	Japan	0.51*	0.05	-	-
Australia	0.86*	0.10	-0.76*	0.12	Korea	0.75*	0.05	0.02*	0.01
Austria	-0.98*	0.03	1.05*	0.03	Luxumburg	0.37*	0.06	-	-
Belgium	0.14	0.06	-	-	Malta	-0.47	2.00	0.46	2.02
Brazil	0.95*	0.03	-0.87*	0.05	Malysia	0.52*	0.05	-	-
Canada	0.19	0.55	-0.26	0.54	Mexico	0.61	0.49	-0.67	0.46
Chile	0.72	0.67	-0.74	0.65	Morocco	0.37	0.06	-	-
China	-0.51*	0.14	0.75*	0.11	New Zeland	-0.90*	0.04	0.97*	0.02
Colombia	0.12	1.06	-0.18	1.05	Norway	-0.27	6.92	0.28	6.95
Czech	0.86*	0.10	-0.73*	0.13	Pakistan	0.98*	0.04	-0.93*	0.06
Denmark	0.76*	0.04	0.01*	0.00	Peru	0.94*	0.05	-0.86*	0.08
Egypt	0.45*	0.06	-	-	Philippine	0.35*	0.06	-	-
Equator	0.01	0.94	-0.08	0.92	Poland	0.97*	0.03	-0.96*	0.04
Estonia	0.40*	0.06	-	-	Portugal	-0.97*	0.04	0.98*	0.05
Finland	-0.33	0.41	0.46	0.39	Russia	-0.81*	0.08	0.93	0.05
France	0.21*	0.06	-	-	Singapore	0.66v	0.05	-	-
Germany	0.14*	0.06	-	-	Slovenia	0.29*	0.06	-	-
Greece	-0.02*	0.00	0.01*	0.01	South Africa	0.05	0.07	-	-
Holland	0.49	0.74	-0.55	0.71	Spain	0.59*	0.05	-	-
Hong Kong	-0.83*	0.36	0.85*	0.34	Sri lanka	0.35*	0.06	-	-
Hungry	0.67**	0.34	-0.74*	0.31	Switzerland	0.94*	0.07	-0.87*	0.09
Iceland	-0.68*	0.21	0.53*	0.24	Taiwan	0.61*	0.05	-	-
India	0.52*	0.05	-	-	Thailand	0.60*	0.05	-	-
Indonesia	0.71***	0.43	-0.76**	0.40	Turkey	0.56*	0.05	-	-
Irelande	-0.13	0.66	0.04	0.67	UK	-0.50	0.68	0.44	0.71
Italy	0.37*	0.06	-	-	USA	0.42*	0.06	-	-

Notes: AR is the Autoregressive coefficients and MA is the Moving Average coefficients; Std.Dev is the standard errors of the estimated parameters; *, ** and *** denote the significant level at 1%. 5% and 10% levels, respectively.

6.3 The Illiquidity Spillover across International Financial Market during the Crisis of July 2007 to February 2009

During a crisis, the financial market becomes illiquid because the financial crisis can be caused by liquidity. We try in this section to examine if the last financial crisis of 2007 was a factor of the transmission of illiquidity through international markets. Following Forbes and Rogibon (2002), we examine the impact of USA return and its illiquidity shock on the illiquidity shock of the others markets during the normal and crisis period using the equations (7) and (8). The result of unit root test (Tables 7a and 8a) show that weekly index and shock index return are stationary.

The estimated results of the equation (7) are summarized in table 7b and indicate that the sign of coefficients α is negative and statistically significant for all markets except 9 markets. In addition, the coefficient of the local market is statistically negative for 25 markets and positively significant for 19 markets.

Table 5: Regression results of the impact of local return on individual market illiquidity shock

Country	Coefficient	Std.Dev	Country	Std.Dev
Argentina	-1.20*	0.60	Japan	0.23
Australia	-0.66**	0.27	Korea	-1.13**
Austria	-0.38**	0.20	Luxumburg	-1.81*
Belgium	-0.90	0.75	Malta	-1.72***
Brazil	-0.43**	0.07	Malysia	0.05
Canada	-0.80*	0.03	Mexico	-0.14*
Chile	-1.79*	0.01	Morocco	-2.62*
China	-0.25**	0.10	New Zeland	-2.63*
Colombia	-0.45**	0.27	Norway	-0.50
Czech	-0.82*	0.01	Pakistan	0.59
Denmark	-0.28**	0.12	Peru	-0.08
Egypt	-0.53*	0.14	Philippine	-0.83
Equator	1.31	1.19	Poland	-0.49*
Estonia	-1.59*	0.63	Portugal	-0.11
Finland	-1.75*	0.73	Russia	0.01
France	-1.16**	0.51	Singapore	0.38
Germany	-0.44**	0.15	Slovenia	-0.25
Greece	-0.19*	0.02	South Africa	0.21
Holland	0.55*	0.01	Spain	-1.76*
Hong Kong	-0.46*	0.01	Sri lanka	-2.71*
Hungry	-1.99*	0.56	Switzerland	0.50
Iceland	-0.18	0.11	Taiwan	0.25
India	-0.22	0.82	Thailand	-2.28**
Indonesia	-1.77*	0.01	Turkey	-1.02
Irelande	-0.28*	0.09	UK	-1.68*
Italy	-1.76***	1.03	USA	-0.358

Notes: Std.Dev is the standard errors of the estimated parameters; *, ** and *** denote the significant level at 1%, 5% and 10% levels, respectively.

For the impact of USA return on the illiquidity shock, we note that the coefficient is statistically negative for 20 markets during the crisis and 18 during the normal period. However, the impact of USA return is statistically positive on 22 and 25 markets respectively during the crisis and normal period while only 9 cases are not influenced by the USA stock return during the crisis period and 8 during the normal period. This means that a positive return of USA increases the illiquidity shock of 22 and 25 markets

respectively during the crisis and normal period. However, the return of USA decreases only the illiquidity shock of 20 and 18 markets respectively during the crisis and normal period. Hence, the positive impact of the stock return of USA is more pronounced than its negative impact.

Table 6 : Granger Causality results of illqiuidty shock and market return

Country	lag order	H^1_0 : LR stat	H^2_0 : LR stat	Country	lag order	H^1_0 : LR stat	H^2_0 : LR stat
Argentina	6	11.97***	6.4	Japan	7	12.86***	13.82**
Australia	20	22.95	20.66	Korea	1	15.21*	0.05
Austria	10	20.24**	127.37*	Luxumburg	12	22.25**	45.51*
Belgium	4	5.71	4.39	Malta	2	2.42	10.79*
Brazil	20	15.89	14.02	Malysia	6	3.74	8.2
Canada	20	13.84	6.49	Mexico	20	10.43	9.66
Chile	12	15.17	124.80*	Morocco	2	5.71***	3.18
China	9	14.05	44.81*	New Zeland	20	20.84	21.36
Colombia	20	60.37*	20.36	Norway	20	10.28	19.14
Czech	6	25.66*	8.5	Pakistan	7	17.00**	46.21*
Denmark	4	0.89	2.04	Peru	20	54.87*	15.31
Egypt	9	4.03	14.07	Philippine	12	5.85	23.40**
Equator	11	22.96**	59.77*	Poland	20	19.22	52.50*
Estonia	8	15.54**	36.38*	Portugal	20	24.47	31.32**
Finland	5	24.23*	19.25*	Russia	4	3.08	4.5
France	10	10.77	11.03	Singapore	2	0.19	3.77
Germany	4	12.65*	21.98*	Slovenia	20	21.04	51.58*
Greece	3	32.87*	9.15**	South Africa	1	0.04	2.24
Holland	4	1.77	0.66	Spain	2	1.55	3.08
Hong Kong	20	5.23	32.76**	Sri lanka	8	43.73*	16.55**
Hungry	20	20.7	13.47	Switzerland	20	18.16	21.45
Iceland	2	0.06	0.41	Taiwan	4	0.54	16.25*
India	6	13.47**	18.09*	Thailand	5	17.48*	30.46*
Indonesia	20	21.25	17.86	Turkey	6	16.43*	9.13
Irelande	12	35.47*	69.43*	UK	12	22.85**	73.66*
Italy	9	17.28**	19.55**	USA	20	23.21	24.5

Notes: H^1_0 is the null hypothesis that weekly illiquidity shock market does not Granger cause weekly market return. H^2_0 is the null hypothesis that weekly market return does not Granger cause weekly illiquidity shock market. LR stat is the likelihood ratio statistic for the null hypothesis. Reject of null hypothesis at 1%. 5% and 10% is denoted by *, **, ***.

Furthermore, if the return-illiquidity relationship is stronger in the crisis period, we expect that the coefficient (θ) of crisis period is bigger that the coefficient of the normal period (γ).

In other hands, 23 markets have $\theta > \gamma$ which implies a strong return illiquidity relationship during the crisis period. So, the USA market return has an impact on the illiquidity shock of the others markets, especially during the crisis period.

Next, we estimate the impact of the USA illiquidity shock on the others countries illiquidity through the equation (8). The results are reported in table 8b. From these results, we perceive that the same results as in the equation (7) for the coefficient α. 41 markets having a negative coefficient and only 6, their coefficient are positive. Furthermore, the impact of local return is roughly the same. In fact, the coefficient of the local market is statistically negative for 15 markets and positively significant for 27 markets.

Table 7a: Conditional Heteroskedasticity and Unit root test of weekly index return

Country	ARCH-LM	ADF test	PP test	KPSS test	Country	ARCH-LM	ADF test	PP test	KPSS test
Argentina	19.42*	-9.16	-17.66	0.10	Japan	4.19	-8.58	-16.58	0.10
Australia	17.03*	-9.62	-16.05	0.13	Korea	26.97*	-9.58	-17.06	0.11
Austria	2.10	-7.90	-15.85	0.13	Luxumburg	9.49*	-7.00	-15.02	0.12
Belgium	18.53*	-7.84	-13.64	0.16	Malta	6.91**	-7.99	-17.05	0.13
Brazil	16.06*	-9.27	-17.15	0.08	Malysia	2.39	-8.01	-14.29	0.18
Canada	23.98*	-8.57	-17.72	0.08	Mexico	14.03*	-8.37	-18.35	0.11
Chile	15.86*	-9.63	-18.09	0.06	Morocco	4.58	-8.08	-15.30	0.09
China	4.64***	-8.90	-15.26	0.11	New Zeland	1.60	-8.16	-16.89	0.13
Colombia	6.09**	-7.95	-16.53	0.12	Norway	8.18**	-8.14	-15.46	0.09
Czech	9.41*	-10.19	-16.64	0.06	Pakistan	25.13*	-7.85	-13.69	0.08
Denmark	9.11**	-9.03	-17.69	0.09	Peru	13.74*	-8.62	-15.00	0.10
Egypt	6.22*	-8.06	-15.16	0.12	Philippine	0.68	-8.54	-16.96	0.12
Equator	28.46*	-10.96	-22.60	0.06	Poland	17.36*	-9.68	-13.94	0.09
Estonia	17.23*	-7.92	-13.80	0.13	Portugal	9.24*	-8.05	-16.80	0.20
Finland	6.26**	-9.48	-15.98	0.10	Russia	22.09*	-10.08	-15.85	0.10
France	1.97	-9.70	-17.83	0.11	Singapore	11.93*	-7.98	-15.80	0.14
Germany	13.17*	-10.22	-17.27	0.09	Slovenia	2.16	-7.00	-16.06	0.24
Greece	48.80*	-8.82	-14.09	0.12	South Africa	16.27*	-9.73	-18.12	0.07
Holland	0.22	-8.57	-16.04	0.11	Spain	9.16**	-8.45	-19.18	0.13
Hong Kong	9.08**	-7.54	-15.66	0.13	Sri lanka	2.91	-7.37	-13.51	0.22
Hungry	2.13	-9.12	-14.19	0.12	Switzerland	2.52	-9.35	-16.61	0.13
Iceland	0.14	-7.90	-15.03	0.09	Taiwan	7.64**	-7.30	-15.75	0.15
India	8.32**	-8.00	-15.33	0.12	Thailand	2.55	-7.56	-16.74	0.11
Indonesia	6.72**	-8.22	-16.88	0.14	Turkey	8.04**	-8.61	-15.94	0.12
Irelande	4.21	-10.60	-18.92	0.15	UK	4.47***	-9.96	-17.60	0.09
Italy	3.63	-8.38	-17.11	0.11	USA	9.35*	-9.63	-16.18	0.10

Notes: Reject of null hypothesis at 1%, 5% and 10% is denoted by *,**,***. ARCH-LM is the statistics test for conditional heteroskedasticity of order 2.

The USA illiquidity shock impacts positively and significantly on 27 markets during the two periods. However, the coefficients of the illiquidity shock of USA during the normal and crisis periods are statistically negative only for 11 cases. So, the USA illiquidity shock leads the illiquidity shock of the others countries during the normal and crisis periods. Therefore, the illiquidity shocks of markets are not impacted by the crisis.

Moreover, we find that the effect of US shock, during the crisis period, is the same for emerging and advanced markets. In fact, on average the US shock is about 0.013 for both

markets. However, during the normal period, on average the US shock is more pronounced on emerging than advanced markets.

Moreover, when the coefficient (θ) is significant, we find 21 cases where $\theta>\gamma$. Indicating that, the spillover effect during the financial crisis is stronger.

Comparing the results of the impact of to USA returns and illiquidity shock on the shock of the others countries, we find first that positive effect of return and shock is more important than the negative during the two periods. Moreover the USA illiquidity shock is more important than its return. In fact, the USA illiquidity shock affects positively 27 markets illiquidity shocks, during the two periods while only 25(normal) and 22 (crisis) markets are positively influenced by its return.

Table 8a: Conditional Heteroskedasticity and Unit root test of weekly shock index return

Country	ARCH-LM	ADF test	PP test	KPSS test	Country	ARCH-LM	ADF test	PP test	KPSS test
Argentina	0,01	-7,37	-16,98	0,45	Japan	4,22	-9,03	-18,79	0,21
Australia	0,04	-9,14	-15,95	0,17	Korea	13,30*	-11,68	-20,09	0,07
Austria	0,02	-8,57	-17,61	0,26	Luxumburg	3,73	-8,17	-18,90	0,32
Belgium	2,27	-8,48	-17,18	0,43	Malta	0,07	-8,04	-15,73	0,33
Brazil	0,05	-8,42	-17,47	0,07	Malysia	4,62	-7,58	-20,00	0,48
Canada	0,17	-8,89	-15,95	0,06	Mexico	0,00	-9,03	-15,73	0,08
Chile	0,00	-9,20	-15,77	0,06	Morocco	2,04	-7,29	-17,39	0,43
China	6,67**	-5,19	-16,88	0,25	New Zeland	0,03	-9,76	-16,21	0,13
Colombia	0,00	-8,78	-15,73	0,06	Norway	0,00	-9,44	-15,79	0,07
Czech	8,38**	-8,08	-17,31	0,04	Pakistan	0,02	-9,48	-15,66	0,06
Denmark	49,26*	-18,08	-25,25	0,04	Peru	0,18	-9,24	-16,11	0,12
Egypt	3,06	-8,88	-23,75	0,62	Philippine	2,11	-10,38	-14,92	0,27
Equator	0,43	-7,49	-15,18	0,34	Poland	0,02	-9,24	-16,24	0,14
Estonia	11,77*	-5,90	-17,36	0,96	Portugal	0,02	-8,32	-15,55	0,07
Finland	0,54	-8,54	-15,80	0,10	Russia	0,11	-6,74	-16,46	0,29
France	0,14	-7,54	-17,06	0,46	Singapore	11,74*	-8,04	-20,23	0,52
Germany	0,12	-8,84	-16,12	0,07	Slovenia	1,68	-9,21	-16,87	0,31
Greece	3,67	-6,65	-9,74	0,04	South Africa	0,06	-9,28	-14,67	0,20
Holland	0,00	-9,11	-15,75	0,13	Spain	2,68	-7,92	-18,97	0,53
Hong Kong	0,00	-8,56	-15,59	0,35	Sri lanka	5,71***	-7,35	-16,61	0,08
Hungry	0,00	-9,50	-15,71	0,05	Switzerland	0,05	-8,56	-16,85	0,08
Iceland	0,82	-6,81	-14,75	0,14	Taiwan	14,99*	-7,19	-20,10	0,55
India	6,92**	-6,78	-18,73	0,35	Thailand	24,90*	-7,41	-19,79	0,36
Indonesia	0,01	-9,02	-15,86	0,06	Turkey	11,56*	-7,37	-19,88	0,19
Irelande	0,01	-9,31	-15,89	0,05	UK	0,02	-9,19	-15,58	0,08
Italy	0,50	-6,40	-17,60	0,28	USA	3,54	-8,57	-17,82	0,34

Notes: Reject of null hypothesis at 1%. 5% and 10% is denoted by *, **, ***. ARCH-LM is the statistics test for conditional heteroskedasticity of order 2.

6.4 Discussion

Our findings reveal a positive relationship between stock return and illiquidity, especially during the crisis period. This is due to the fact that investors are forced to sell their assets at lower price in order to avoid more loss.

In second step, we provide evidence of spillover effect from US market to the other markets through return and illiquidity shock. The effect of liquidity shocks is higher during the crisis period than the normal period, highlighting that the sensitivity of financial markets and investors to a given shock rose substantially.

Table 7b: Results of the impact of US return on individual market illiquidity shock

Coefficient	Country	Value	Std.Dev	Coefficient	Country	Value	Std.Dev	Coefficient	Country	Value	Std.Dev
α	Argentina	-0.109*	2.50E-03	α	Greece	0.017	4.81E-04	α	Norway	-0.002*	4.74E-06
β		0.902*	2.81E-02	β		0.051	8.34E-04	β		-0.017*	6.54E-04
γ		-2.654*	9.08E-02	γ		0.004	1.50E-02	γ		0.047**	2.35E-02
θ		-2.578*	1.25E-01	θ		0.016	3.23E-02	θ		-0.015	2.49E-02
α	Ausralia	0.003	1.12E-02	α	Holland	-0.01*	8.42E-05	α	Pakistan	-0.025*	7.84E-04
β		-0.67	5.71E-01	β		-0.1*	7.74E-03	β		0.604*	1.02E-01
γ		4.703*	7.38E-01	γ		0.037*	7.60E-03	γ		-0.789*	2.39E-01
θ		2.427*	2.70E-01	θ		-0.301*	4.25E-03	θ		-0.153*	3.63E-03
α	Austria	-0.04*	1.47E-04	α	Hong Kong	-0.05*	6.00E-04	α	Peru	-0.105*	1.10E-03
β		-0.031*	4.03E-03	β		-0.054*	6.47E-03	β		-0.712*	3.03E-02
γ		0.492*	3.04E-03	γ		0.023	2.35E-02	γ		2.619*	1.42E-01
θ		0.967*	2.09E-03	θ		-0.055*	9.91E-03	θ		3.277*	7.03E-02
α	Belgium	-0.138*	3.79E-04	α	Hungry	0.007*	9.14E-05	α	Philippine	-0.017*	3.83E-04
β		1.214*	2.55E-02	β		0.283*	9.65E-02	β		-0.237*	6.35E-03
γ		-0.741*	1.40E-01	γ		-0.333**	1.30E-01	γ		1.282*	2.55E-02
θ		0.673*	4.62E-02	θ		-0.314*	3.79E-02	θ		-0.18*	2.10E-02
α	Brazil	-0.061*	1.75E-05	α	Iceland	0.031*	7.40E-05	α	Poland	-0.037*	1.49E-05
β		-0.059*	1.19E-03	β		-0.005	8.49E-03	β		-0.061*	2.45E-04
γ		0.101*	5.61E-03	γ		-0.233*	2.77E-03	γ		-0.124	1.88E-01
θ		0.347*	1.09E-02	θ		-0.147	9.80E-02	θ		-0.049*	2.18E-04
α	Canada	-0.081*	1.90E-03	α	India	-0.088*	1.54E-04	α	Portugal	-0.117*	1.07E-03
β		-0.15*	4.04E-02	β		-1.176*	3.06E-02	β		-0.26*	6.50E-02
γ		-0.136	1.39E-01	γ		0.598*	2.58E-01	γ		0.785*	4.09E-02
θ		0.727*	7.34E-02	θ		0.717*	2.66E-02	θ		1.666*	8.34E-03
α	Chile	-0.008*	1.05E-04	α	Indonesia	-0.002	4.35E-03	α	Russia	-0.053*	1.57E-04
β		-0.126*	1.88E-03	β		-0.571*	6.54E-02	β		-0.021*	1.84E-03
γ		0.049	7.94E-02	γ		2.772*	3.55E-01	γ		-0.033*	4.73E-03
θ		-0.232*	6.51E-03	θ		0.637*	1.07E-01	θ		0.027*	2.63E-03
α	China	0.009*	4.10E-04	α	Irelande	-0.064*	6.92E-05	α	Singapore	-0.172*	1.71E-04
β		0.127*	1.03E-02	β		0.24*	1.09E-03	β		0.194	3.27E-01
γ		0.18*	5.29E-03	γ		-0.434*	1.28E-03	γ		0.338**	1.36E-01
θ		0.893*	1.38E-02	θ		-1.004	6.24E-01	θ		-1.148*	3.07E-01
α	Colombia	0.004*	2.34E-04	α	Italy	-0.072*	7.75E-03	α	Slovenia	-0.105*	7.47E-05
β		0.044	4.09E-02	β		1.784*	2.17E-01	β		-0.019*	6.32E-04
γ		-0.063*	1.53E-02	γ		-2.892*	2.67E-01	γ		-0.915*	5.25E-03
θ		0.22*	4.47E-02	θ		-1.295**	5.28E-01	θ		-0.418*	2.07E-03
α	Czech	-0.082*	5.98E-04	α	Japan	-0.08*	3.36E-04	α	South Africa	-0.113*	1.11E-04
β		0.905*	2.96E-02	β		-0.124*	1.86E-03	β		0.056*	8.36E-04
γ		0.923*	1.69E-02	γ		1.216*	2.57E-02	γ		-0.043*	3.45E-03

Param	Country	Estimate	Std.Dev	Param	Country	Estimate	Std.Dev	Param	Country	Estimate	Std.Dev
θ	Denmark	-0.767*	1.37E-02	θ	Korea	-3.829*	1.55E-02	θ	Spain	0.052	5.59E-01
α		-0.006*	9.74E-06	α		-0.078*	2.34E-03	α		-0.066*	1.42E-04
β		0.038*	7.54E-04	β		-1.459*	1.52E-01	β		-0.476*	5.84E-03
γ		0.011*	1.35E-03	γ		2.579*	1.76E-01	γ		-1.67*	1.28E-02
θ	Egypt	-0.275**	1.40E-01	θ	Luxumburg	-1.095*	4.01E-02	θ	Sri lanka	0.462*	1.81E-03
α		-0.133*	3.25E-05	α		-0.079*	8.83E-04	α		-0.052*	5.22E-03
β		0.251*	3.66E-03	β		-1.64*	1.74E-02	β		-2.428*	1.95E-01
γ		-0.196*	3.28E-03	γ		1.103*	3.51E-02	γ		0.74*	3.23E-04
θ	Equator	0.417*	1.19E-02	θ	Malta	0.514*	3.49E-02	θ	Switzerland	0.062	1.63E-01
α		-0.118*	1.77E-04	α		-0.102*	4.52E-03	α		0.006*	1.25E-03
β		0.156*	7.08E-03	β		0.357*	1.24E-01	β		-0.115*	2.28E-02
γ		0.584*	2.28E-03	γ		0.284**	1.34E-01	γ		0.146***	8.31E-02
θ	Estonia	-0.023*	6.08E-04	θ	Malysia	-0.033	5.04E-02	θ	Taiwan	0.702**	2.75E-01
α		-0.134*	4.25E-03	α		-0.121*	6.29E-03	α		-0.176*	1.73E-03
β		0.234*	6.59E-03	β		-0.615*	1.50E-02	β		-0.089	6.70E-02
γ		1.101*	9.44E-02	γ		0.757*	1.88E-02	γ		0.001	4.35E-02
θ	Finland	0.029**	1.51E-02	θ	Mexico	0.531*	1.65E-01	θ	Thailand	-0.227*	2.66E-02
α		-0.019*	1.93E-04	α		-0.013*	2.02E-05	α		-0.064*	2.59E-04
β		0.972*	1.03E-02	β		-0.124*	4.12E-03	β		0.492*	3.58E-03
γ		-2.584*	1.16E-02	γ		0.124*	4.95E-03	γ		-0.42*	2.10E-02
θ	France	0.552*	1.52E-02	θ	Morocco	0.024*	2.31E-03	θ	Turkey	-2.797*	1.23E-02
α		-0.071*	8.06E-04	α		-0.049*	1.23E-03	α		-0.141*	1.32E-02
β		-0.806**	3.94E-01	β		-1.078*	4.65E-02	β		-0.361	8.04E-01
γ		1.897*	3.66E-01	γ		1.981*	9.00E-02	γ		-1.113**	4.43E-01
θ	Germany	2.075**	7.91E-01	θ	New Zeland	-0.867*	7.44E-02	θ	UK	-5.873*	5.31E-01
α		-0.036*	1.17E-05	α		-0.076	2.84E-01	α		-0.015*	8.36E-06
β		0.143*	2.94E-03	β		-1.637	5.85E+01	β		0.473*	6.63E-04
γ		-0.387*	1.78E-03	γ		-0.455	6.23E+00	γ		-0.092*	7.32E-04
Θ		0.453*	1.22E-01	θ		0.277**	1.40E-01	θ		0.642	4.96E-01

Notes: α, β, γ andΘ are the estimated parameter of equation 7. Std.Dev is the standard errors of the estimated parameters; *, ** and *** denote the significant level at 1%, 5% and 10% levels, respectively.

The US markets are the source of perceived financial risk during the stress period.

The decline of US stock prices, caused by the subprime crisis, leads the local investor to liquidate their position in stock in order to meet margin requirement. Due to the problem of liquidity in local market, they are not able to sell their assets and try to sell in foreign market and cause a pressure on foreign market and therefore a liquidity problem and cause financial contagion. Hence the liquidity shock caused by US market will spread to the other market without the assumption of common linkage among the markets.

Moreover, the illiquidity shock spillover is more pronounced than return spillover, during the subprime crisis. This finding corroborates the fact that investors are fear of liquidity shock (Bernard et al. (2004)). Therefore, illiquidity is the immediate cause of financial crisis and contagion rather than the return spillover.

7 Conclusion

The main purposes of this paper are to check whether there are persistent liquidity spillovers across international stock market during the financial crisis, and to investigate the proprieties of stock market liquidity. To do so, we construct the Amihud illiquidity measure of 52 stock markets. The main results show, first, a high impact of volatility on stock market liquidity. In others words, the stock market becomes illiquid during the volatile period. We uncover a negative impact of return on illiquidity sock of some countries which means a higher return associated with a higher liquidity of the market. Also, the result shows that there is a cross-effect and bi-directional relationship between stock market return and its illiquidity shock. Hence, we conclude that the stock market return may influence future trading behavior, which in turn affect the illiquidity. While the illiquidity may impact the stock return through the trading cost (Amihud and Mendelson 1986).

Second, we examine the effect of US stock return and its illiquidity shock on others financial markets illiquidity shock during the financial crisis 2007. The results imply a higher spillover of illiquidity shock of US market during the crisis. Moreover, both US stock return and illiquidity shock have a strong effect on the illiquidity shock of the others markets.

The study promotes better understanding of the dynamics of liquidity by analyzing its determinant and its co-movement across international financial market.

Table 8b: Regression results of the impact of US shock on individual market illiquidity shock

Coefficient	Country	Value	Std.Dev	Coefficient	Country	Value	Std.Dev	Coefficient	Country	Value	Std.Dev
α	Argentina	-0.070*	4.54E-04	α	Greece	0.017*	7.08E-05	α	Norway	-0.003*	7.80E-05
β		-0.662*	5.41E-03	β		0.053*	3.12E-04	β		0.006**	3.01E-03
γ		0.091*	1.57E-04	γ		0.010	7.90E-03	γ		0.001*	3.26E-04
θ		0.043*	4.56E-04	θ		0.0612	-2.04E-01	θ		0.011	1.20E+00
α	Ausralia	0.006	7.27E-03	α	Holland	-0.013*	1.25E-05	α	Pakistan	-0.004*	3.14E-04
β		0.910*	3.62E-01	β		0.005*	9.97E-04	β		0.422*	1.14E-03
γ		0.088*	1.52E-02	γ		-0.001*	8.66E-05	γ		-0.013*	2.01E-04
θ		0.120*	4.98E-02	θ		0.008*	1.97E-04	θ		0.024*	1.80E-03
α	Austria	-0.043*	3.98E-03	α	Hong Kong	0.030*	2.36E-03	α	Peru	-0.089*	8.25E-04
β		0.346*	8.41E-02	β		0.190*	2.43E-02	β		0.303*	1.91E-02
γ		-0.002	1.00E-02	γ		-0.014*	2.37E-03	γ		-0.042*	1.11E-03
θ		-0.033	4.98E-02	θ		0.027*	4.68E-03	θ		0.313*	3.50E-03
α	Belgium	-0.146*	3.15E-03	α	Hungry	0.006	2.04E-02	α	Philippine	-0.025*	7.59E-03
β		1.084*	1.60E-02	β		0.091	5.08E-01	β		0.033	5.71E-02
γ		-0.020	1.41E-02	γ		-0.040	1.85E-01	γ		0.006	4.19E-02
θ		0.048*	4.52E-03	θ		0.010	3.41E-02	θ		0.037	3.05E-02
α	Brazil	-0.062*	3.90E-05	α	Iceland	0.029*	1.32E-03	α	Poland	-0.037*	3.93E-05
β		0.061*	9.73E-04	β		-0.090	1.38E-01	β		-0.105*	7.94E-04
γ		-0.001	2.63E-04	γ		0.004*	2.02E-03	γ		0.002*	2.23E-04
θ		0.014*	1.49E-04	θ		0.026*	3.36E-03	θ		0.001*	3.54E-03
α	Canada	-0.086*	6.42E-03	α	India	-0.088	6.97E-02	α	Portugal	-0.118*	1.09E-03
β		0.440*	2.13E-01	β		-0.395	3.86E-01	β		0.377*	2.38E-02
γ		0.024	1.83E-02	γ		-0.028	2.03E-01	γ		-0.025*	7.14E-04
θ		0.020	3.77E-02	θ		-0.152*	5.23E-02	θ		0.099*	1.34E-03
α	Chile	-0.004*	1.65E-03	α	Indonesia	-0.020*	5.87E-05	α	Russia	-0.053*	2.73E-04
β		-0.120**	5.75E-02	β		0.030*	2.40E-03	β		-0.045*	2.61E-03
γ		-0.002	2.23E-03	γ		0.009*	1.42E-04	γ		0.204*	1.07 E-04
θ		-0.005	1.87E-02	θ		0.001	7.94E-03	θ		0.016	1.77E-03
α	China	0.008*	6.81E-05	α	Irelande	-0.063*	6.02E-05	α	Singapore	-0.179*	7.93E-05
β		0.134*	6.52E-04	β		0.091*	8.13E-04	β		-0.014*	4.64E-03
γ		0.004*	4.15E-05	γ		0.006*	1.07E-04	γ		-0.061*	2.37E-04
θ		0.021	1.85E-02	θ		-0.061	4.01E-02	θ		-0.019*	1.81E-03
α	Colombia	0.003*	7.97E-05	α	Italy	-0.065*	8.01E-04	α	Slovenia	-0.108*	4.43E-04
β		0.013*	1.33E-03	β		-0.272*	3.76E-03	β		-0.492*	2.98E-03
γ		0.004*	1.66E-04	γ		0.047*	5.28E-03	γ		-0.002	3.53E-03
θ		0.006*	3.40E-04	θ		-0.014*	2.42E-03	θ		0.048*	3.43E-04

α	Czech	-0.077*	1.27E-04	α	Japan	-0.072	2.07E-02	α	South Africa	-0.104*	7.60E-04
β		1.056*	8.99E-03	β		-0.051	6.71E-01	β		-0.123*	1.12E-02
γ		0.016*	3.07E-04	γ		-0.001	1.45E-02	γ		0.065*	2.14E-03
θ		-0.058*	3.84E-04	θ		-0.039	7.39E-02	θ		0.066*	1.93E-03
α	Denmark	-0.006*	4.66E-04	α	Korea	-0.073*	1.01E-03	α	Spain	-0.056*	3.17E-04
β		-0.028***	1.66E-02	β		-1.144*	2.28E-02	β		-1.533*	5.81E-02
γ		-0.002***	1.17E-03	γ		0.006*	9.78E-04	γ		0.071*	2.42E-03
θ		-0.012*	3.08E-04	θ		-0.097*	1.81E-03	θ		0.022*	2.20E-05
α	Egypt	-0.132*	2.03E-04	α	Luxumburg	-0.093*	3.52E-04	α	Sri lanka	-0.053*	1.96E-04
β		0.087*	2.70E-03	β		-1.382*	4.99E-03	β		-2.253*	1.15E-02
γ		0.042*	1.53E-04	γ		0.023*	4.50E-04	γ		0.151*	5.38E-03
θ		0.057*	1.60E-04	θ		0.492	3.01E+00	θ		0.301*	3.95E-04
α	Equator	-0.119*	3.72E-03	α	Malta	-0.098*	1.83E-04	α	Switzerland	0.008*	1.17E-04
β		1.633*	2.50E-01	β		0.334*	2.18E-03	β		0.102*	7.83E-04
γ		0.025*	8.67E-03	γ		0.051*	2.28E-04	γ		-0.005*	1.49E-04
θ		-0.077*	1.54E-02	θ		0.071*	1.58E-04	θ		0.164*	2.42E-02
α	Estonia	-0.127*	1.71E-05	α	Malysia	-0.128*	3.24E-04	α	Taiwan	-0.165*	1.05E-04
β		-0.191*	1.02E-02	β		0.011*	2.77E-03	β		-0.003	1.16E-02
γ		0.102*	4.75E-04	γ		0.015*	4.95E-04	γ		0.039*	1.19E-04
θ		0.074*	2.35E-04	θ		0.124*	3.18E-04	θ		0.082*	8.64E-04
α	Finland	-0.003*	8.88E-05	α	Mexico	-0.013*	9.77E-04	α	Thailand	-0.067*	1.14E-04
β		0.140*	1.41E-02	β		-0.080*	1.71E-02	β		0.153*	2.48E-02
γ		0.014*	5.29E-04	γ		-0.001*	1.49E-05	γ		0.031*	2.67E-04
θ		-0.055*	8.62E-04	θ		-0.005	5.08E-03	θ		-0.016*	6.91E-03
α	France	-0.085*	6.75E-04	α	Morocco	-0.030*	3.10E-04	α	Turkey	-0.133***	7.75E-02
β		0.293*	1.29E-02	β		-1.925*	2.77E-02	β		-1.133	1.47E+00
γ		0.045*	1.34E-02	γ		0.018*	4.35E-04	γ		-0.026	5.90E-02
θ		-0.058*	5.86E-04	θ		0.006*	6.32E-04	θ		-0.374*	1.28E-02
α	Germany	-0.044*	1.11E-04	α	New Zeland	-0.075	2.15E-01	α	UK	-0.015*	1.17E-03
β		0.018*	3.17E-03	β		-1.062	2.21E+01	β		0.363*	2.87E-02
γ		-0.009*	2.23E-04	γ		-0.010	3.70E-01	γ		0.304	8.94E-01
θ		0.028*	4.17E-04	θ		0.069	1.38E+00	θ		0.112*	2.95E-02

Notes: α,β,γ andΘ are the estimated parameter of equation 8. Std.Dev is the standard errors of the estimated parameters. *,** and *** denote the significant level at 1%, 5% and 10% levels, respectively.

Another open issue relates to what policy can do to defend the domestic economy and domestic markets from adverse global shocks. The suggestive findings on the transmission of the global shock transmission acknowledge the role of .financial exposure and integration of countries as a transmission channel.

In this study, we use only one liquidity measure because the constraint of data availability for all market. So, for future research direction, this study can be extended in several ways. An examination of the external volatility on liquidity would seem to be desirable. Further and as mentioned in many researches (Chorida et al. (2006)) the inclusion of the interaction between stock and bond would be more complete. Finally, a study of jointly the funding and liquidity problems in the leading financial crisis and contagion is not explored.

References

[1]   Amihud, Y. 2002. "Illiquidity and stock returns: cross-section and time-series effects." Journal of Financial Markets, 5:31-56.

[2]   Amihud, Y. and H. Mendelson. 1986. "Asset pricing and the bid-Ask spread." Journal of Financial Economics, 17:223-249.

[3]   Balduzzi, P., E.J. Elton, and T.C. Green. 2001. "Economic news and bond prices: Evidence from the US treasury market." Journal of Financial and Quantitative Analysis, 36:523-543.

[4]   Beber, A., M.W. Brandt, and K.A. Kavajecz. 2006. "Fight-to-quality or flight-to-liquidity? Evidence from the euro-area bond market." Working Paper, NBER, N° 12376.

[5]   Bernardo, A.E, and I. Welch. 2004. "Liquidity and financial market runs." Quarterly Journal of Economics, 119:135-158.

[6]   Boyer, B.H., T. Kumagai, and K. Yuan. 2006. "How do crises spread? Evidence from accessible and inaccessible stock indices." Journal of Finance, 61:957-1003.

[7]   Brunnermeier, M.K., and L.H. Pedersen. 2009. "Market liquidity and funding liquidity." The Review of Financial Studies, 22:6:2201-2238.

[8]   Chen, S., and S.H. Poon. 2007. "International stock market liquidity and financial crisis." Unpublished paper, Working Paper, University of Manchester.

[9]   Chordia, T., R. Roll, and A. Subrahmanyam. 2001. "Market liquidity and trading activity." Journal of Finance, 56:501-530.

[10] Chordia, T., R. Roll, and A. Subrahmanyam. 2002. "Order imbalance, liquidity, and market returns." Journal of Financial Economics, 65:111-130.

[11] Chordia, T., A. Sarkar, and A. Subrahmanyam. 2005. "An empirical analysis of stock and bond market liquidity." Review of Financial Studies, 18:85-129.

[12] Chordia, T., A. Sarkar, and A. Subrahmanyam. 2011. "Liquidity dynamics and cross-autocorrelations." Journal of Financial and Quantitative Analysis, 46:3:709-736.

[13] Cifuentes, R., G. Ferrucci, and H.S. Shin. 2005. "Liquidity risk and contagion." Journal of the European Economic Association, 3:556-566.

[14] Fleming, M. 2003. "Measuring treasury market liquidity." Economic Policy Review, 9:83-108.

[15] Fleming, M., and E.M. Remolona. 1999. "Price formation and liquidity in the US Treasury market: The response to public information." Journal of Finance, 54:1901-1915.

[16] Forbes, K. J, and R. Rigobon. 2002. "No contagion, only interdependence: Measuring stock market comovements." Journal of Finance, 57:2223-2261.

[17] Goldfajn, I, and R.O Valdes. 1997. "Are currency crises predictable?." IMF, Research Department, Working Paper N° 159.

[18] Hameed, A., W. Kang, and S. Viswanathan. 2010. "Stock market decline and liquidity". Journal of Finance, 65:1:257-293.

[19] Harris, L. 1990. "Liquidity, trading rules, and electronic trading systems". New York University Salomon Center Monograph Series in Finance, Monograph 1990-4.

[20] Liu, W. 2006. "A Liquidity augmented capital asset pricing model." Journal of Financial Economics, 82:631-671.

[21] Masson, P. 1999. "Contagion: Macroeconomic models with multiple equilibria." Journ al of International Money and Finance, 18:587-602.

[22] Odean, T. 1999. "Do investors trade too much?." American Economic Review, 89:1279–1298.

[23] O'Hara, M. 1995 "Market Microstructure Theory". Basil Blackwell, Cambridge, MA.

[24] Pastor, L, and R.F. Stambaugh. 2003. "Liquidity risk and expected stock returns." Journal of Political Economy, 111:642-685.

[25] Plantin, G, H. Sapra and H.S Shin. 2005. "Marking to market, liquidity and financial stability." Bank of Japan, IMES Discussion Paper Series 2005-E-X.

[26] Schnabel, I, and H.S Shin. 2004. "Liquidity and contagion: the crisis of 1763." Journal of European Economic Association, 2:6: 929–968.