

Capturing Liquidity Premia in High Frequency Financial Time Series

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Abstract

The recent stock market crisis has raised uncertainty and has experienced a significant increase in volatility. If looking to market prices in the long run, volatility increase has led to a dramatic fall in prices but a closer examination of high frequency data can give evidence that trading volume distributions as well as the number of transactions in stocks are connected with market volatility. The goal of this paper is to investigate the dynamic relationship between trading volume and market volatility in high frequency financial time series during financial crisis.

Keywords: Volatility; Trading Volume; Liquidity Risk; Bid – Ask Spread

1. Introduction

The recent stock market crisis (2008) began in July 2007 when a loss of confidence by investors in the value of securitized mortgages in the United States resulted in a liquidity crisis with a substantial injection of capital into financial markets. In September 2008 the crisis deepened as stock markets worldwide crashed and entered a period of high volatility, and a considerable number of banks, mortgage lenders and insurance companies failed in the following weeks. Recent financial literature has documented a severe reduction of stock market liquidity during market downturns. In particular, several empirical studies investigate factors that may influence stock market liquidity during financial crisis. Among these, the last one has experienced extreme liquidity risk: excessive volatile market conditions tend to produce unpredictable short term stock price movements opening up bid ask spreads of individual stocks and leading to market illiquidity. This situation is mostly related to sellers trying to close their positions in no bid market conditions: in illiquid stock markets, investors are substantially unable to sell large amounts of shares without generating sharp decline in prices.

This paper examines the determinants of changes in liquidity and their relationship with stock market returns of the Italian stock market during the recent financial crisis. In particular, we develop a model that measures liquidity by the degree to which the quantity of stocks traded affects the market price of stocks. Liquid markets are markets where

participants can rapidly execute large volume transactions without a significant price impact of the stocks; in an illiquid market, however, they can determine adverse impact on stock prices. Section II describes the technique for measuring stock market liquidity and all the time series indicators related to market liquidity shocks.

2. Measuring Liquidity Risk

There are no liquidity measures universally adopted in financial applications. In literature two types of measures of market liquidity are used: measures related to trading activity and measures related to trading costs. Three forms of market liquidity can be inspected: tightness, depth and resiliency. The first measures the intensity the bid and ask prices diverge from the mid market prices; depth is related to the volume of trades which is unlikely to move prevailing market prices and is typically referred to the fluctuation in bid-ask spreads as a result of the impact from order executions. Resiliency measures the speed with which imbalances in order flows are dissipated and is related to the speed with which the bid-ask spread and order volume are restored to normal market conditions. In order to examine intraday liquidity patterns we propose a set of measures applied to half hourly stock time series. The following conventional “market liquidity” indicators are constructed for all the stocks and the intraday periods:

- Volume: total number of shares traded;
- Value: total turnover value measured in local currency;
- Number of “Information orders”: total number of orders with size greater than the median;
- Orders “exceeding the tick size”;
- Excess returns orders: total number of orders that generate returns greater than the median;
- Illiquidity measure (Amihud 2002) defined as

$$IL_i = \frac{|R_i|}{Vol_i}$$

where $|R_i|$ is the absolute return and Vol_i is the total value trades in the i -th period.

- Interperiod volatility defined as:

$$IV_i = \frac{P_{H,i} - P_{L,i}}{[P_{H,i} + P_{L,i}]^2} \cdot 100$$

where $P_{H,i}$ and $P_{L,i}$ are respectively the highest and the lowest price in the i -th period.

Following empirical evidence that traders tend to concentrate their activity at the close and the open of the market in bear markets, all the liquidity indicators are summarised daily by computing a concentration measure to investigate relations to price volatility and bid-ask spreads. Moreover, the standard deviation of the chi square test between a selected day empirical frequency distribution and all the others is proposed to depict persistence of market illiquidity. Finally, using time series ordinary least squares, we es-

timate the dynamic interaction between liquidity indicators and absolute stock daily returns.

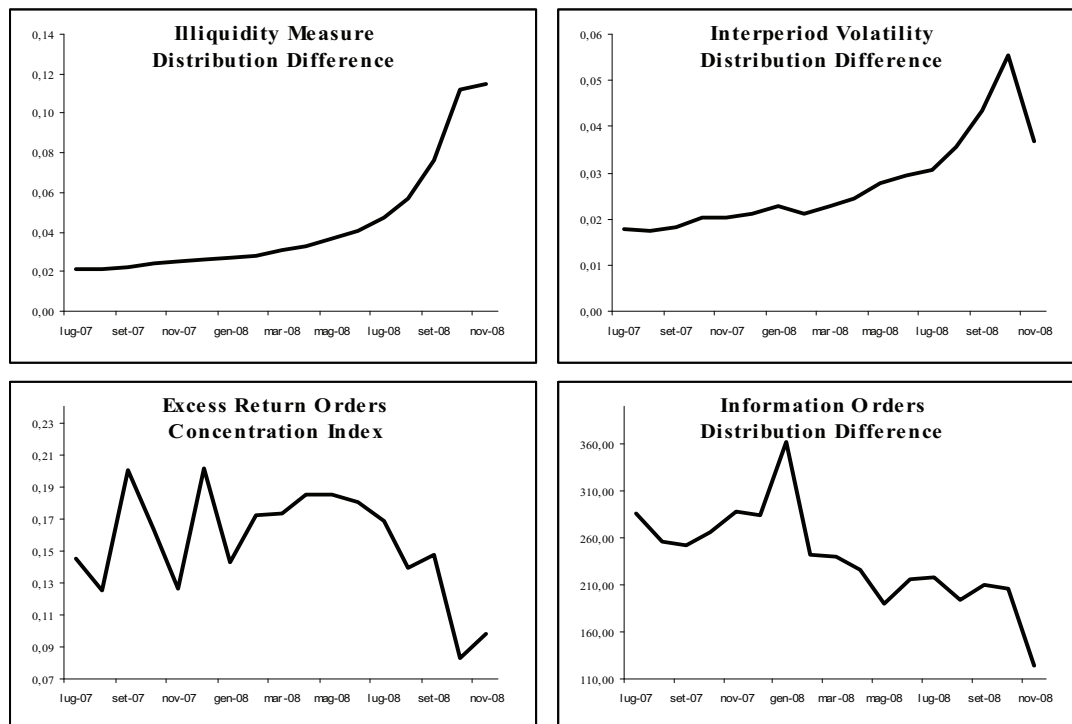
3. Empirical Results and analysis

The study employs a trade-by-trade data set which provides order book data for the Italian equity market with information on prices and volumes transacted along with prevailing bid and ask quotes. Some of the proposed liquidity indicators, for the Fiat stock half hourly time series as an example, are summarised monthly in Table 1 (descriptive statistics) and Figure 1.

Table 1: Fiat stock time series liquidity measures: descriptive statistics

<i>Distribution Difference</i>	Mean	Std	Min	Max
Total numbers of share traded	32,40	4,66784	25,43	43,92
Orders exceeding the tick size	206,48	47,4077	113,57	337,35
Illiquidity measure	0,0437	0,0291	0,0211	0,1151
Interperiod volatility	0,0274	0,0101	0,0174	0,0554
<i>Concentration</i>	Mean	Std	Min	Max
Number of information orders	0,0714	0,0026	0,0682	0,0795
Excess returns orders	0,1550	0,0326	0,0832	0,2011

Figure 1: Fiat stock time series liquidity measures



As shown in Figure 1, market liquidity by all measures deteriorated sharply during the financial crisis showing similar paths. During the crisis periods, the fall in depth was dramatic. For instance, market depth measured as the number of “Information Orders”

rose by more than 100% within the first seven months, while in terms of “Interperiod Volatility”, rose by more than 300% during the crisis. The sharp falls in depth and rising price volatility all pointed to a rapid fading of liquidity in the stock market during the crisis. Table 2 reports the results of regression equation which depicts the relationship between daily stock returns and liquidity indicators and (5% significant level).

Table 1: Fiat stock regression equation

<i>Distribution Difference</i>	Parameter	<i>t</i> -statistic	Prob.
Orders exceeding the tick size	0,000764	5,23738	0,00%
Excess returns orders	-0,001386	-2,56924	1,07%
Illiquidity measure	1,345565	2,53022	1,19%
<i>Concentration</i>	Parameter	<i>t</i> -statistic	Prob.
Excess returns orders	-0,020019	-2,61603	0,93%
R^2 59%	DW-statistic	2,2678	
F-statistic 30,9944	Prob(F-statistic)	0,0000	
Number of observations	306		

Generally speaking, 13 out of the 20 processed stocks from the MIB40 Index show a positive relation between illiquidity and returns and there is no evidence that relates the results to stock market capitalization: overall the regression has an R^2 of about 39%. Two distribution difference indexes – “Illiquidity Measure” and “Orders exceeding the tick size” were significant in all the estimated models whereas the “Excess returns orders” concentration variable was significant for 15 stocks.

4. Concluding Remarks

This paper investigated whether stock market illiquidity can affect the volatility level generating excess returns. In particular, a standard regression model was used to examine whether specific liquidity indicators can measure the impact of illiquidity during the recent financial crisis on Italian stock market returns. In terms of the empirical results, it was found that mainly “depth” and “concentration” can explain transmission effects on stocks’ returns. However, the significance of the model seems to vary according to specific stocks and was perhaps influenced by the regulatory prohibiting short selling.

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