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Abstract

Using monthly data instead of daily data, I investigate the dynamic relationship between the short selling activity, market return, illiquidity and volatility of the NASDAQ 100 from February 2000 to December 2020. The findings suggest that high level of short selling can lower illiquidity and volatility. This relationship weakens during the financial crisis of 2008. The finding also suggests that the idea that short selling destabilizes the market is unfounded.

Introduction

Short selling is often thought of as the culprit of market declines. Most recently, short selling is the center of attention again when a group of traders on Reddit bankrupted a hedge fund by driving up the price of GameStop's stock, which then led to a hearing and the Securities and Exchange Commission revisiting of rules on short selling. During the financial crisis of 2008, the SEC temporarily banned the short selling of 1000 financial stocks. SEC Chairman Christopher Cox said the ban would restore equilibrium to markets and would not have been necessary in a well-functioning market. Eurozone countries regulators reacted the same way in the sovereign debt crisis of 2011-2012. Spain's stock market regulators argued that "failure to ban short sales would heighten uncertainty." However, many existing studies on the relationship between short selling and market returns suggest the contrary, as well as the detrimental effects of shorting bans on market efficiency.

In 2010, when China launched a pilot scheme to lift the short-selling ban on stocks on a designated list, Chang, Luo and Ren (2014) found that the stocks on that list experience negative returns before the ban was lifted, then experience increasing price efficiency and decreasing stock

return efficiency after the ban was lifted. Lamont and Stein (2004) used short selling measures to study their relationships with market return. They found that the problem was too little short selling in an emerging market, rather than too much short selling in a failing market. Empirical evidence from Cohen, Diether, and Malloy (2007) suggests that short selling makes overvaluations less severe, and they move prices toward fundamentals. Their results also show that the shorting market is important for private information revelation, which is an important component of the efficient market hypothesis stating that stock prices should reflect all relevant information.

This study examines the relationship between aggregate short selling and illiquidity, volatility and market return using the NASDAQ 100 index over a period of 20 years using monthly data rather than daily data and covering a longer period of time than analyzed in existing literature. The results of this study show that short selling is associated with higher liquidity and lower volatility, which in turn improves market quality. This study also confirms the positive correlation between short selling and market return like that of Sobaci, Sensoy, and Erturk (2014) and Bailey and Zheng (2012) studies.

Literature Review

Short selling is often under scrutiny for worsening the market and making the market inefficient, governments sometimes try to impose constraints to prevent that. However, there are many studies demonstrate the positive contribution of short selling in accomplishing the opposite.

Information incorporation in stock prices is one of the most important aspect to ensure the prices reflect their fundamentals. Diamond and Verrechia (1987) pointed out that because short sellers do not have the right to the sale proceeds, they never short for liquidity reasons, which imply that short sellers do not short uninformed. Boehmer et. al (2008) constructed a long daily panel of short sales from 2000 – 2004 of six account types – individual, institutional (program and

nonprogram), member firm propriety and found that short sellers are extremely informed, and can identify both overvalued and undervalued stocks. Boehmer and Wu (2013) demonstrates that higher level of shorting not only improves informational efficiency during intraday trading, but also quickens the cooperation of public information into stock prices at longer horizons, and in turn ensuring accuracy of prices. Chen and Rhee (2010) studies the market in Hong Kong and found that short sales quicken the price adjustment of not only firm-specific news, but market-wide information. Karpoff and Lou (2010) measured short selling in a set of firms that were disciplined by the SEC for financial misinterpretation. In their sample of 454 firms during the period of 1988 – 2005, 98% have abnormal negative returns and average 1-day stock price decline of 18.2%. These firms are used to test if short sellers can anticipate bad news. They found that short interest in these firms rises significantly 19 months before the news of financial interpretation becomes public, and the amount also positively correlate with the severity of the misinterpretation. They also examined if short sellers negatively affect other investors. Not only did they not find evidence to that effect, they found the short selling dampens the effect of price inflation of the firms studied, and quickens the discovery of the financial misinterpretation – especially of those with severe financial misinterpretation. Takahashi (2010) used a 10-year panel of flow-based measure of shorting demand in Japan and found that short sellers act as informed investors when it comes to bad news, and they could identify stock price deviations from fundamentals.

Lamont and Stein (2004) studied the correlation between the monthly short sale ratio and index return of over 12 months prior for the US market. Their study found that the relationship is highly negative, even during the peak of the dot-com bubble in 2000. They also suggest that efforts to ban or restrict short sales during crises are misguided. Lynch et. al (2014) also showed the same relationship between aggregate short sale and market return.

Studies that look at the relationship between short selling and market liquidity and volatility like that of Diamond and Verrechia (1987) and Boehmer et. al (2013) predicts that a shorting ban could hurt market liquidity and worsen market quality because short sellers are potentially the liquidity provider.

Data and methodology

The data covers a period from February 1, 2000 to December 15, 2020. The monthly short sales ratio of each constituent stocks of the NASDAQ 100, their market capitalization, monthly values and turnover rate were obtained from Bloomberg. Those data were used to construct the analyzed variables: aggregate short ratio, volatility and illiquidity.

Aggregate short ratio is calculated as follows:

$$SRt = \frac{\sum_{i=1}^{N} SRi(t) \times MCi(t)}{\sum_{i=1}^{N} MCi(t)} \quad \textbf{(1)}$$

In Eq. (1), N=100 is the number of stocks included in the NASDAQ 100, SRi(t) is the short sale ratio of month t of company i, and MCi(t) is the market capitalization of company i at the end of month t.

For month t, the unconditional volatility proxy for the NASDAQ 100 is calculated as:

$$V\mathrm{t} = \frac{\mathrm{P_{H(t)} - P_{L(t)}}}{(\mathrm{P_{H(t)} + P_{L(t)}})/2} \quad \textbf{(2)}$$

Where $\mathrm{P_{H(t)}}$ and $\mathrm{P_{L(t)}}$ are the high and low values of the NASDAQ 100 on month t.

The measure of illiquidity on month t ILQt is based on the work of Amihud (2002) and calculated as:

$$ILQt = \frac{|rNASDAQ100,t|}{TRN_t} \quad \textbf{(3)}$$

Where $|rNASDAQ100,t|$ is the absolute value of the monthly return of the NASDAQ 100

and TRN_t is the turnover rate of the index in month t. This value is multiplied by 10^6 as suggested by Amihud (2002). The higher the ratio, the less liquid the NASDAQ 100.

To analyze the dynamic relationship between the variables, I take the first differences of each. For SRt: $\triangle SR_t = SR_t - SR_{t-1}$; similarly, $\triangle V_t = V_t - V_{t-1}$; $\triangle ILQ_t = ILQ_t - ILQ_{t-1}$ and market return is calculated as $r_{NASDAQ100,t} = \frac{(\text{NASDAQ100}_t\text{-NASDAQ100}_{t-1})}{\text{NASDAQ100}_{t-1}}$.

I use the unrestricted VAR model with 5 lags to examine the joint dynamics, ARCH and GARCH model to capture the volatility of the series overtime. The dynamic relations between the analyzed variables are obtained by the dynamic conditional correlation (DCC) model of Engle (2002). I also used the Granger causality test to investigate the causalities between the lagged variables. To check for stationary, multicollinearity and autocorrelation, I used the augmented Dickey-Fuller test and the variance inflation factor test, respectively.

Empirical Results

Upon checking the unit root test using the augmented Dickey-Fuller test on all variables, all series are stationary as the test rejects the null hypothesis of unit root for all series at the 1% significance level. All series are therefore not cointegrated. The mean VIF value is 1.60, meaning multicollinearity is not a concern.

According to Table 1, volatility and illiquidity has a negative correlation with aggregate short ratio as expected and are significant at the 1% level. Market return also has a negative correlation with aggregated short ratio, which is neither unexpected nor expected due to contradicting findings of whether short sellers are contrarians or momentum traders.

Table 1: Covariance matrix

Variables	(1)	(2)	(3)	(4)
(1) AggShortRatio	1.000			
(2) Volatility	-0.480*	1.000		
(3) Illiquidity	-0.190*	0.672*	1.000	
(4) MarketReturn	-0.135*	0.203*	0.069	1.000
*** p<0.01, ** p<0.05, * p<0.1				

From Table 2 and Figure 1, it can be seen that aggregate short ratio reaches peak in 2014 during the Greece and Eurozone crisis. It is also worth noting that the low level of short selling during the financial crisis of 2008 and the dot-com bubble in 2000 is almost the same, and those same periods experience spikes in both volatility and illiquidity. It can also be seen that in the period 2003 – 2007, when the short selling level picks up, volatility remains low. The financial crisis of 2008 is an interesting point, because even after the short selling level picks up, volatility, illiquidity remains high.

Table 2: Descriptive statistics of the variables from February 1, 2000 to December 15, 2020

Variable	Obs	Mean	Std. Dev.	Min	Max
AggShortRatio	251	2.241	.477	1.135	3.942
Volatility	251	.101	.068	.024	.38
Illiquidity	250	1348.51	1207.471	26.716	8642.945
SRt	250	-.001	.453	-1.331	1.42
Vt	250	.001	.049	-.162	.221
ILQt	250	-2.159	1449.085	-6060.294	5409.301
MarketReturn	250	-.002	.072	-.159	.359

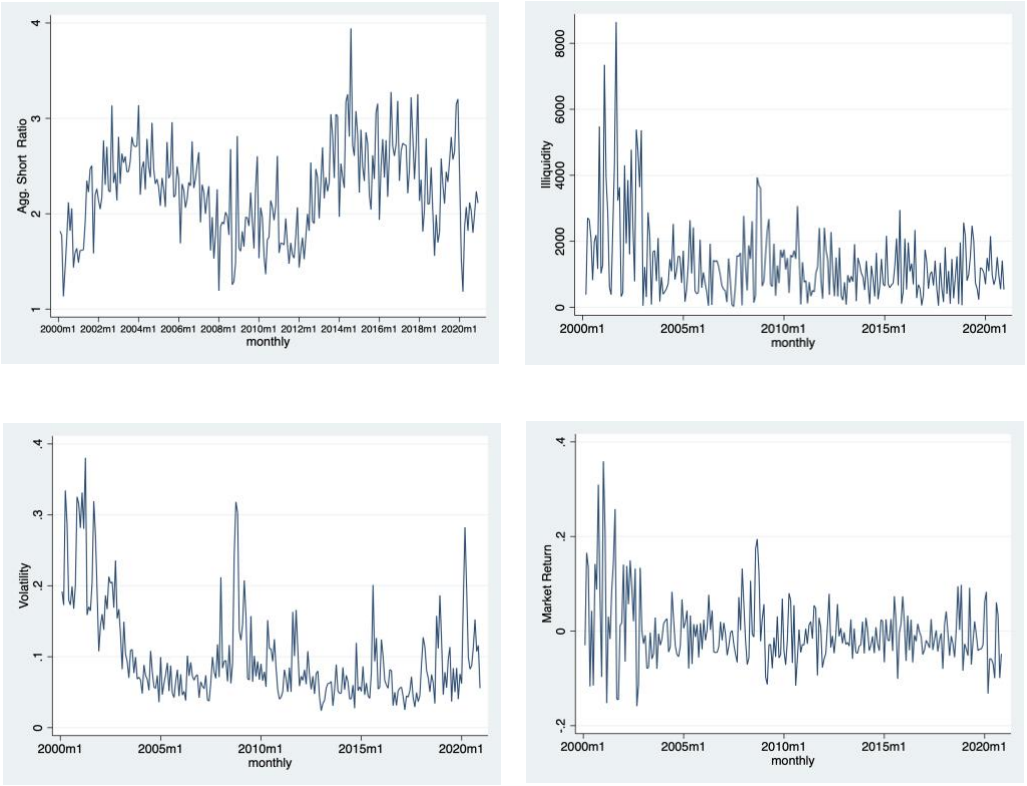

Figure 1: monthly values of the aggregated short ratio, volatility, illiquidity and market return from February 2000 to December 2020

Table 3: Parameters estimates for VAR(5), ARCH/GARCH and DCC process

	ΔSRt		ΔVt		ΔILQt		rNASDAQ100	
	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value
ΔSRt−1	-0.7455264***	0.000	-0.0120563	0.126	230.1844	0.292	-0.0036504	0.787
ΔSRt−2	-0.6490318***	0.000	0.0133405	0.194	564.024**	0.048	-0.022847	0.195
ΔSRt−3	-0.2072546**	0.044	0.0105868	0.348	497.000	0.112	-0.0265644	0.170
ΔSRt−4	-0.1296557	0.166	0.0108299	0.291	-42.300	0.882	0.0001388	0.994
ΔSRt−5	-0.0967844	0.189	-0.0009144	0.910	-26.000	0.907	0.0126197	0.362
ΔVt−1	-1.866482**	0.024	-0.5399766***	0.000	3942.298	0.117	-0.2872672*	0.065
ΔVt−2	-1.289747	0.182	-0.1978495*	0.061	7230.000**	0.014	-0.3521922*	0.052
ΔVt−3	-0.0348166	0.970	-0.2301716**	0.024	1880.35	0.508	-0.2510374	0.153
ΔVt−4	0.4212909	0.624	-0.1733031*	0.066	154.000	0.953	0.2066455	0.201
ΔVt−5	0.36947	0.602	0.0019427	0.980	2200.000	0.306	0.0728111	0.584
ΔILQt−1	0.0000163	0.528	-0.000003	0.292	-0.8748325***	0.000	0.0000086*	0.079
ΔILQt−2	0.000022	0.468	-0.0000031	0.35	-0.7494521***	0.000	0.0000173***	0.002
ΔILQt−3	0.0000035	0.912	-0.0000017	0.629	-0.5705827***	0.000	0.0000108*	0.075
ΔILQt−4	-0.0000047	0.876	-0.000004	0.226	-0.585011***	0.000	0.0000054	0.341
ΔILQt−5	-0.0000155	0.531	-0.0000011	0.673	-0.2721408***	0.000	0.0000005	0.912
rNASDQ100t−1	0.2934772	0.415	-0.2134302***	0.000	-1184.257	0.279	0.1158255*	0.087
rNASDQ100t−2	-0.7827954**	0.043	0.0003554	0.993	-557.000	0.635	-0.0708499	0.329
rNASDQ100t−3	-0.3470735	0.345	0.0969657**	0.016	384.25	0.731	0.0900567	0.192
rNASDQ100t−4	-0.1718107	0.647	0.0333976	0.416	-1830.000	0.108	0.069747	0.322
rNASDQ100t−5	0.2425779	0.511	0.0678843*	0.092	-255.000	0.820	0.1415256**	0.041
constant	-0.004919	0.827	0.0008815	0.720	-2.196676	0.974	-0.0021205	0.616

	$\triangle SR_t$	$\triangle V_t$	$\triangle ILQ_t$	$r_{NASDAQ100,t}$
α	0.1624	0.7046***	0.3553***	0.2631***
β	-0.4117	0.2091***	0.6032***	0.6970***

DCC parameters

a	**b**
0.073***	0.686***

In the tables, *,**,*** denote significance at the 10%, 5% and 1% level respectively.

The VAR coefficients in Table 2 shows explanatory power of the lagged variables on themselves. The lagged values of daily changes in short ratio, however, does not seem to have an explanatory on any other variables. The results from the ARCH/GARCH model shows overall amplified persistence in volatility for all variables except for that of the monthly changes in aggregate short ratio. The alpha term of $\triangle V_t$ also shows a significant proportion of volatility from one period being carried to the next. The effect of returns is extremely persistence, which could indicate that short selling does not manipulate the market.

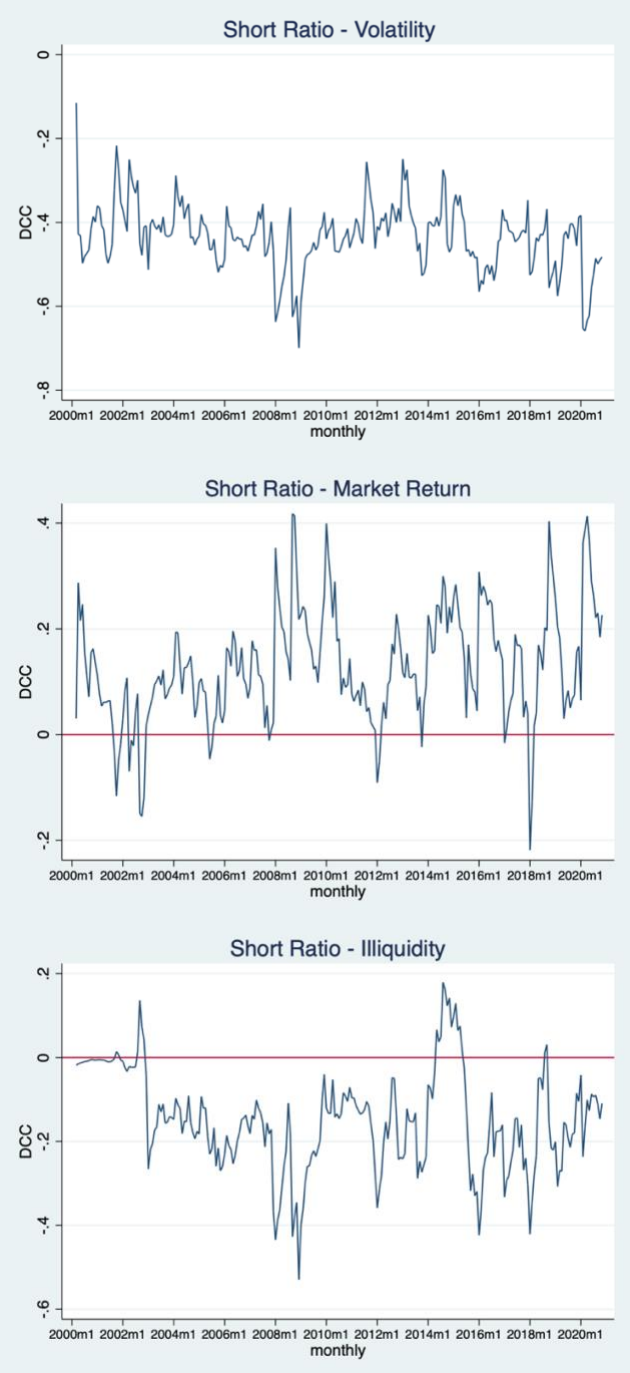

Figure 2: Dynamic correlation between daily changes in SRt, Vt, ILQt and NASDAQ 100

Figure 2 presents the correlation between short selling and other variables in the same period. I find that while the relationship between short ratio and market and market return is not always positive, but for the most part, an increase in market return is associated with an increase in short selling. This suggests that short selling does not causes, triggers market to decline, contrary

to popular beliefs. Similarly, short selling largely has a negative correlation with illiquidity, i.e higher level of short selling makes the market more liquid. Even during the periods that the relationship is positive, the correlation reaches less than 0.2. Short selling is always negatively correlated with volatility in the time period studied, even through crisis periods.

In testing Granger causalities between the variables, I found that lagged SRt Granger causes lagged market return and lagged Vt. Lagged market return Granger causes lagged ILQt. Lagged Vt Granger causes lagged market return, lagged Vt. Lagged Vt Granger causes market return and SRt. The results are shown in the Appendix section.

Conclusion:

In this study, I find that short sellers are contrarian traders, rather than momentum traders as suggested by Lamont and Stein (2004) and Lynch et. al (2014). I also find that short selling does not negatively affect the market, but rather improves it. My results confirm that of Sobaci, Sensoy, and Erturk (2014) that aggregate short ratio increases liquidity, decreases volatility and positively correlate with market returns. Even with monthly data over a longer period of, those effect could still be captured and proven.

Appendix

Granger causality Wald tests

Equation	Excluded	chi2	df	Prob>Chi2
L_MarketReturn	L.SRt	0.843	2	0.656
L_MarketReturn	L.Vt	0.975	2	0.614
L_MarketReturn	L.ILQt	5.137	2	0.077
L_MarketReturn	ALL	10.655	6	0.100
L_SRt	L.MarketReturn	7.849	2	0.020
L_SRt	L.Vt	10.475	2	0.005
L_SRt	L.ILQt	0.847	2	0.655
L_SRt	ALL	18.110	6	0.006
L_Vt	L.MarketReturn	18.699	2	0.000
L_Vt	L.SRt	8.229	2	0.016
L_Vt	L.ILQt	1.243	2	0.537
L_Vt	ALL	28.422	6	0.000
L_ILQt	L.MarketReturn	1.105	2	0.575
L_ILQt	L.SRt	0.900	2	0.638
L_ILQt	L.Vt	0.672	2	0.715
L_ILQt	ALL	3.902	6	0.690

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