Do Arbitrageurs Amplify Economic Shocks?

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Introduction

The Issue

Speculators (arbitrageurs) destabilize asset markets?

Theory: If speculators capital constrained, asset prices excessively sensitive to shocks (either sentiment or news)

--- e.g. Hedge funds w/ levered positions in cheap stock.

Negative earnings surprise or further bearish sentiment and price falls.

Forced unwinding → price falls more w/ shocks than a stock w/o any hedge funds.

Amplification mechanism:

Maintaining positions tied to asset values

Upward sloping demand curves

Amplification and financial crises

LTCM 1998

Quants Summer 2007

Current situation, forced unwinds or deleveraging

Reuters Newswire reports (October 24, 2008):

"The manager of the world's biggest bond fund said on Friday that forced liquidations, based on margin calls, are driving stocks lower, and not fear. Bill Gross, chief investment officer of Pacific Investment Management Co. or Pimco, said on CNBC television that margin calls were driving the selling that has resulted in a long-term deleveraging of assets not seen since the 1930s."

Our Goal

Look at short arbitrage in equity markets.

Several reasons for why short selling ideal

(1) Plentiful data on shorts (undertaken by professionals).

(2) Short sales highly levered (margin accounts etc…).

(3) Anecdotes on "short covering" causing excess volatility in markets.

- A famous case is eBay in summer of 2006.

- Volkswagen 10/28/08, hedge fund short cover, share up from €420/share to €1,005.01/share. VW $370.4-bil mkt cap > Exxon $343-bil mkt cap

  ** Price down significantly after short covering

Idea

Use earnings announcements as shock (measurable in contrast to sentiment)

A simple model w/ three dates:

(1) Arb short over-priced stock w/ + sentiment

(2) Earnings announcement at intermediate date

(3) Ability to hold shorts depends on past performance

Main predictions:

(1) Return higher on good news for a stock w/ short selling than for a stock w/o.

(2) Short covering following good news

(3) Low returns subsequently on good news for stocks with short selling compared to those w/o.

Empirical Work

Monthly data on short sales in U.S. equities, '93-'07

Pooled regression (CAR, AVGTURN, and POSTCAR) around earnings announcement dates, (-7 to +1, -7 to +1, and +2 to +180) on:

--- Highly shorted stocks (top 33% of short ratio for that quarter)

--- High earnings surprise dummy (top 33% for that quarter)

*** (High absolute earnings dummy, top 33% for AVGTURN)

--- Highly shorted dummy interacted w/ high earnings surprise dummy

Coefficients of interest on interaction HIUExHISR

\+ for CAR

\+ for AVGTURN

\- for POSTCAR

Most important worry is the omitted variables bias/endogeneity of short interest.

--- Elaborate controls using firm characteristics

--- Stock fixed effects

--- Time-varying quarter by industry effects

--- Two quasi-experiments

(1) Exploit differences in short selling regulations across exchanges (triple diff)

(2) Rise of hedge funds since 2000 increase short selling among small stocks (quadruple diff)

*** Framed in terms of leverage, etc… but could be due to other factors.

Related Literature

Growing literature testing partial equilibrium implications of limits to arbitrage models

--- e.g., Savor and Gamboa-Cavazos (2005) , Lamont and Stein (2004)

Our paper test of destabilization

Closest is Lamont and Stein (1999) on housing market

Our setting is a lot better!

Model

Single asset (stock) in unit net supply and three dates: 0, 1, and 2.

At 2, payoff v --- either $\bar{v}$ or $\underline{v}$ w/ prob 1/2

At 1, v announced

Price at time t is p_t

Noise traders and risk neutral speculators

Aggregate noise trader demand time 0 and 1 are given by (in share terms)

$$Q_0^N = \frac{E_0[v] + S}{p_0} = \frac{\frac{1}{2}\bar{v} + \frac{1}{2}\underline{v} + S}{p_0} \qquad (1)$$

and

$$Q_1^N = \frac{E_1[v] + S(v)}{p_1} = \frac{v + S(v)}{p_1} \qquad (2)$$

respectively.

Assume arbs' resources given by F_0 and $F_1(v)$
Insufficient to bring prices to fundamental value.

Initial aggregate speculator demand given by

$$Q_0^S = -\frac{F_0}{p_0} \tag{3}$$

where $F_0 < S$ (more general set-up in Appendix).

At time 1, all uncertainty resolved, speculators take the maximum possible short position

$$Q_1^S = -\frac{F_1}{p_1} \tag{4}$$

provided $F_1(v) \leq S(v)$.

Key assumption regarding arbitrageurs' resources

$$F_1(v) = F_0 + aF_0\left(1 - \frac{p_1(v)}{p_0}\right), \tag{5}$$

where $a > 1$.

Solve for asset prices.

By no arbitrage, $p_2 = v$.

Since aggregate demand in each period must equal the unit supply, i.e.

$$Q_t^S + Q_t^N = 1, \tag{6}$$

price at time 0 is

$$p_0 = \frac{1}{2}\bar{v} + \frac{1}{2}\underline{v} + S - F_0. \tag{7}$$

Equating supply and demand at time 1 and then substituting from equation (5), we get

$$p_1(v) = \frac{v + S(v) - F_0(1+a)}{1 - a\dfrac{F_0}{p_0}} \ . \tag{8}$$

The earnings response coefficient, denoted by β, is:

$$\beta(v) = \frac{\frac{\Delta p}{p}}{\frac{\Delta v}{p}} = \frac{p_1 - p_0}{v - E[v]} \qquad (9)$$

Proposition 1: *The earnings response coefficient is greater for shorted stocks than for un-shorted stocks.*

Make use of the following rearrangement of terms in (9):

$$\beta(v) = k\left(1 + \frac{S(v) - S}{v - E[v]}\right),$$

where $k = \left(1 - a\frac{F_0}{p_0}\right)^{-1} \geq 1.$

$k = 1$ for stocks w/ zero initial short interest.

All else equal, the ERC of a shorted stock should be larger by a factor of k.

Depending on unobservable parameter a, k can reasonably vary from 1.1 to 1.3 (assuming a short interest ratio of 8%).

Proposition 2*: For shorted stocks, the change in short ratio is inversely related to the earnings surprise. Share turnover around earnings announcements is more sensitive to unexpected earnings for highly shorted stocks than for un-shorted stocks.*

--- Note that for un-shorted stocks, there is no turnover since we only have noise traders and no arbitrageurs.

Proposition 3: *If sentiment increases proportionally w/ unexpected earnings news, then for highly shorted stocks, the expected return to shorting can be higher after unexpectedly good earnings news.*

--- In a more dynamic set-up with multiple earnings dates, we could also accomplish the same result by introducing transitory earnings shocks.

Table 1: Summary Statistics

	Mean	25th	Median	75th
	(1)	(2)	(3)	(4)
Short Ratio (% of shares outstanding)	3.39 [4.77]	.56	1.69	4.25
AVGTURN (mean turnover (%) from day -5 to +1)	1.00 [2.63]	.19	.46	1.03
CAR (cumulative abnormal return (%) from day -5 to +1)	.35 [10.18]	-4.23	.10	4.77
POSTCAR (cumulative abnormal return from day +2 to +126)	-.28 [34.11]	-17.58	-2.46	13.10
Unexpected Earnings (as a % of previous price)	-.13 [1.99]	-.09	.01	.12
Market Capitalization (millions of dollars)	3670 [15,622]	239	606	1886
Price/Earnings (if positive)	40.8 [160.5]	14.0	19.3	29.9
Analyst Disagreement	.17 [.64]	.02	.06	.13
Past Volatility	1.52 [1.39]	1.51	2.15	3.10
Convertible Debt (millions of dollars)	34.6 [176.9]	0	0	0

Panel Regression Specifications

Specification 1:

$$CAR_{i,t} = \alpha + \beta_1 UEHIGH_{i,t} + \beta_2 HISR_{i,t} + SIZEdummies_{i,t} + P/E\,dummies_{i,t} + DISAGREEMENTdummies_{i,t} + CONVDEBTdummies_{i,t} + VOLATILITYdummies_{i,t} + INDUSTRYdummies_i + QUARTERdummies_t + \varepsilon_{i,t}$$

Specification 2:

$$CAR_{i,t} = \alpha + \beta_1 UEHIGH_{i,t} + \beta_2 HISR_{i,t} + \beta_3 UEHIGH_{i,t} \times HISR_{i,t} + SIZEdummies_{i,t} + P/E\,dummies_{i,t} + DISAGREEMENTdummies_{i,t} + CONVDEBTdummies_{i,t} + VOLATILITYdummies_{i,t} + INDUSTRYdummies_i + QUARTERdummies_t + \varepsilon_{i,t}$$

Specification 3:

$$
\begin{aligned}
CAR_{i,t} = {} & \alpha + \beta_1 UEHIGH_{i,t} + \beta_2 HISR_{i,t} + \beta_3 UEHIGH_{i,t} \times HISR_{i,t} \\
& + SIZE dummies_{i,t} + SIZE dummies_{i,t} \times UEHIGH_{i,t} + P/E\ dummies_{i,t} \\
& + P/E\ dummies_{i,t} \times UEHIGH_{i,t} + DISAGREEMENT\ dummies \\
& + DISAGREEMENT\ dummies \times UEHIGH_{i,t} \\
& + CONVDEBT dummies_{i,t} + CONVDEBT dummies_{i,t} \times UEHIGH_{i,t} \\
& + VOLATILITY dummies_{i,t} + VOLATILiTY\ dummies_{i,t} \times UEHIGH_{i,t} \\
& + INDUSTRY dummies_i + QUARTER\ dummies_t + \varepsilon_{i,t}
\end{aligned}
$$

Table 2: OLS Estimates of the Sensitivity of Stock Returns to Unexpected Earnings

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Indicator for High Unexpected Earnings (UEHIGH)	4.07 (.07)	3.90 (.08)		4.34 (.08)	4.08 (.09)		4.10 (.07)	3.93 (.08)	
Indicator for High Short Ratio (HISR)	-.15 (.07)	-.32 (.09)	-.28 (.09)	-.27 (.09)	-.52 (.10)	-.48 (.10)	-.18 (.07)	-.34 (.09)	-.29 (.09)
High Unexpected Earnings×High Short Ratio (UEHIGH×HISR)		.51 (.15)	.43 (.15)		.76 (.16)	.70 (.16)		.49 (.15)	.39 (.16)
Stock Fixed Effects	No	No	No	Yes	Yes	Yes	No	No	No
Quarter×Industry Effects	No	No	No	No	No	No	Yes	Yes	Yes

Table 3: OLS Estimates of the Sensitivity of Turnover to Unexpected Earnings

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
High Absolute Unexpected Earnings (ABSUEHIGH)	.43 (.04)	.29 (.04)		.17 (.02)	.09 (.02)		.43 (.05)	.29 (.04)	
Indicator for High Short Ratio (HISR)	.69 (.04)	.55 (.03)	.56 (.02)	.33 (.02)	.25 (.02)	.26 (.02)	.68 (.04)	.55 (.03)	.56 (.02)
High Absolute Unexpected Earnings Decile×High Short Ratio (ABSUEHIGH×HISR)		.38 (.09)	.35 (.09)		.24 (.03)	.22 (.04)		.39 (.09)	.35 (.09)
Stock Fixed Effects	No	No	No	Yes	Yes	Yes	No	No	No
Quarter×Industry Effects	No	No	No	No	No	No	Yes	Yes	Yes

Table 4: OLS Estimates of the Effect of Unexpected Earnings on Subsequent Stock Returns

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Indicator for High Unexpected Earnings (UEHIGH)	1.16 (.23)	2.17 (.26)		.62 (.24)	1.41 (.27)		1.26 (.23)	2.22 (.26)	
Indicator for High Short Ratio (HISR)	-1.82 (.29)	-.83 (.33)	-.99 (.33)	-3.53 (.37)	-2.77 (.39)	-2.98 (.40)	-1.83 (.28)	-.90 (.32)	-1.05 (.32)
High Unexpected Earnings×High Short Ratio (UEHIGH×HISR)		-2.98 (.51)	-2.49 (.54)		-2.31 (.52)	-1.69 (.54)		-2.83 (.50)	-2.37 (.53)
Stock Fixed Effects	No	No	No	Yes	Yes	Yes	No	No	No
Quarter×Industry Effects	No	No	No	No	No	No	Yes	Yes	Yes
p-value of test that $\beta_1+\beta_3=0$		0.06			0.04			0.15	

Quasi-Experiments

Our effects should be stronger for NASDAQ stocks which are easier to short

--- Short selling regulations more lax for stocks listed on NASDAQ than on the NYSE.

--- Short interest ratios substantially higher for NASDAQ stocks all else equal.

$$HISR_{i,t} = \alpha + \beta_1 NASDAQ_{i,t} + SIZE dummies_{i,t} + P/E\ dummies_{i,t} + DISAGREEMENT dummies_{i,t} + IO dummies_{i,t} + CONVDEBT dummies_{i,t} + VOLATILITY dummies_{i,t} + INDUSTRY dummies_i + YEAR dummies_t + \varepsilon_{i,t}$$

Table 5: The Effect of being Traded on NASDAQ on the Probability of Having a High Short Ratio

Indicator for	.086
NASDAQ traded stock	(.009)

Table 6: Estimates of the Effect of Unexpected Earnings on Stock Returns, Turnover and Subsequent Stock Returns for NASDAQ versus NYSE Stocks

	CAR	AVGTURN	POSTCAR
	(1)	(2)	(3)
High Unexpected Earnings (UEHIGH or ABSUEHIGH for column (2))	3.93 (.14)	.19 (.05)	3.99 (.48)
Indicator for High Short Ratio (HISR)	-.30 (.16)	.24 (.03)	-1.08 (.56)
Indicator for NASDAQ stock (NASDAQ)	-.34 (.17)	.32 (.05)	-1.55 (.62)
UEHIGH×HISR	.71 (.23)	.20 (.05)	-2.06 (.69)
UEHIGH×NASDAQ	.93 (.22)	.10 (.07)	1.83 (.77)
HISR×NASDAQ	-1.00 (.25)	.48 (.06)	.08 (.89)
UEHIGH×HISR×NASDAQ	.80 (.37)	.69 (.16)	-4.01 (1.21)

Quasi-experiment 2: Increase since 2000 of hedge funds shorting small stocks (NYSE Quintiles 1-5) compared to large stocks (NYSE Quintiles 8-10)

Hanson and Sunderam (2008)

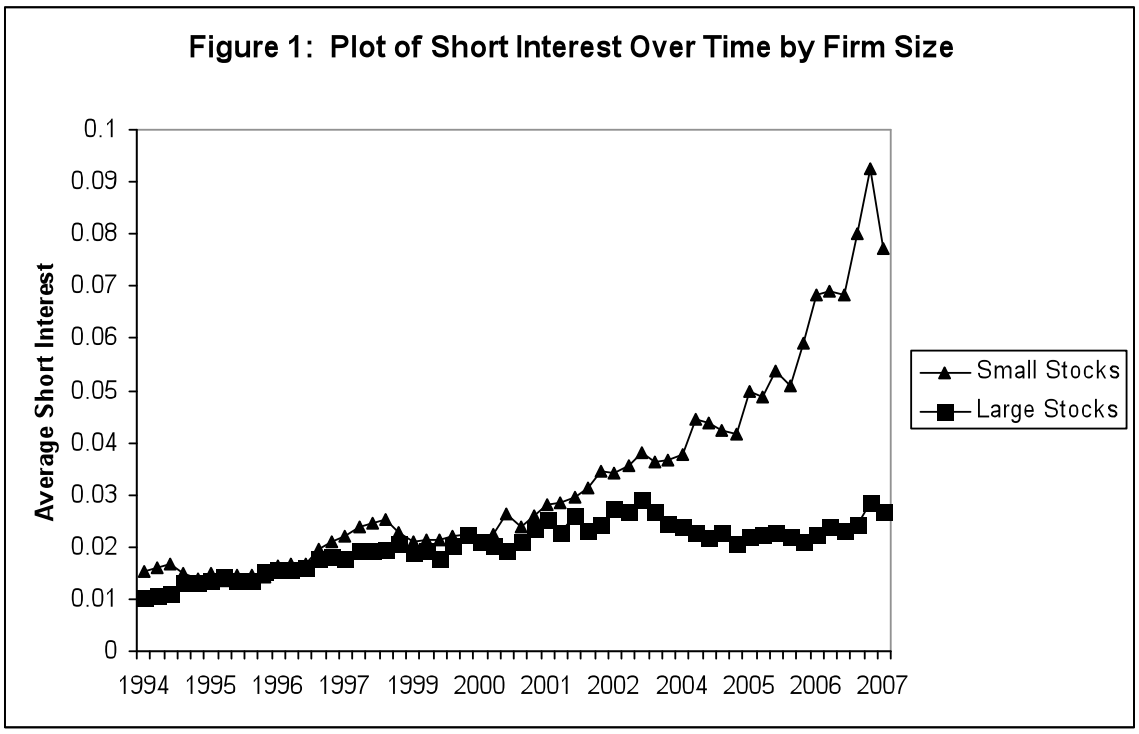

Table 7: Estimates of the Effect of Unexpected Earnings on Stock Returns, Turnover and Subsequent Stock Returns for Small and Large Cap Stocks Before and After 1999

	Small Stocks			Large Stocks		
	CAR	AVGTURN	POSTCAR	CAR	AVGTURN	POSTCAR
	(1)	(2)	(3)	(4)	(5)	(6)
High Unexpected Earnings (UEHIGH or ABSUEHIGH for columns (2) and (4))	4.98 (.26)	.24 (.08)	5.93 (1.02)	3.04 (.26)	.21 (.05)	1.61 (.81)
Indicator for High Short Ratio (HISR)	-.76 (.30)	.37 (.13)	-.23 (1.21)	-.21 (.28)	.10 (.05)	.87 (1.03)
Indicator for After 1999 (AFTER)	1.26 (1.09)	.34 (.36)	-5.55 (3.55)	-.17 (.87)	.21 (.11)	5.96 (2.56)
UEHIGH×HISR	1.18 (.42)	.71 (.26)	-3.48 (1.67)	1.03 (.39)	.57 (.17)	-.48 (1.48)
UEHIGH×AFTER	-.01 (.36)	-.15 (.10)	1.11 (1.34)	.88 (.32)	.16 (.09)	-1.04 (1.06)
HISR×AFTER	-1.11 (.40)	.44 (.15)	-1.33 (1.53)	-.35 (.39)	.70 (.08)	-3.08 (1.34)
UEHIGH×HISR×AFTER	1.04 (.58)	-.33 (.29)	-3.84 (2.17)	-47 (.56)	-.02 (.21)	-1.15 (1.96)

Conclusion

There are a number of avenues for further research:

(1) Asymmetries

(2) We can also use options data as opposed to short interest data to measure levered long or short positions in stocks and perform a similar set of analyses as in this paper.

(3) Other destabilization mechanisms such as front-running (w/ Chen, Hanson and Stein)