

# Market manipulation 3.0

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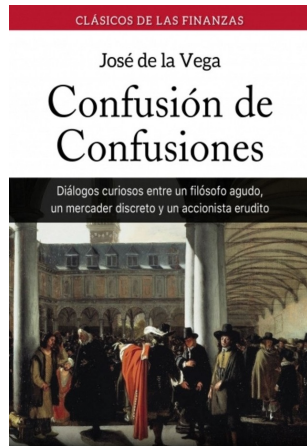
# Market manipulation: Definition

According to the SEC:

- “Manipulation is intentional conduct designed to deceive investors by controlling or artificially affecting the market for a security.  
Manipulation can involve a number of techniques to affect the supply of, or demand for, a stock.
- They include:
  - spreading false or misleading information about a company;
  - improperly limiting the number of publicly-available shares;
  - or rigging quotes, prices or trades to create a false or deceptive picture of the demand for a security.
- Those who engage in manipulation are subject to various civil and criminal sanctions.”

# Market manipulation: A long history

- Joseph de la Vega, 1688
  - *"The greatest comedy is played at the Exchange. There,... the speculators excel in tricks, they do business and find excuses wherein hiding places, concealment of facts, quarrels, provocations, mockery, idle talk, violent desires, collusion, artful deceptions, betrayals, cheatings, and even tragic end are to be found."*
  - *"The bulls spread a thousand rumors about the stocks, of which one would be enough to force up the prices."*



# Market manipulation: Motivation

- One of the reasons the SEC was established in 1934 was to eliminate stock market manipulation.
- **It's not just history:** *"The world has changed a great deal since the late 1600s, but market manipulations do not go out of style."* (Leinweber & Madhavan, 2001)
- **It's not just isolated instances:** Hundreds of cases involving message manipulation
- **It's not just micro-cap stocks:** Multibillion large caps were the subject of successful manipulations.

# Motivation: What's new?

- **Social media presents opportunities for fraudsters** (Investor Alert: Social Media and Investing, SEC, 2014).
- One way fraudsters may exploit social media is to engage in a market manipulation, such as spreading false and misleading information about a company to affect the stock's share price (typically small, so-called “microcap” companies). Wrongdoers may perpetuate stock rumors on social media, as well as on online bulletin boards and in Internet chat rooms. (SEC, 2014)

# Motivation: What's new?

- *"The web has become the new prime venue for the old game of market manipulation. (...) The net raises market manipulation to a level only dreamed of by past shysters."* (Leinweber & Madhavan, 2001)
- *"Cybernetic market manipulation schemes that leverage modern technologies like electronic network, social media, and artificial intelligence, are more harmful than traditional scheme."* (Lin, 2017)
- *"An individual user with no track record or reputation can in some cases reach as many readers as Fox News, CNN, or the New York Times."* (Allcott & Gentzkow, 2017)
- Jonathan Lebed, a teenager in the US successfully manipulated a dozen of stocks by posting messages on Yahoo Finance message boards and made profits of \$800,000 (Lewis, 2001).

# Motivation: What's different?

## EXHIBIT 1

### Market Manipulation Before and After the Internet Era

Attribute	Pre-Web	Post-Web
Access to media	Difficult to gain access to conventional media; often very expensive	Easy and cheap; manipulator can post messages or rumors
Anonymity	Very difficult to remain anonymous	Easy; anonymity is typical on the Internet
Scalability	Difficult to repeat a rumor often	Easy and cheap through message replication and postings on multiple boards
Time	Typically slow; rumors spread through word of mouth could be repeated. More difficult for print media	Extremely fast; reaction time is in seconds, facilitating “pump and dump” strategies
Impact	Depends	High, especially in stocks favored by day traders

Source: Leinweber & Madhavan (2001)

# Examples of cyber-manipulations: Fake news (Leinweber & Madhavan, 2001)

- “In April 1999, an employee of PairGain posted a message on a Yahoo! bulletin board alleging that PairGain had agreed to be acquired.”
- “In February 2000, hackers posted a fake message about a merger between Aastorm Biosciences Inc. (ASTM) and Gerno Corp that stated that the merger price would be \$11.79 per share for ASTM.”

EXHIBIT 2

Daily Prices and Volume in PairGain Stock: April 1999



EXHIBIT 3

Daily Prices and Volume in Aastorm Stock: January 21–February 18, 2000





# Examples of cyber-manipulations: Pure message events (Leinweber & Madhavan, 2001)

- “In August 1999, the stock was trading at about \$4 when 'Tokyo Joe' (since indicted) pushed the stock in a chat room. One participant was quoted as saying: 'Wait until the traders see IMA after lunch.' Joe replied: 'It will be \$14 when you are back.' ”
- “On Friday, November 12, the manipulators posted more than 500 fake messages using 50 different Web identities promoting shares of NEI Webworld, Inc.”

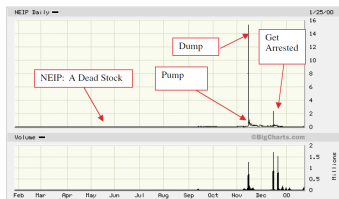
EXHIBIT 4

Daily Prices and Volume in Information Management Associates Stock: March 1999–March 2000



EXHIBIT 5

Daily Prices and Volume in NEI Webworld Stock: February 1999–January 2000



# Examples of cyber-manipulations: It's Not Just Micro-Caps (Leinweber & Madhavan, 2001)

- “In March 2000, a day trader posted a fake announcement regarding the earnings of Lucent Technologies (...). The effect was dramatic. Over \$7 billion of market capitalization evaporated within a few hours, all driven by a dozen messages repeating the false rumor.”

## EXHIBIT 6

### Fake Lucent Announcement

Subject: LUCCENT RELEASES EARNINGS WARNING! DAWH!  
From: hot\_like\_wanabe  
Posted: 2000-03-22 18:57:00

Msg: 88257 of 88478  
Company Press Release  
SOURCE: Lucent Technologies  
Lucent Technologies Comments on Expectations for Second Fiscal  
Quarter 2000 Earnings

MURRAY HILL, N.J., March 22 /REUTERS/ -- Lucent Technologies (NYSE: LU - news) said today that, based on preliminary estimates, it expects operating results for its second fiscal quarter of 2000 to be lower than analysts' estimates. The company expects to report revenues in the range of \$9.4 to \$9.5 billion for the quarter, which will end Mar. 31, 2000, flat with the prior year period(s).

## EXHIBIT 7

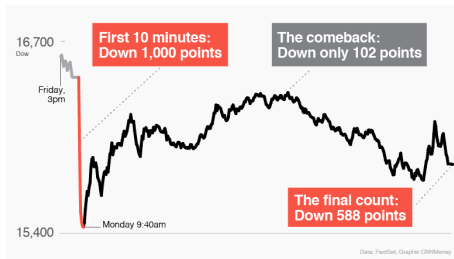
### Daily Prices and Volume in Lucent Technologies Stock: February 2000–April 2000



# An example of large manipulation: The Flash Crash?

- May 6, 2010, Flash Crash: 1 trillion USD
- September 30, 2010: the SEC and CFTC published the report following their joint investigation
- According to the report, the Flash Crash was not related to manipulative conduct or illegal behavior
- April 2015: Navinder Singh Sarao was arrested for market manipulation that allegedly contributed to the May 2010 Flash Crash
- *“According to the DOJ, Sarao manipulated futures contracts tied to the S&P 500 over the course of many years, including in the days and hours leading up to the Flash Crash, which netted him \$40 million in ill-gotten gains”* (Lin, 2017)

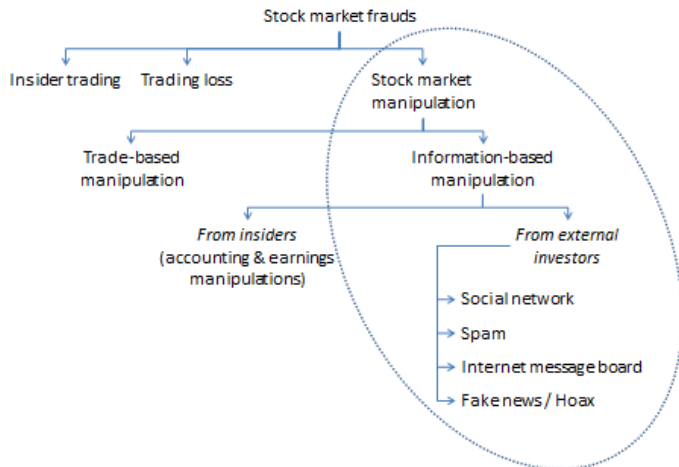
# Another Flash Crashes, another manipulations?



## A survey of evidence

- Social Networks
- Spam
- Internet message board
- Fake news
- Hoax

# Manipulations: A typology



# Previous related surveys

- Putniņš, T. J. (2012). Market manipulation: A survey. *Journal of Economic Surveys*, 26(5), 952-967.
- Nardo, M., Petracco-Giudici, M., Naltsidis, M. (2016). Walking down wall street with a tablet: A survey of stock market predictions using the web. *Journal of Economic Surveys*, 30(2), 356-369.
- Lin, T. C. (2016). The new market manipulation. *Emory LJ*, 66, 1253.
- Leuz, C., Meyer, S., Muhn, M., Soltes, E., & Hackethal, A. (2017). Who Falls Prey to the Wolf of Wall Street? Investor Participation in Market Manipulation, NBER (No. w24083).
- Allcott, H., & Gentzkow, M., (2017). Social Media and Fake News in the 2016 Election. *Journal of Economic Perspectives*, 31 (2), 211-36.

# Theoretical models on market manipulation

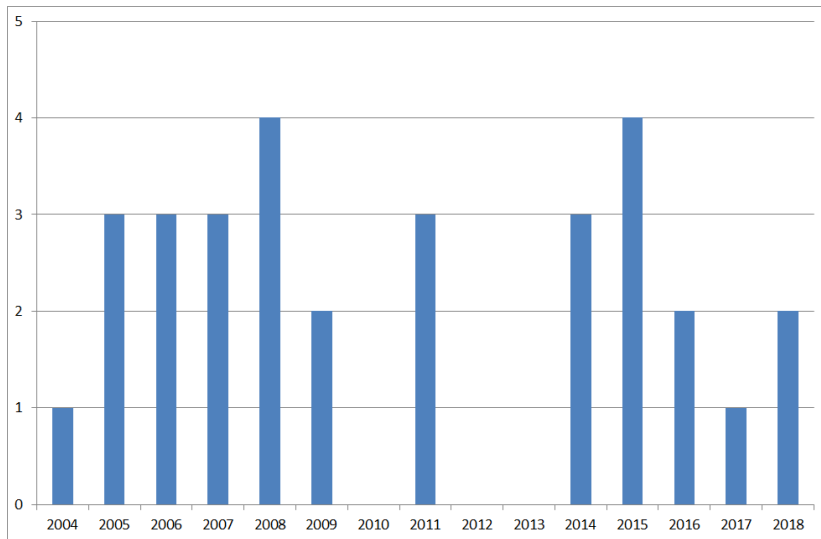
- Allen & Gale (1992), Allen & Gorton (1992): trade-based manipulation.
- Benabou & Laroque (1992): information-based manipulation based on reputation.
- Kumar & Seppi (1992), Merrick et al. (2004): manipulation with the futures market
- Gerard & Nanda (1993): manipulation in seasoned equity offerings



# SEC litigation releases analysis

- According to Aggarwal & Wu (2006), based on SEC litigation releases, there were 142 cases of stock market manipulation from 1990 to 2001.
- Most manipulation cases has happened in relatively small and illiquid markets (such as the OTC Bulletin Board and the Pink Sheets).
- Mei et al. (2004): From January 1980 to December 2002, only 159 pump-and-dump cases (based on SEC litigation releases). Data available only for 71 cases.
- Only a small fraction of manipulation is detected and prosecuted (Comerton-Forde and Putnins, 2014).
- Focusing on reported cases tends to create a selection bias toward unsophisticated manipulation (Bonner et al., 1998).

# AMF litigation releases



# Stock spam e-mails and Internet message board

- Frieder and Zittrain, 2007: Unsolicited e-mails (spams): 80% of all Internet e-mails traffic. 15% of these are stock touts.
- Hanke and Hauser, 2008: Spam e-mails have an impact on stock prices, trading volume and volatility.
- Nelson et al., 2013: Disclaimers in spam messages reduce, but do not eliminate, the market impact.
- Sabherwal et al., 2013; Similar pattern on message boards: two-day pump followed by a two-day dump manipulation pattern among online traders.

# Twitter crash

- In 2013, the Twitter account of AP has been hacked (by the Syrian Electronic Army?)

Dow Jones Industrial Average (^DJI) - DJI

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**14,719.46** +152.29 (1.05%) 4:10PM EDT

Enter name(s) or symbol(s)

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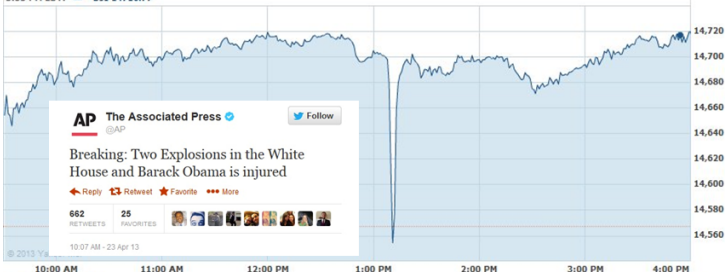
[EVENTS](#)

[TECHNICAL INDICATORS](#)

[CHART SETTINGS](#)

[RESET](#)

3:53 PM EDT: ■ ^DJI 14716.77



Volume: 770,500



- The Bhopal disaster
  - The worst industrial disaster in history. December 2–3, 1984 at the Union Carbide India Limited (UCIL) pesticide plant in Bhopal
  - About 4,000 deaths and + 500,000 injuries
- Yes men
  - December 3, 2004 a fake interview at the BBC: The company would agree to clean up the site and compensate those harmed, for a amount of US\$12 billion
  - Dow Chemical loses \$2million (−4.2%)
  - Lecœur & Pessar, 2006, Les Yes Men: De l'usage de la “rectification d'identité” pour Bhopal, Multitudes, n25.

# Hoax and manipulation

- Bloomberg (Nov. 22, 2016): “Vinci SA fell victim to a fake release claiming the French builder had fired its finance chief amid accounting irregularities, prompting the stock to plunge before the company denied the report.”



# Hoax and manipulation: Another cases

- 2016 (Nov.), The US firm Fitbit (takeover bid by the Chinese funds ABM Capital).
- 2015, The US firm Avon (tender offer)
- 2013, The Australian group Whitehaven Coal (hoax from ecologist activists?)
- 2014, G4S (hoax from activists?)
- 1814 (Feb. 21), Rumours announced that the war was over and Napoleon killed. Investors bid up the stocks on the London exchange. In the investigation that followed, a scheme to manipulate prices on the London stock exchange was uncovered (Lord Thomas Cochrane?)

# Insider trading from outside

- Unusual Option Market Activity and the Terrorist Attacks of Sept. 11, 2001 (Allen M. Poteshman, *Journal of Business*, 2006, vol. 79, no. 4)
- “After September 11, 2001, there was a great deal of speculation that the terrorists or their associates had traded in the option market on advanced knowledge of the impending attacks. This paper generates systematic information about option market activity that can be used to assess the option trading that precedes any event of interest.”
- “Examination of the option trading leading up to September 11 reveals that there was an unusually high level of put buying. This finding is consistent with informed investors having traded options in advance of the attacks.”



- Borussia Dortmund bus attack (2017 April, 11): two injuries
- First, the Islamic motive was suspected after a letter was found close to the site of the bombings
- Actually, the main motive was stock market manipulation (BVB is the only German listed soccer team)
- The suspect bought options on BVB's stock worth roughly 78,000 euros

- Simpson (2018) : “tweets with a negative sentiment were followed by an increase in uncertainty in the VIX and SP 500 1 and 2 minutes after the tweet. Similar results were found for positive tweets”.
- Ge, Kuro, & Wolfe (2018): “tweets move company stock prices and increase trading volume, volatility and institutional investor attention”.

## Twitter and manipulation

# Objectives

- Market manipulation is a broader topic than information-based manipulation on Twitter about small-cap companies
- Fraudsters may use, or combine, different channel of communication to conduct frauds.
- Manipulation on large capitalization stocks might be completely different from pump-and-dump scheme on social media
- The technological evolution and the rise of algorithmic trading can increase the profitability of manipulation.

# Objectives

- Explore the relation between the content published on **social media** and **small-capitalization stock returns**
- **Examine users' characteristics** to identify is the price patterns are related to the tweeting activity of a specific subset of users.
- Analyze **if fraudsters/promoters use social media to temporarily inflate the price of small capitalization stocks.**

- Focus on small-capitalization stocks (penny stocks, micro-cap stocks) quoted on the OTC Markets (previously known as Pink Sheets)
- All Common Stock and Ordinary Shares of companies incorporated in the United States, excluding American Depositary Receipts, ETF, Funds, and Warrants. Our sample consists of 5,087 companies.
- Bloomberg: daily price data, traded volume data, and market capitalization for all 5,087 stocks.

- Twitter is a micro-blogging platform that enables users to send and read short 140-character messages called “tweets”.
- Computer program in the Python programming language to [collect data in real time using Twitter Search and Stream Application Programming Interface \(API\)](#).
- All the messages containing a “\$” [sign followed by the ticker name](#), as in Sprenger et al. (2014).
- Sample period: October 5, 2014, to September 1, 2015. We collect a total of [7,196,307 tweets](#).

Figure: Example of tweets



**knucklehead777**  
@1war\_dawg

Follow

**\$BMIX** ABOUT TO RUN FASTER THAN MAYWEATHER

1:47 PM - 4 May 2015

1 Retweet 1 Like



**Obi**  
@aaaamhim

Follow

**\$AAPH** 121 million O\S and it's at .0006!!!!  
Seriously! !!!! See you at .0025. Bring them to you BEFORE the crowd. See you at .0025

9:21 AM - 27 Oct 2014



**Penny Hotstocks**  
@Penny\_Hotstocks

Follow

CES Synergies Inc. **\$CESX** Visit their website [bit.ly/1SSPWXv](http://bit.ly/1SSPWXv)

6:30 AM - 6 Aug 2015

1 Retweet



**SPUMPS**  
@PUMPNN

Follow

**\$DTST** exploding!! Up 270% now! [@etrade](#)  
[@stockchartscom](#) [@OTCMarkets](#)  
[@WolfOfWeedST](#) [@YahooFinance](#)

9:57 AM - 12 Mar 2015



- **Event**: when the number of messages posted on Twitter about company  $i$  during a given day  $t$  exceeds the average of the previous 7 days plus two standard deviations
- Minimum of 20 tweets from 20 distinct users to avoid having our results driven by a few active users. Market capitalization greater than \$1,000,000 at the beginning of the event window.
- Event window [-10:+10] - Estimation window [-260:-11]
- **Total of 635 events for 318 companies**

- Significant positive abnormal return on day  $t-1$  and day  $t$  (+4.1% ; +6.8%)
- Significant negative cumulative abnormal return on day  $t+1$  to  $t+5$  (-3.10%)
- Increase in abnormal volume from day  $t-2$  to  $t+5$
- Three hypotheses can explain the price and volume patterns
  - Over-optimistic noise traders [Behavioral Finance]
  - Overreaction to news [Market Efficiency]
  - Pump-and-dump scheme [Market Manipulation]

- We define a list of 156 stock promoters / paid advertisers by analyzing the tweeting activity of all users from our database with a minimum of 100 tweets (7,069 users)
- Stock promotion is not illegal per se. If promoters provide full disclosure of their compensation (type, amount, person paying the compensation) in all their communication, and if the information provided is neither false nor misleading, stock promotion can be legal.

# Stock Promoters

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**Tweets** **266K**

**Following** **4,206**

**Followers** **11.4K**

**Likes** **499**

[Follow](#)

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Market Awareness/ Stock Alerts.  
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**Jet Life PennyStock\$** @JetPenny · 4h  
Toachi Mng Inc. (TIMGF: OTC Pink Current) | Piggyback Qualified -  
**Toachi Mng Inc. (TIMGF: OTC Pink Current) | Piggy...**  
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Solgold PLC (SLGGF: OTC Pink Current) | Piggyback Qualified -

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# Stock Promoters


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- "Many of our awareness campaigns are paid via third parties, these third parties are often investor relations companies and/or market awareness companies who have been subsequently hired by the company or an investor/investor group that have shares in the company receiving the awareness. Paid awareness is nearly always a means to sell shares to the public in the open market, so you should always assume if there is an awareness campaign then someone is selling shares of the company in question".
- "We may have an inherent conflict of interest [...] We reserve the right to either BUY or SELL shares in the profiled company's stock, either BEFORE the date of the profile, DURING the date of the profile or at ANY time after the date of the profile".

# Pump-and-dump trackers

- We identify two users whose tweeting activity is dedicated to tracking pump-and-dump schemes: “@ThePumpTracker” and “@PUMPSandDUMPS”.
- “Track pump and dump’s, pump promotions, chatroom pumps, scams, ICO scams, crypto scams” and publish a message on Twitter to alert individual investors every time they suspect that a stock is under manipulation.

## Hypothesis #1

- The price increase on the event day is higher when at least one tweet was sent by a **stock promoter**. The price reversal after the event is stronger when at least one tweet was sent by a stock promoter on the event day
- Stock promoters' activity **pumping the price of a stock on the event day** by sending false or misleading information on Twitter, and **then selling the stock at an artificially inflated prices** after the pumping period.



## Hypothesis #2

- The price increase on the event day is lower when at least one tweet was sent by a [user tracking pump-and-dump schemes](#) on the event day.
- Pump-and-dump trackers' activity [mitigating the price increase](#) on the event day by alerting users on Twitter of a potential pump-and-dump scheme.

# Cross-sectional Analysis

**Table:** Messages containing the cashtag \$UBIQ posted on Twitter on Feb 6, 2015.

Date	User	Message content
2015-02-05 16:40:35	pickoftheday1	\$UBIQ Nice days here today Ubiquity Inc. QB UBIQ 0.729 + 0.159 27.89% V [url]
2015-02-05 16:42:44	cabroncita	UBIQ Nice green close today!! Put this one on your radar! \$UBIQ [url]
2015-02-05 16:46:14	cabroncita	\$UBIQ Company Website [url]
2015-02-05 16:51:04	JetPenny	Cabroncita: \$UBIQ Company Website [url]
2015-02-05 16:59:37	iHangout4	cherrob: The Hunt for the Next 10 Bagger: \$UBIQ Nice days here today Ubiquity [url]
2015-02-05 16:59:38	iHangout4	cherrob: BREAKOUTS..RUNNERS AND HOT PENNIES: \$UBIQ Nice days here today [url]
2015-02-05 17:01:46	Hot.pennyalert	budfoxhub: \$UBIQ +27% big close today bull run starting! [url]
2015-02-05 17:20:54	cabroncita	\$UBIQ Check out their patents! <a href="http://t.co/ckhN8B36yB">http://t.co/ckhN8B36yB</a>
2015-02-05 17:47:36	ThePUMPTracker	Alert : <a href="http://t.co/zVxyqFLK7">http://t.co/zVxyqFLK7</a> announces \$UBIQ as 02/06/2015 promo. Get the detailed promo
2015-02-05 17:50:46	PennyStocksBlog	RT @ThePUMPTracker: Alert : [url] announces \$UBIQ as 02/06/2015 promo. [url]
2015-02-05 19:31:49	Pubcos	\$UBIQ seems to be building. Looks like there could be some momentum. Let s see...
2015-02-05 19:35:16	Pubcos	\$UBIQ new entertainment amp communications experience creators & viewers together [url].
2015-02-05 19:38:08	Pubcos	Information is power. You may want to put this company on your radar: [url] \$UBIQ
2015-02-05 19:42:48	Pubcos	\$UBIQ +27% growth today. Congrats....
2015-02-06 09:01:32	PUMPSandDUMPS	Before you get taken by today s \$UBIQ pump you better review the ticker s Past Performances
2015-02-06 09:25:39	StockPromoters	\$UBIQ StockPromoters.com <a href="http://t.co/v3yEIMowcM">http://t.co/v3yEIMowcM</a>
2015-02-06 09:27:31	hecklerhouse	\$UBIQ chatter chatter
2015-02-06 10:43:25	WallStreetPenni	Mick Dodge: \$UBIQ is working hard to create a diverse [url]
2015-02-06 10:43:26	WallStreetPenni	Affix Trader: \$UBIQ Ubiquity is focused in five specific areas.... [url]
2015-02-06 10:51:09	JetPenny	Affix Trader: \$UBIQ Don t miss their patent portfolio overview! IP [url]
2015-02-06 15:15:29	explodeprofits	DITRstocks: \$UBIQ Short Term Indicators Barchart Opinion [url] [url]
2015-02-06 15:17:05	JetPenny	DITRstocks: \$UBIQ Short Term Indicators Barchart Opinion [url]

# Cross-Sectional Analysis

$$\begin{aligned} AR_t^i = & \alpha + \beta_1 AR_{t-1}^i + \beta_2 MarketCap_t^i + \beta_3 Price_t^i + \beta_4 NonTradingDays_t^i \\ & + \beta_5 MarketType_t^i + \beta_6 Sentiment_t^i + \beta_7 News_t^i + \beta_8 NumberMessages_t^i \\ & + \beta_9 StockPromoter_t^i + \beta_{10} PumpTracker_t^i + \beta_{11} IRAccount_t^i + \epsilon_t \end{aligned} \quad (1)$$

$$\begin{aligned} CAR_{t+1,t+n}^i = & \alpha + \beta_1 AR_t^i + \beta_2 MarketCap_t^i + \beta_3 Price_t^i + \beta_4 NonTradingDays_t^i \\ & + \beta_5 MarketType_t^i + \beta_6 Sentiment_t^i + \beta_7 News_t^i + \beta_8 NumberMessages_t^i \\ & + \beta_9 StockPromoter_t^i + \beta_{10} PumpTracker_t^i + \beta_{11} IRAccount_t^i + \epsilon_t \end{aligned} \quad (2)$$

# Descriptive Statistics

Table: Descriptive Statistics

Variable	Mean	Median	Min	Max	Std-Dev
$AR_t$	0.0688	0.0142	-0.7731	1.9837	0.2386
$CAR_{t+1;t+5}$	-0.0311	-0.0306	-0.9673	1.4782	0.2365
$MktCap_t$	196.2422	9.3357	1.0011	15037.7915	1278.4197
$Price_t$	2.1342	0.1225	0.0001	168.75	8.3172
$NonTradingDays_t$	0.0508	0.0	0.0	0.8571	0.1269
$MktType_t$	0.126	0.0	0.0	1.0	0.3321
$Sentiment_t$	0.3063	0.2727	-0.9436	1.0	0.317
$News_t$	0.1843	0.0	0.0	1.0	0.388
$MessageNumber_t$	192.5465	48.0	20.0	5250.0	514.5267
$StockPromoter_t$	0.6346	1.0	0.0	1.0	0.4819
$PumpTracker_t$	0.0898	0.0	0.0	1.0	0.2861
$IRAccount_t$	0.4961	0.0	0.0	1.0	0.5004

# Cross-sectional Analysis

Table: Contemporaneous Regression -  $AR_t$

Model	[1]		[2]		[3]	
Variable	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat
$\alpha$	0.1296***	5.9237	0.0413	1.1532	0.0034	0.0890
$AR_{t-1}$	-0.2188***	-3.9294	-0.2268***	-4.0162	-0.2425***	-4.3619
<i>MktCap</i>	-0.0159***	-3.0639	-0.0136***	-2.6893	-0.0124**	-2.4930
<i>Price</i>	-0.0011*	-1.8117	-0.0011**	-2.0287	-0.0010	-1.4964
<i>NonTradingDays</i>	-0.1404**	-2.3708	-0.1149*	-1.9156	-0.0848	-1.4392
<i>MarketType</i>	-0.0213	-0.7907	-0.0097	-0.3643	-0.0128	-0.4909
<i>Sentiment</i>			0.0911***	3.3576	0.0865***	3.2003
<i>News</i>			0.0305	1.2926	0.0239	1.0336
<i>MessageNumber</i>			0.0110	1.4499	0.0109	1.4398
<i>StockPromoter</i>					0.0612***	3.4007
<i>PumpTracker</i>					-0.0948***	-3.2784
<i>IRAccount</i>					0.0144	0.7864
Adj- $R^2$ (%)	4.62		6.23		8.23	
Observations	635		635		635	

# Cross-sectional Analysis

Table: Predictive Regression -  $CAR_{t+1,t+5}$

Model	[1]		[2]		[3]	
Variable	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat
$\alpha$	-0.0239	-1.1423	-0.0009	-0.0212	0.0205	0.5100
$AR_t$	-0.1805***	-3.6333	-0.1814***	-3.5638	-0.1848***	-3.7125
<i>MktCap</i>	0.0026	0.5494	0.0026	0.5360	-0.0018	-0.3665
<i>Price</i>	0.0001	0.2700	0.0001	0.1700	-0.0001	-0.2062
<i>NonTradingDays</i>	0.0133	0.1995	0.0132	0.1966	0.0132	0.2017
<i>MarketType</i>	-0.0172	-0.5488	-0.0176	-0.5635	-0.0253	-0.8074
<i>Sentiment</i>			0.0161	0.5002	0.0097	0.3030
<i>News</i>			-0.0013	-0.0626	-0.0030	-0.1407
<i>MessageNumber</i>			-0.0065	-0.8569	-0.0035	-0.4615
<i>StockPromoter</i>					-0.0430**	-2.2386
<i>PumpTracker</i>					-0.0845***	-2.8325
<i>IRAccount</i>					0.0315*	1.6703
Adj- $R^2$ (%)	2.72		2.40		4.39	
Observations	635		635		635	

# Cross-sectional Analysis

Table: Predictive Regression -  $CAR_{t+1,t+n}$

Model	n=1		n=2		n=10	
Variable	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat
$\alpha$	-0.0045	-0.1982	0.0458	1.3415	0.1382**	2.2166
$AR_t$	-0.0665**	-2.2536	-0.1122***	-2.8144	-0.0909	-1.5180
<i>MktCap</i>	-0.0006	-0.2504	-0.0040	-1.0680	-0.0087	-1.1945
<i>Price</i>	0.0008**	2.2017	-0.0001	-0.2789	0.0012	0.4891
<i>NonTradingDays</i>	-0.0386	-1.0564	0.0058	0.1073	0.3447	1.6212
<i>MarketType</i>	-0.0274*	-1.7096	-0.0603**	-2.4085	0.0338	0.5947
<i>Sentiment</i>	-0.0008	-0.0448	0.0044	0.1933	-0.0096	-0.2396
<i>News</i>	-0.0017	-0.1360	-0.0132	-0.9674	0.0134	0.5047
<i>MessageNumber</i>	0.0059	1.2633	-0.0011	-0.1933	-0.0254**	-2.3697
<i>StockPromoter</i>	-0.0365***	-3.4556	-0.0414***	-2.6506	-0.1043***	-3.2928
<i>PumpTracker</i>	-0.0240*	-1.7447	-0.0729***	-3.9165	-0.0809**	-2.0453
<i>IRAccount</i>	0.0097	0.9502	0.0081	0.5626	0.0519*	1.6506
Adj- $R^2$ (%)	3.51		4.41		5.04	
Observations	635		635		635	

# Cross-sectional Analysis

- *StockPromoter<sub>t</sub>*: Positive coefficient on  $AR_t$  and negative coefficient on  $CAR_{t+1,t+n}$  - Consistent with pump-and-dump schemes
- *PumpTracker<sub>t</sub>*: Negative coefficient on  $AR_t$  and negative coefficient on  $CAR_{t+1,t+n}$  - Consistent with pump-and-dump schemes
- *Sentiment<sub>t</sub>* and *News<sub>t</sub>*: Not significant on  $CAR_{t+1,t+n}$ . Favor the manipulation hypothesis over the behavioral alternatives (over-optimism / over-reaction to news)



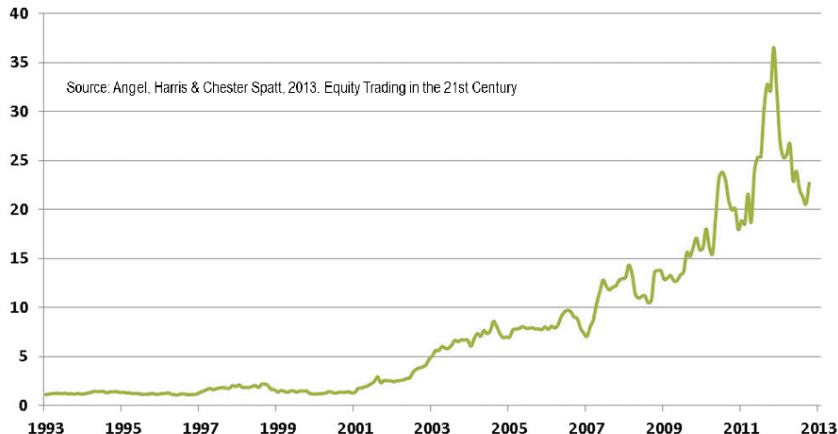
## Conclusion

# Conclusion

- Overall, **our findings are consistent with the patterns of a pump-and-dump scheme**, where fraudsters/promoters use social media to temporarily inflate the price of small capitalization stocks
- Investors should be skeptical of information published by any non-verified account and should carefully examine previous tweets from the users to detect any anomalies (scheduled automatic posting, abnormal followers/retweets ratio, stock promotion activity)
- Need for a higher control of the information published on social media and **better education for investors** looking for trading opportunities on the Internet.

# Why so many orders?

## Quote-to-Trade Ratio



# Conclusion: OTR?

- MiFID II (RTS9) requires to compute the ratio of orders to transaction (Order to Trade Ratio or OTR)
- Maximum OTR varies a lot from one venue to another:
  - Olso: 70:1
  - UBS MTF: 750:1
  - Eurex: depends...
  - ICE futures: 11,250,000:1 (?)

# Definition of the maximum allowed OTR on Eurex

The threshold for the volume based OTR is defined as follows,

$$\text{Limit}_{OTR_{vol}} = \text{Base}_{vol} \cdot PF_{vol} \cdot f_{vol}(SQ, QSQ, QP, SMC),$$

where  $\text{Base}_{vol}$  is a threshold per product group capturing different behaviour across product groups.  $PF_{vol} \geq 1$  is a factor per product, it captures products with different behaviour in a product group. And  $f_{vol}(SQ, QSQ, QP, SMC)$  is a function which accounts for the higher ordered volume of market makers, which is defined as follows,

$$f_{vol}(SQ, QSQ, QP, SMC) := \begin{cases} \max\{g^{vol}(SQ) \cdot QSQ \cdot QP \cdot ((1 - SMC) + SMC_{vol} \cdot SMC), 1\}, & \text{if } QP > MMR \cdot GF^{vol} \\ 1, & \text{else} \end{cases},$$

while  $MMR$  is the requirement from the market making program (e.g. 85%),  $GF^{vol}$  is a grace factor,  $QP$  is the quote performance,  $QSQ$  is the time-weighted average quote size.  $SMC$  is an indicator function (0 or 1) whether a member fulfilled quotation requirements during stressed market conditions and  $SMC_{vol} > 1$  is the corresponding incentive.  $g^{vol}(SQ)$  accounts for higher ordered volume for quoting tighter spreads,

$$g^{vol}(SQ) = \begin{cases} a_1^v, & \text{if } 0 < SQ \leq l_1^v \\ a_2^v, & \text{if } l_1^v < SQ \leq l_2^v \\ \vdots & \\ a_{n-1}^v, & \text{if } l_{n-2}^v < SQ \leq l_{n-1}^v \\ a_n^v, & \text{if } l_{n-1}^v < SQ \leq l_n^v \end{cases},$$

with  $0 < a_1^v < a_2^v < \dots < a_{n-1}^v < a_n^v < \infty$  and  $0 < l_1^v < l_2^v < \dots < l_{n-2}^v < l_{n-1}^v < l_n^v$ . Apart for the  $SMC$  incentive the higher thresholds are granted to all market participants fulfilling the performance requirements.