Market manipulation 3.0

G. Capelle-Blancard* & T. Renault*

*Université Paris 1 Panthéon-Sorbonne, CES, LabEx ReFi

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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.”
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).
**EXHIBIT 1**

Market Manipulation Before and After the Internet Era

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

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.”
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.”
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.”
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?

First 10 minutes: Down 1,000 points
The comeback: Down only 102 points
The final count: Down 588 points
A survey of evidence

- Social Networks
- Spam
- Internet message board
- Fake news
- Hoax
Manipulations: A typology

Stock market frauds

Insider trading

Trading loss

Stock market manipulation

Trade-based manipulation

Information-based manipulation

From insiders
(accounting & earnings manipulations)

From external investors

Social network

Spam

Internet message board

Fake news/Hoax
Previous related surveys

Theoretical models on market manipulation

- Kumar & Seppi (1992), Merrick et al. (2004): manipulation with the futures market.
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 have 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

![Bar chart showing AMF litigation releases from 2004 to 2018](chart.png)
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?)
Hoax

- **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%)
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.”
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?)

“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.”
Insider trading from outside

- 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 channels 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 if 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 Depository 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

$BMIX ABOUT TO RUN FASTER THAN MAYWEATHER
1:47 PM - 4 May 2015
1 Retweet 1 Like

$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

CES Synergies Inc. $CESX Visit their
website bit.ly/1SSPWXv
6:30 AM - 6 Aug 2015
1 Retweet

$DTST exploding!! Up 270% now! @etrade
@stockchartscom @OTCMarkets @WolfOfWeedST @YahooFinance
9:57 AM - 12 Mar 2015
Event Study

- **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**
Event Study

- 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]
Stock Promoters

- 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.
"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”.
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.

<table>
<thead>
<tr>
<th>Date</th>
<th>User</th>
<th>Message content</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015-02-05 16:40:35</td>
<td>pickoftheday1</td>
<td>$UBIQ Nice days here today Ubiquity Inc. QB UBIQ 0.729 + 0.159 27.89% V [url]</td>
</tr>
<tr>
<td>2015-02-05 16:42:44</td>
<td>cabroncita</td>
<td>UBIQ Nice green close today!! Put this one on your radar! $UBIQ [url]</td>
</tr>
<tr>
<td>2015-02-05 16:46:14</td>
<td>cabroncita</td>
<td>$UBIQ Company Website [url]</td>
</tr>
<tr>
<td>2015-02-05 16:51:04</td>
<td>JetPenny</td>
<td>Cabroncita: $UBIQ Company Website [url]</td>
</tr>
<tr>
<td>2015-02-05 16:59:37</td>
<td>iHangout4</td>
<td>cherrob: The Hunt for the Next 10 Bagger: $UBIQ Nice days here today Ubiquity [url]</td>
</tr>
<tr>
<td>2015-02-05 16:59:38</td>
<td>iHangout4</td>
<td>cherrob: BREAKOUTS..RUNNERS AND HOT PENNIES: $UBIQ Nice days here today [url]</td>
</tr>
<tr>
<td>2015-02-05 17:01:46</td>
<td>Hot_pennyalert</td>
<td>budfoxhub: $UBIQ +27% big close today bull run starting! [url]</td>
</tr>
<tr>
<td>2015-02-05 17:20:54</td>
<td>cabroncita</td>
<td>$UBIQ Check out their patents! <a href="http://t.co/ckhN8B36yB">http://t.co/ckhN8B36yB</a></td>
</tr>
<tr>
<td>2015-02-05 17:47:36</td>
<td>ThePUMPTracker</td>
<td>Alert : <a href="http://t.co/zVyxyqFLK7">http://t.co/zVyxyqFLK7</a> announces $UBIQ as 02/06/2015 promo.Get the detailed promo</td>
</tr>
<tr>
<td>2015-02-05 17:50:46</td>
<td>PennyStocksBlog</td>
<td>RT @ThePUMPTracker: Alert : [url] announces $UBIQ as 02/06/2015 promo. [url]</td>
</tr>
<tr>
<td>2015-02-05 19:31:49</td>
<td>Pubcos</td>
<td>$UBIQ seams to be building. Looks like there could be some momentum. Let s see...</td>
</tr>
<tr>
<td>2015-02-05 19:35:16</td>
<td>Pubcos</td>
<td>$UBIQ new entertainment amp communications experience creators &amp; viewers together [url].</td>
</tr>
<tr>
<td>2015-02-05 19:38:08</td>
<td>Pubcos</td>
<td>Information is power. You may want to put this company on your radar: [url] $UBIQ</td>
</tr>
<tr>
<td>2015-02-05 19:42:48</td>
<td>Pubcos</td>
<td>$UBIQ +27% growth today. Congrats....</td>
</tr>
<tr>
<td>2015-02-06 09:01:32</td>
<td>PUMPSandDUMPS</td>
<td>Before you get taken by today s $UBIQ pump you better review the ticker s Past Performances</td>
</tr>
<tr>
<td>2015-02-06 09:27:31</td>
<td>hecklerhouse</td>
<td>$UBIQ chatter chatter</td>
</tr>
<tr>
<td>2015-02-06 10:43:25</td>
<td>WallStreetPenny</td>
<td>Mick Dodge: $UBIQ is working hard to create a diverse [url]</td>
</tr>
<tr>
<td>2015-02-06 10:43:26</td>
<td>WallStreetPenny</td>
<td>Affix Trader: $UBIQ Ubiquity is focused in five specific areas.... [url]</td>
</tr>
<tr>
<td>2015-02-06 10:51:09</td>
<td>JetPenny</td>
<td>Affix Trader: $UBIQ Don t miss their patent portfolio overview! IP [url]</td>
</tr>
<tr>
<td>2015-02-06 15:15:29</td>
<td>explodeprofits</td>
<td>DITRstocks: $UBIQ Short Term Indicators Barchart Opinion [url] [url]</td>
</tr>
<tr>
<td>2015-02-06 15:17:05</td>
<td>JetPenny</td>
<td>DITRstocks: $UBIQ Short Term Indicators Barchart Opinion [url]</td>
</tr>
</tbody>
</table>
Cross-Sectional Analysis

\[ AR^i_t = \alpha + \beta_1 AR^i_{t-1} + \beta_2 \text{MarketCap}^i_t + \beta_3 \text{Price}^i_t + \beta_4 \text{NonTradingDays}^i_t \\
+ \beta_5 \text{MarketType}^i_t + \beta_6 \text{Sentiment}^i_t + \beta_7 \text{News}^i_t + \beta_8 \text{NumberMessages}^i_t \\
+ \beta_9 \text{StockPromoter}^i_t + \beta_{10} \text{PumpTracker}^i_t + \beta_{11} \text{IRAccount}^i_t + \epsilon_t \]  

(1)

\[ CAR^i_{t+1, t+n} = \alpha + \beta_1 AR^i_t + \beta_2 \text{MarketCap}^i_t + \beta_3 \text{Price}^i_t + \beta_4 \text{NonTradingDays}^i_t \\
+ \beta_5 \text{MarketType}^i_t + \beta_6 \text{Sentiment}^i_t + \beta_7 \text{News}^i_t + \beta_8 \text{NumberMessages}^i_t \\
+ \beta_9 \text{StockPromoter}^i_t + \beta_{10} \text{PumpTracker}^i_t + \beta_{11} \text{IRAccount}^i_t + \epsilon_t \]  

(2)
## Descriptive Statistics

**Table: Descriptive Statistics**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Median</th>
<th>Min</th>
<th>Max</th>
<th>Std-Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>$AR_t$</td>
<td>0.0688</td>
<td>0.0142</td>
<td>-0.7731</td>
<td>1.9837</td>
<td>0.2386</td>
</tr>
<tr>
<td>$CAR_{t+1:t+5}$</td>
<td>-0.0311</td>
<td>-0.0306</td>
<td>-0.9673</td>
<td>1.4782</td>
<td>0.2365</td>
</tr>
<tr>
<td>$MktCap_t$</td>
<td>196.2422</td>
<td>9.3357</td>
<td>1.0011</td>
<td>15037.7915</td>
<td>1278.4197</td>
</tr>
<tr>
<td>$Price_t$</td>
<td>2.1342</td>
<td>0.1225</td>
<td>0.0001</td>
<td>168.75</td>
<td>8.3172</td>
</tr>
<tr>
<td>$Non,TradingDays_t$</td>
<td>0.0508</td>
<td>0.0</td>
<td>0.0</td>
<td>0.8571</td>
<td>0.1269</td>
</tr>
<tr>
<td>$Mkt,Type_t$</td>
<td>0.126</td>
<td>0.0</td>
<td>0.0</td>
<td>1.0</td>
<td>0.3321</td>
</tr>
<tr>
<td>$Sentiment_t$</td>
<td>0.3063</td>
<td>0.2727</td>
<td>-0.9436</td>
<td>1.0</td>
<td>0.317</td>
</tr>
<tr>
<td>$News_t$</td>
<td>0.1843</td>
<td>0.0</td>
<td>0.0</td>
<td>1.0</td>
<td>0.388</td>
</tr>
<tr>
<td>$MessageNumber_t$</td>
<td>192.5465</td>
<td>48.0</td>
<td>20.0</td>
<td>5250.0</td>
<td>514.5267</td>
</tr>
<tr>
<td>$StockPromoter_t$</td>
<td>0.6346</td>
<td>1.0</td>
<td>0.0</td>
<td>1.0</td>
<td>0.4819</td>
</tr>
<tr>
<td>$Pump,Tracker_t$</td>
<td>0.0898</td>
<td>0.0</td>
<td>0.0</td>
<td>1.0</td>
<td>0.2861</td>
</tr>
<tr>
<td>$IRAcount_t$</td>
<td>0.4961</td>
<td>0.0</td>
<td>0.0</td>
<td>1.0</td>
<td>0.5004</td>
</tr>
</tbody>
</table>
Cross-sectional Analysis

**Table: Contemporaneous Regression - \( AR_t \)**

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

Capell-Blancard & Renault (CES)
## Cross-sectional Analysis

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

<table>
<thead>
<tr>
<th>Model</th>
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<tr>
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<td>Adj-$R^2$ (%)</td>
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</tr>
<tr>
<td>Observations</td>
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</table>
## Cross-sectional Analysis

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

<table>
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<tr>
<th>Model</th>
<th>n=1</th>
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</tr>
</tbody>
</table>
Cross-sectional Analysis

- **StockPromoter\(_t\)**: Positive coefficient on \( AR\_t \) and negative coefficient on \( CAR\_{t+1,t+n} \) - Consistent with pump-and-dump schemes

- **PumpTracker\(_t\)**: Negative coefficient on \( AR\_t \) and negative coefficient on \( CAR\_{t+1,t+n} \) - Consistent with pump-and-dump schemes

- **Sentiment\(_t\)** and **News\(_t\)**: Not significant on \( CAR\_{t+1,t+n} \). Favor the manipulation hypothesis over the behavioral alternatives (over-optimism / over-reaction to news)
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

Source: Angel, Harris & Chester Spatt, 2013. Equity Trading in the 21st Century
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,

\[ Limit_{OTR_{vol}} = Base_{vol} \cdot PF_{vol} \cdot f_{vol}(SQ, QSQ, QP, SMC), \]

where \( Base_{vol} \) 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,

\[
g^{vol}(SQ) = \begin{cases} 
a^v_1, & \text{if } 0 < SQ \leq l^v_1 \\
a^v_2, & \text{if } l^v_1 < SQ \leq l^v_2 \\
\vdots & \\
a^v_{n-1}, & \text{if } l^v_{n-2} < SQ \leq l^v_{n-1} \\
a^v_n, & \text{if } l^v_{n-1} < SQ \leq l^v_n
\end{cases}
\]

with \( 0 < a^v_1 < a^v_2 < \cdots < a^v_{n-1} < a^v_n < \infty \) and \( 0 < l^v_1 < l^v_2 < \cdots < l^v_{n-2} < l^v_{n-1} < l^v_n \). Apart for the SMC incentive the higher thresholds are granted to all market participants fulfilling the performance requirements.