Gambling in Penny Stocks: The Case of Stock Spam E-mails

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Abstract
Stocks are a top area for spammers, largely due to the quick returns they can earn from touting penny stocks. However, little is known about whether stock spam e-mail recipients' trading behavior is linked to the contents of spam e-mails. We analyzed the content of stock spam e-mails promoting stocks to individual investors to determine the factors that influenced traders' reactions. Using over 40,000 spam messages touting 785 firms in 580 spam campaigns (SC—a period of spamming activity with no more than 5 consecutive days without a spam e-mail.) from November 2004 to August 2007, we investigated 5 attributes that could have potentially affected whether investors bought the touted firm's stock, namely, target price, message length, e-mail source, incentives, and touting international business. We found that e-mails providing a short-term price target generated abnormal returns and trading volume. If spammers purchased the stock prior to the start of an SC and sold at the closing price on the day with heaviest touting, the abnormal return was 5.85 percent for SCs with a price target. Further, e-mails touting U.S. stocks had abnormal returns while those touting non-U.S. firms did not. We did not find significant differences in market reactions for message length, e-mail source, or incentives.

Keywords: Spam e-mails; Penny stocks.

Introduction

As the Internet has become an integral part of people's lives around the world, criminals have increasingly adopted online strategies, such as stock spam e-mail campaigns (SCs), to reach large numbers of potential victims cheaply and efficiently. Although the majority of spam e-mail recipients ignore these fraudulent messages, a small percentage of recipients respond and lose money. Holt and Graves (2007) analyzed advance fee fraud e-

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mails in which the sender claimed to need assistance moving a large sum of money out of their country. Nhan, Kinkade, and Burns (2009) also analyzed fraudulent e-mails and found that cyber criminals employed relationship-building social engineering methods rather than directly asking for sensitive information. Researchers (e.g., Hanke & Hauser, 2008; Frieder & Zittrain, 2008; Hu, McInish, & Zeng, 2009) have shown that penny stocks experience substantial fluctuations in price and trading volume during SCs.

Both individuals and businesses invest significant time and capital to fight spam e-mails. However, little is known about whether recipients' trading behavior is linked to the content of spam e-mail messages. We analyzed the content of spam e-mails promoting stocks to individual investors to determine the characteristics that influenced recipients' reactions. Our research may alert individual investors and assist policy makers in the regulation of spam e-mails.

We analyzed over 40,000 spam messages touting 785 firms.[4] We defined a spam campaign or SC as a period of spamming activity with no more than 5 consecutive days without a spam e-mail. We coded each of the 580 SCs based on content analysis of the spam messages. We found that abnormal returns, trading volume, and intraday price volatility were significantly higher for spam e-mails containing a target price. Further, if the spam e-mail mentioned that the firm was headquartered outside the U.S. or was doing business outside the U.S., we found that the level of abnormal volume was less than for firms doing business just within the U.S. Further, we found no abnormal returns for these non-U.S. firms.

Literature Review and Hypothesis Development

The Growing Problem of Spam E-mail

The amount of spam e-mail continues to grow despite the installation of spam blocking software and worldwide anti-spam legislation.[5] Moreover, according to a recent BBC report, finance tops spammers' favorite topics.[6] Security firm McAfee conducted an S.P.A.M. (Spammed Persistently All Month) experiment in 2008.[7] It found that an average web user without spam filter received about 70 spam messages each day. In the same experiment, US participants were most affected and they received 23,233 spam e-mails during the month-long experiment. Germany participants were the least affected, receiving only 2,331 junk e-mails.

Extant literature has mainly focused on market reactions to stock spam e-mails. Bohme and Holz (2006) documented a short term cumulative increase in stock price and trading volume. Frieder and Zittrain (2008) found that spammers earned about 4.29% abnormal returns if they bought on the day before touting began and sold on the day of heaviest touting. The stock price declined significantly in the days after heaviest touting. Hanke and Hauser (2008) argued that liquidity was the major factor in the success of spam e-

[4] We thank Leonard Richardson from www.crummy.com for supplying the spam e-mail dataset.
[5] The Controlling the Assault of Non-Solicited Pornography And Marketing Act of 2003 (CAN-SPAM Act) was signed into law by President George W. Bush on December 16, 2003. The Israeli Knesset has approved an "Opt-In" anti-spam statute effective December 1, 2008 in its communication law which was modeled after European Union's Directive 2002/58/EC and requires affirmative permission before a commercial message is allowed.
[6] http://news.bbc.co.uk/2/hi/technology/7482991.stm
[7] http://www.govtech.com/security/Recent-Experiment-Reveals-the.html

mails. They showed that spamming on successive days increased demand for target stocks and extended the time window for spammers to liquidate their position.

Little research has been done to analyze the *content* of stock spam e-mails. One exception is Hu et al. (2009), who used computational linguistics and showed that stock spam e-mails that followed the CAN-SPAM Act of 2003 disclosure requirements had a lower market impact. In our study, we broadened their analysis and investigated how market reactions were linked to the various attributes of stock spam e-mails.

Effective E-mail Marketing

Although few studies have analyzed the content of stock spam e-mails, literature on effective e-mail marketing is emerging. Krishnamurthy (2001) found that message relevance and monetary benefit were the main factors influencing consumer attitudes. Lewis (2002) reported that price, urgency, incentives, message length, and technology were the major factors for effective e-mail marketing. Chaffey (2003) summarized the factors for successful e-mail promotion using mnemonic "CRITICAL": creative, relevance, incentive, targeting and timing, integration, copy, attributes, and landing page. Creative, copy, and attributes referred to the design of the e-mail, including its layout, its structure and explanation of the offer, its header information and subject line. Relevance and targeting were related to whether the e-mail met the needs of its recipients. Incentive referred to what recipients gained from following the advice in the e-mail. Timing referred to when the e-mail was sent, while integration was related to the relative timing of the e-mail or whether it was part of an overall marketing campaign. By analyzing advance fee fraud e-mails, Chang (2008) identified fraudulent schemes and informed Internet users of the methods employed by fraudsters, such as assertion of authority and expert power, reference to organizations, providing partial proof and legitimacy, reasoning, creating urgency, and implying scarcity.

Hypotheses

Guided by the effective e-mail marketing literature, we analyzed a random sample of the spam e-mails touting penny stocks, focusing on the following factors.[8]

Price. The Web is price driven. If there is an attractive opportunity, there will be more followers. Studies documented that analysts' target prices have investment value (Huang, Mian, & Sankaraguruswamy, 2009; Brav & Lehavy, 2003; Asquith, Mikhai, & Au, 2005). Brav and Lehavy (2003) found a significant market reaction to analysts' target prices. Womack (1996) found that event day trading volume approximately doubled normal volume for stocks upgraded to strong buy recommendations by major U.S. brokerage firms. Mikhai, Walther, and Willis (2007) found that retail investors were more likely to trade in response to analyst upgrades and buy recommendations whereas institutional investors accounted for more of the stock price reaction to the release of negative information. In addition, retail investors were less likely than institutions to consider analyst conflicts and incentives in responding to recommendations. Malmendier and Shanthikumar (2007) demonstrated that small investors naïvely responded to analyst recommendations. Based on the above discussions, we proposed the following hypothesis:

[8] Urgency is also an important factor. If there is an expiration date, there might be more people readily taking actions. However, urgency is an element in all of the random e-mails we read. Thus, we do not explore the effectiveness associated with the urgency factor.

Hypothesis 1: Stock spam e-mails with a target price are more effective than those without a target price.

Message length. The message length is an important determinant of successful e-mail campaigns. Consumers generally prefer short messages with no more than one scroll of the screen. Chittenden and Rettie (2003) found that longer e-mail messages were associated with lower consumer response and higher unsubscribe rates.

We found that some spam e-mails included previous news releases, making these messages very lengthy. However, the circulation of previous press releases to a wider audience may have an impact on stock prices. Tetlock (2008) investigated stock market reactions to public news stories containing stale information. If investors' confused old information already reflected in stock prices with new information, they may trade on stale information. Tetlock (2008) found that individual investors overreacted to stale information and caused temporary movements in asset prices. Barber and Loeffler (1993) analyzed the effect of second-hand information on the behavior of stock prices and volume using the monthly "Dartboard" column of the *Wall Street Journal*. They found significant increase in abnormal return and trading volume in response to stale information. Hence:

*Hypothesis 2*a: Market reactions are inversely related to the length of stock spam e-mails.

*Hypothesis 2*b: Stock spam e-mails containing previous press releases are more effective compared to those without press releases (stale information hypothesis).

Source. Permission based e-mails in the form of newsletters dominate in e-mail marketing because they tend to have a line of subscribers. Intrusiveness in advertising may cause annoyance and thus negative consumer attitudes. Li, Edwards, and Lee (2002) suggested that incentives, targeting, and permission reduced intrusiveness. Marinova, Murphy, and Massey (2002) argued that obtaining permission from customers to be contacted worked to the company's benefit. Chittenden and Rettie (2003) analyzed 30 e-mail campaigns and found three effective factors: e-mail length, incentive, and number of images. Merisavo and Raulas (2004) found that consumers who agreed to receive (opt-in) regular e-mails from a multinational cosmetics company not only visited its retail stores more frequently, but also recommended the brand to their friends. Artz and Cooke (2007) found that electronic listserv was a viable vehicle to promote environmentally sustainable behaviors. Based on this literature, we hypothesized:

Hypothesis 3: Permission based e-mails in the form of newsletters are more effective in generating abnormal market reactions compared to those e-mails not in the form of newsletters.

Incentives. If the market efficiency is semi-strong, investors may trade profitably if they have inside information. Huber, Kirchler, and Sutter (2008) found that informed traders, mainly insiders, significantly outperformed less informed traders. Lin and Howe (1990) examined insider trading in the OTC market. They also found that insiders made

positive abnormal trading profits. Some of the stock spam e-mails touted that they possessed inside information and urged investors to invest before the inside information became public.

The stock market is more reactive to seasoned analysts' recommendations. Mikhai, Walther, and Willis (1997) found that the market's reaction to recommendation revisions varied depending on analyst experience; revisions issued by more experienced analysts resulted in more significant abnormal returns. Similarly, Mikhai, Walther, and Willis (2004) documented that abnormal returns surrounding the release of recommendation revisions were positively associated with the profitability of an analyst's previous recommendations. Based on these considerations, we hypothesized:

Hypothesis 4a: Stock spam e-mails that hint that they are based on inside information are more effective (inside information hypothesis)

Hypothesis 4b: Spam e-mails touting their previous track records are more effective (track record hypothesis).

Touting international business. Gelos and Wei (2005) found that funds systematically invested less in less transparent countries. Psychological aspects are also important. Investors feel somewhat uneasy about investing their money in a remote country or an unfamiliar currency (Solnik & McLeavey, 2008). In other words, there exists a home preference in portfolio investment (French & Poterba, 1991; Cooper & Kaplanis, 1994; Tesar & Werner, 1995). Therefore, we proposed:

Hypothesis 5: Stock spam e-mails touting firms headquartered outside the United States are less effective than those touting domestic firms (home bias hypothesis).

Data and Methodology

Data

We obtained 41,135 spam messages touting 785 firms from November 2004 to August 2007 from www.crummy.com.Several studies used this dataset to investigate the effect of stock spam e-mails (for examples, see Hanke & Hauser, 2008; Bohme & Holz, 2006; and Hu et al., 2009).

We were able to obtain daily closing prices, high and low intraday prices, volume, market value, market to book ratio, number of shares outstanding, and industry data from DataStream for 395 of these firms. We manually collected the country and state of incorporation data using Google search.

Following Frieder and Zittrain (2006), a Spam Campaign (SC) was defined as a period of spamming activity with no more than 5 consecutive days without a spam e-mail. Following Hu et al. (2009), PeakDay was defined as the day within the campaign with the maximum number of spam e-mails, taking the first such day if there were ties. Our sample included 580 stock SCs. We coded stock spam messages during each SC using content analysis.

Definition of Spam Attributes

We first randomly selected and analyzed 50 spam e-mails. Then based on our analysis and the survey of effective e-mail marketing literature, we identified five key spam attributes:

Price. We retrieved the current price, target price, and long-term target price from the spam e-mails. In addition to recording these prices, we also coded two dummy variables for target price: short-term target price (*Price_ST*) and long-term target price (*Price_LT*) with a value of 1 if the respective price was included in the spam message and 0 otherwise.

Message length. We used the word count function in Microsoft Word to calculate the number of words in the spam e-mail as a measure of *Message Length*. Some of the spam e-mails included a previous press release from the target firm. Therefore, we coded a dummy variable, *Press Release*, as 1 if a press release was included and 0 otherwise.

Source. We retrieved the senders' information identified in the spam e-mail. If the sender was identified as a stock research report or newsletter, we coded the *Source* dummy as 1 and 0 otherwise.

Incentives. Some of the e-mails touted inside information or proven record. We coded two dummy variables, *Inside Information* and *Proven Record*, as 1 if the spam e-mail touted such information and 0 otherwise.

Touting international business. If the spam e-mail mentioned either that the firm was headquartered outside the U.S. or was doing business outside the U.S., we coded a dummy variable, *Touting International Business*, as 1 and 0 otherwise.

Methodology

We first identified spam attributes for each SC. Then we applied event study methodology to determine market reactions associated with each spam attribute. Specifically, we examined abnormal returns, volume, and volatility effects at the *PeakDay* of the SC. We also examined the cumulative abnormal returns (CARs) surrounding the SCs. We defined abnormal return (*AR*) as the difference between the stock return and the Russell 2000 return, which was a proxy for market return. Brown and Warner (1985) showed that a simple market model worked well for most event studies. Specifically, we defined the following variables:

Return—$R_t = \ln S_t - \ln S_{t-1}$, where S_t was the adjusted closing price of the stock on day t;

Turnover—$Turnover_t = \ln(1 + Dolvol_t / \overline{DolVol})$; and

Volatility—$Risk_t$ = intraday price range/average intraday price range where the intraday Price range = ln(intraday high price – intraday low price).

We also calculated abnormal return, *AR*, and abnormal volume (*AVOL*):

$AR = R_t - R_{m,t}$, where $R_{m,t}$ was the Russell 2000 return on day t;

$$AVOL_t = (DolVol_t - \overline{DolVol}) / \overline{DolVol}$$

where $DolVol_t$ was dollar volume at day t and $\overline{DolVol}$ was the average dollar volume during the sample period.

Our regression equation was as follows:

$$Y_i = \beta_0 + \beta_1 Price\_ST_i + \beta_2 Price\_LT_i + \beta_3 Message\ Length_i + \beta_4 Press\ Release_i + \beta_5 Source_i + \beta_6 Compensation_i + \beta_7 Inside\ Information_i + \beta_8 Proven\ Record_{i,t} + \beta_9 Touting\ International\ Business_i + \beta_{10} Size_i + \beta_k Industry_i + \varepsilon_i$$

where Y_i was the abnormal return, turnover, and risk, in turn, for the i^{th} SC. β_0 was an intercept term and ε was a random error term. The spam attributes dummies were defined under "Definition of Spam Attributes" earlier in this section. *Compensation* was a dummy variable that equaled 1 if the spam e-mail indicated either the dollar amount or the number of free trading shares spammers would receive for carrying out the SC, and 0 otherwise. *Size* was the natural logarithm of the market value in 2004 of the sample firm. We used the industry classification from DataStream to code the *industry* dummies, which included basic materials, consumer goods, consumer services, financials, healthcare, industrials, oil & gas, technology, telecommunications. The utility industry was excluded from the regression and thus reflected in the intercept term. Market reactions might vary systematically across stocks and there might be unobserved heterogeneous cross-sectional effects. We standardized all of the independent variables except for dummies in the regression. We also adjusted standard errors for heteroscedasticity.

We further studied market reactions to the *premium* implied in the spam e-mail. The *premium* was defined as: *premium* = ln(*Price_ST*/current price), where both the target price and current price were retrieved from the spam e-mail. We conducted Spearman correlation of the *premium*, abnormal return (*AR*), *turnover*, and *risk*.

Results

Spam Characteristics

Table 1 summarized major aspects contained in the stock spam e-mails. Based on the content of these spam messages, we identified five key attributes. The first attribute, price, was related to whether the spam message provided a target price for the underlying stock. A higher target price might attract attention from more small investors. A total of 197 SCs gave a *Price_ST* for the firm touted while 86 SCs also provided a *Price_LT*.

Table 1
Content analysis of spam e-mails

We analyze the content of spam e-mails for 580 SCs. An SC is defined as a period of spamming activity with no more than 5 consecutive days without a spam e-mail. We identify characteristics of stock spam e-mails. *Price_ST* is a dummy variable that equals 1 if the spam e-mail mentions a price target and 0 otherwise. *Price_LT* is a dummy variable that equals 1 if the spam e-mail mentions a long-term target price and 0 otherwise. *Press Release* is a dummy variable that equals 1 if a press release is included in the spam e-mail and 0 otherwise. *Source* is a dummy variable that equals 1 the sender is identified as a stock research report or newsletter and 0 otherwise. We retrieve the payment information from stock spam e-mails using Perl scripts. *Compensation_USD* and *Compensation_Shares* are dummy variables that equal 1 if the spam e-mail indicates the dollar amount or the number of free trading shares, respectively, spammers received for carrying out the SC, and 0 otherwise. *Inside Information* is a dummy variable that equals 1 if the spam e-mail touts inside information and 0 otherwise. *Proven Record* is a dummy variable that equals 1 if the spam e-mail touts a proven record and 0 otherwise. *Touting International Business* is a dummy variable that equals 1 if the spam e-mail mentions either that the firm is headquartered outside the U.S. or is doing a business outside the U.S. and 0 otherwise. Panel A presents the number and percentage (out of 580) of stock spam e-mails with a value of 1 for each of these dummies. Panel B presents additional statistics for *Message length*, the number of words in the spam e-mail. Also, for firms with *Compensation_USD = 1 and Compensation_Shares*= 1, Panel B presents statistics for the dollar amounts and number of shares, respectively.

Table 1 Continued.

Panel A: Spam e-mail characteristics

Characteristics	Frequency	Percent
Price_ST	197	33.97%
Price_LT	86	14.83%
Press Release	392	67.59%
Source	246	42.4%
Compensation_USD	231	39.83%
Compensation_Shares	57	9.83%
Inside Information	138	23.79%
Proven Record	77	13.28%
Touting International Business	307	52.93%

Panel B: Additional statistics

Variable	N	Mean	Median	Minimum	Maximum	Std. dev.
Message Length (in words)	580	943	770	34	4203	694
Compensation_USD	231	20,029	10,000	200	425,000	41,805
Compensation_Shares	57	1,717,509	325,000	16,500	50,000,000	6,711,313

Our second attribute, *Message Length*, measured the number of words in the spam e-mail (Table 1, Panel B). The mean *Message Length* was about 943 words while the minimum and maximum lengths were 34 and 4,203 words, respectively. The median *Message Length* was 770 words, which was less than the mean *Message Length*. Thus, *Message Length* was positively skewed and had a wide dispersion as reflected by the standard deviation. We also coded a variable, *Press Release*, which was related to whether the spam e-mail included a previous news release from the target firm. Research has shown that investors responded to articles containing only stale information. *Press Release* equaled 1 for 392 SCs.

The third attribute, *Source*, was related to the identity of the spammer. The CAN-SPAM of 2003 requires that spammers disclose their identity and payment information. We first examined whether the spam e-mails disclosed the spammer identity. *Source* equaled 1 for 246 SCs, indicating that about 42 percent spammers disclosed their identity, mostly in the form of a stock research report or newsletter.

We also retrieved the payment information from stock spam e-mails using Perl scripts (see Table 1, Panel B).[9] 231 SCs disclosed the dollar amount paid for the SC. The dollar compensation, when *Compensation_USD* = 1, ranged from $200 to $425,000 with a mean of $20,029. 57 SCs disclosed the number of free trading shares spammers received. The mean share compensation, when *Compensation_Shares* = 1, was 1.72 million shares, which was much higher than the median of 0.32 million shares.

The fourth attribute, incentives, was related to how spammers touted their superior stock picking skills and their track records. Touting inside information they possessed or their past record might also catch investors' attention. *Inside Information* equaled 1 for 138 SCs. *Proven Record* equaled 1 for 77 SCs.

[9] In the spam e-mail, misspelling of words is very common, partly to fool spam filters. For retrieving the payment information, we mainly deal with the misspelling of "o" as "0", such as d0llar, f0ur, th0usand, and so on.

The fifth attribute was related to whether the spam message touted international aspects of the underlying firm. On the one hand, international diversification has become increasingly popular. On the other hand, there is a tendency for small investors to have a home bias, preferring to invest in domestic firms. *Touting International Business* equaled 1 for 307 (53 percent) of SCs.

Spam Target Firm Characteristics

Table 2 reported the Size, M/B, Nosh, industry, and country, and, for U.S. firms, the state of incorporation for firms subject to SCs. As shown in Table 2, Panel A, the mean of *Size* for the spammed firm was about 20 million USD while the median was 75,000 USD. Thus, the majority of firms touted in SCs were small. The mean *M/B* was 4 and the median was 0, indicating that many touted firms had negative book value. The mean number of shares outstanding, *Nosh,* was over 35 million. The *Nosh* ranged from 1,000 shares to over 1 billion shares.

Table 2
Descriptive statistics of stocks touted

We report statistics for the firms touted by spam e-mails in 580 SCs. Market capitalization (*Size*), the market to book ratio (*M/B*), the number of shares outstanding (*Nosh*), and *industry* are from DataStream. We collect place of incorporation using Google searches.

Panel A: Descriptive statistics

Variable	N	Mean	Median	Minimum	Maximum	Std. dev.
Size ($)	378	20,155,714	75,000	186,687,309	0	3,516,620,000
M/B	165	4	0	40	-157	370
Nosh	378	35,406,524	6,125,500	99,435,326	1,000	1,184,048,000

Panel B: Industry of touted firms (n = 382)

Broad classification (level 2)			Detailed classification (level 6)		
Industry	Frequency	Cum. Percent	Industry	Frequency	Cum. percent
Financials	92	24.1	Specialty Finance	74	19.4
Industrials	62	40.3	Software	25	25.9
Technology	54	54.5	Exploration & Prod.	23	31.9
Consumer Services	50	67.5	Business Support Svs.	19	36.9
Oil & Gas	34	76.4	General Mining	12	40.1
Basic Materials	33	85.1	Gold Mining	11	42.9
Healthcare	26	91.9	Telecom. Equipment	10	45.5
Consumer Goods	25	98.4	Media Agencies	9	47.9
Telecommunications	4	99.5	Oil Equip. & Services	9	50.3
Utilities	2	100.0	Specialty Retailers	9	52.6
			Internet	8	54.7
			Specialty Chemicals	8	56.8
			Others	165	100.0

Panel C: Country and state (if U.S.) of incorporation for touted firms (n = 382)

By country			By state (if U.S.)		
Country	Frequency	Cumulative percent	State	Frequency	Cumulative percent
US	297	77.7	CA	66	22.2
Canada	51	91.1	FL	43	36.7
China	14	94.8	TX	42	50.8
Israel	4	95.8	NY	27	59.9
Hong Kong	3	96.6	NV	15	65.0
UK	3	97.4	AZ	11	68.7
Netherlands	2	97.9	NJ	11	72.4
Australia	1	98.2	CO	10	75.8
Colombia	1	98.4	OH	8	78.5
Costa Rica	1	98.7	UT	8	81.1
Ecuador	1	99.0	IL	6	83.2
Germany	1	99.2	OK	6	85.2
Lithuania	1	99.5	PA	5	86.9
Thailand	1	99.7	WA	4	88.2
Ukraine	1	100.0	MD	3	89.2
			NC	3	90.2
			Others	29	100.0

Table 2, Panel B, reported the industry of touted firms. About a quarter of the firms were in the financial industry. Financials, industrials, and technology combined represented over half of the touted firms. Consumer services, oil and gas, and basic materials also fell into the spammer's targeted industry and represented about 30 percent of the touted firms. When we examined the detailed industry classification, firms in the specialty finance, software, exploration and mining were the major industries touted by spammers.

Table 2, Panel C, reported the country and state of incorporation for touted firms. The 382 sample firms were incorporated in 15 different countries. About 78 percent of the firms were incorporated in the United States. There were a significant number of firms, about 13 percent of the sample firms, incorporated in Canada. For the firms incorporated in the United States, about 60 percent were incorporated in four states, namely California, Florida, Texas, and New York.

Summary Statistics Based on Spam E-mail Content Analysis

Are the abnormal market reactions documented in the recent studies (e.g., see Hanke & Hauser, 2008) related to the content of stock spam e-mails?

Table 3 reported the spam campaign level summary statistics. *Price_ST* equaled 1 for about 34 percent of SC. These SCs had higher abnormal returns, about 5 percent, compared to the 0 percent abnormal returns for SCs with *Price_ST*=0. Both *Turnover* and *AVOL* were significantly higher for the SCs with Price_ST = 1. However, there was no significant difference between SCs with *Price_LT* = 1 and *Price_LT*= 0. In summary, it was the Price_ST, not the *Price_LT*, aroused penny stock investors' trading interest. These findings supported *Hypothesis 1*.

Table 3

Content of spam e-mails and market reactions

We report market reactions to spam campaigns (SCs). *Message length_1* (*message length_2*) dummy equals 1 if the number of words is more than 200 (300) and 0 otherwise. *PeakDay* is defined as the day within the SC with the maximum number of spam e-mails, taking the first such day if there are ties. n is the number of SCs. Abnormal return (*AR*) is the difference between *PeakDay* stock return and mean stock return during the sample period. *Turnover* = log (1 + dollar volume/average dollar volume). Abnormal dollar volume (*AVOL*) is the difference between *PeakDay* stock dollar volume and average stock dollar volume during the sample period standardized by the average stock dollar volume. *Risk* = intraday price range / average intraday price range where intraday price range = *ln(intraday high price – intraday low price)*. All data are for January 2004–December 2007.

Characteristics	Class	n	AR		Turnover		AVOL		Risk	
Price_ST	0	383	0.00		0.98	***	1.97	***	1.27	***
	1	197	0.05	***	1.22	***	3.87	***	1.60	***
	Difference		*0.04*	***	*0.24*	***	*1.89*	***	*0.32*	*
Price_LT	0	494	0.02	***	1.05	***	2.47	***	1.40	***
	1	86	0.02		1.14	***	3.61	***	1.31	*
	Difference		*0.00*		*0.09*		*1.14*		*-0.10*	
Message length_1										
	0	37	0.06		1.12	***	3.33	**	1.69	*
	1	543	0.02	**	1.06	***	2.60	***	1.37	***
	Difference		*-0.05*	*	*-0.07*		*-0.74*		*-0.32*	
Message length_2	0	62	0.06	*	1.16	***	3.21	***	1.39	
	1	518	0.01	**	1.05	***	2.57	***	1.39	***
	Difference		*-0.04*	*	*-0.11*		*-0.64*		*0.00*	
Press release	0	188	0.05	***	1.07	***	2.66	***	1.80	***
	1	392	0.01		1.06	***	2.63	***	1.20	***
	Difference		*-0.04*	***	*-0.01*		*-0.03*		*-0.60*	***
Source	0	334	0.02	***	1.09	***	2.83	***	1.47	***
	1	246	0.01		1.02	***	2.39	***	1.28	***
	Difference		*-0.01*		*-0.07*		*-0.44*		*-0.19*	
Compensated in dollars	0	349	0.02	*	1.09	***	2.74	***	1.49	***
	1	231	0.02	**	1.03	***	2.49	***	1.24	***
	Difference		*0.01*		*-0.06*		*-0.26*		*-0.25*	
Compensated in shares	0	523	0.02	***	1.05	***	2.63	***	1.39	***
	1	57	0.02		1.18	***	2.79	***	1.41	
	Difference		*0.01*		*0.14*		*0.16*		*0.02*	
Inside information	0	416	0.02	**	1.03	***	2.48	***	1.45	***
	1	164	0.01		1.15	***	3.05	***	1.22	*
	Difference		*-0.01*		*0.12*		*0.57*		*-0.23*	
Proven record	0	503	0.02	***	1.06	***	2.58	***	1.45	***
	1	77	0.01		1.09	***	3.06	***	0.97	
	Difference		*-0.01*		*0.04*		*0.49*		*-0.48*	*
Touting International Business	0	273	0.04	***	1.12	***	2.90	***	1.38	***
	1	307	0.00		1.01	***	2.41	***	1.40	***
	Difference		*-0.05*	***	*-0.11*		*-0.49*		*0.02*	

Note: *, **, and *** indicate significance at the 0.1, 0.05, and 0.01 level, respectively.

We defined two additional dummy variables. *Message Length_1* (*Message Length_2*) equals 1 if Message *Length* exceeded 200 (300) words and 0 otherwise. We used these variables to simulate the number of words contained in one page or scroll as no more than one scroll of the screen might be an important factor influencing consumers' decisions. Shorter message length (*Message Length_1* =0)was associated with higher *AR*, *Turnover*, and *Risk* on the Peak Day of the SC. But the differences in market reactions for long versus short e-mails were not statistically significant except abnormal return, which was statistically significant at 10 percent level. We concluded that investors had not paid much attention to the e-mail length. These findings were contrary to *Hypothesis 2a*.

We now turn to *Press Release*. As shown in Table 3, the SCs without a press release or an analysis of the firm had both higher abnormal return and higher intraday price volatility during the PeakDay. There were no significant differences in share turnover or abnormal dollar volume on the PeakDay for SCs with or without a press release or an analysis of the firm. These results do not support *Hypothesis 2b*.

For the *source* attribute, we did not find any difference in market reactions whether spam e-mails identified as either stock research report/newsletter or not. Thus, we rejected *Hypothesis 3*. In addition, *Compensation_USD* and *Compensation_Shares* were not important factors in generating *AR*s.

According to semi-strong form market efficiency, investors with inside information earned higher returns. Therefore, many SCs stressed that the spam e-mails contained inside information or pending news. As seen from Table 3, there was no significant difference in *AR, turnover, AVOL,* and *Risk* between SCs with *Inside Information* = 1 and SCs with *Inside Information* = 0. It seems that investors are not lured by the inside information claimed in the spam e-mails. In addition, *Proven Record* was also not significant. These findings do not support either *Hypothesis 4a or 4b*.

More than half of the stock spam e-mails touted the international aspects of the underlying company. The *AR* was about 4 percent for SCs with *Touting International Business* = 0, whereas *AR* was not significant for SCs with *Touting International Business* = 1. Investors were more comfortable trading stocks doing business in the United States, which was consistent with the predictions in *Hypothesis 5*.

Multivariate Analysis

To further investigate the factors associated with market reactions to SCs, we conducted multivariate analysis. The dependent variables were *AR, Turnover, and Risk*s, in turn. The independent variables were firm characteristics and spam attributes. Table 4 reported the regression results. All significance tests were at the 0.01 level unless otherwise indicated. In the *AR* column of Table 4, the coefficient for *Price_ST* was positive and significant whether the dependent variable was *AR*, *Turnover*, or *Risk,* which supported *Hypothesis 1*.

Table 4
Spam campaign *PeakDay* abnormal return and turnover regressions

We report results for OLS regressions with three dependent variables—abnormal return, turnover, and risk, in turn. *Compensation* is a dummy variable that equal 1 if the spam e-mail indicates either the dollar amount or the number of free trading shares spammers received for carrying out the SC, and 0 otherwise. *Size* is the logarithm of market capitalization. Industry classification is from DataStream. *Return* = R_t = ln S_t- ln $S_{t-1}$where S_t is the adjusted closing price of the stock on day t. *Turnover* = ln(1 + dollar volume/average dollar

volume). Risk = intraday price range / average intraday price range where intraday price range = ln (intraday high price – intraday low price). All independent variables except dummy variables are standardized. We adjust standard errors for heteroscedasticity. All data are for January 2004–December 2007.

Variable	AR		Turnover		Risk	
Intercept	0.0614		0.3705		1.2304	
Price_ST	0.0716	***	0.2030	**	0.6314	**
Price_LT	-0.0366		-0.0649		-0.5663	*
Message Length	-0.0024		-0.1133	***	-0.0296	
Press Release	-0.0335	**	-0.0163		-0.6457	***
Source	-0.0094		0.0691		-0.0454	
Compensation	0.0249		0.0481		-0.1207	
Inside information	-0.0198		0.1233		-0.2739	
Proven record	-0.0259		-0.0202		-0.5907	*
Touting international business	-0.0436	***	-0.1469	***	0.1488	
Size	-0.0084		-0.0314		-0.0666	
Basic Materials	-0.0006		0.7409		0.6369	
Consumer Goods	-0.0146		0.7565		0.6633	
Consumer Services	0.0035		0.4969		0.7384	
Financials	-0.0190		0.6210		0.7049	
Healthcare	-0.0219		0.6967		0.7820	
Industrials	-0.0003		0.5020		0.4450	
Oil & Gas	-0.0081		0.7916		0.2436	
Technology	-0.0180		0.8142		0.6567	
Telecommunications	-0.0400		0.5965		0.8502	
Adj. R^2	0.0363		0.0206		0.0120	
N	516		486		486	

Note: *, **, and *** indicate significance at the 0.1, 0.05, and 0.01 level, respectively.

The coefficients for *Message Length* were not statistically significant in the *AR* and *Risk* regression. However, the coefficient was negative and significant in the Turnover regression, which supported *Hypothesis 2a*.

The coefficient for *Press Release* was negative and significant at the 0.05 level when the dependent variable was *AR* and negative and significant when the dependent variables was *Risk*. However, when the dependent variable was *Turnover*, the coefficient for *Press Release* was not statistically significant. These results indicated that stale information promoted in the spam messages did not help push up the stock price as indicated in *Hypothesis 2b*.

The coefficients for *Touting International Business* were negative and significant, when the dependent variables were *AR* and *Turnover*, respectively. The SCs with *Touting International Business* = 0 generated about 4 percent higher *AR*s compared to those SCs with *Touting International Business* = 1. When the dependent variable was *Risk*, the coefficient for *Touting International Business* was positive, but statistically insignificant. Penny stock investors were not willing to invest in a small firm operating internationally. In the international finance literature, a home bias is well documented. Investors prefer to

invest in domestic firms rather than diversify internationally. Our results were consistent with the home bias hypothesis.

We also included *Size* and *Industry* in our regressions. However none of the coefficients were statistically significant. Investors in penny stocks were not driven by firm market capitalization or the industry to which the firm belonged.

Market Adjusted Cumulative Abnormal Returns around SCs

We further explored the relationship between market reactions and the content of spam e-mails. Table 5 reported market adjusted cumulative abnormal returns around spam campaigns. Figure 1 and 2 illustrated the market reactions surrounding PeakDay.

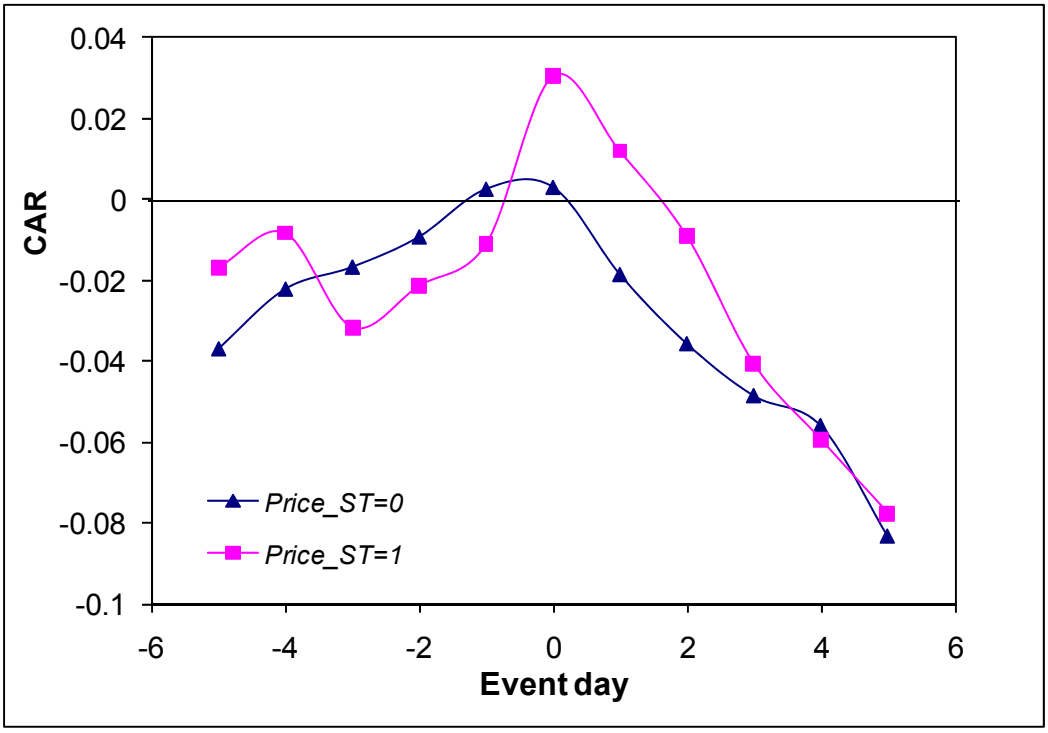

Figure 1. The effect of target price on cumulative abnormal returns (CAR) around Spam Campaigns (SCs).
A SC is defined as a period of spamming activity with no more than 5 consecutive days without a spam e-mail. Event days are relative to the *PeakDay* of the SC, where *PeakDay* is the day within the SC with the maximum number of spam e-mails, taking the first such day for ties. Abnormal return (*AR*) is the difference between *PeakDay* stock return and the Russell 2000 return, which is a proxy for market return. CAR is the cumulative abnormal return from day -5 through the event day. *Price_ST* is a dummy variable that equals 1 if the spam e-mail mentions a price target and 0 otherwise.

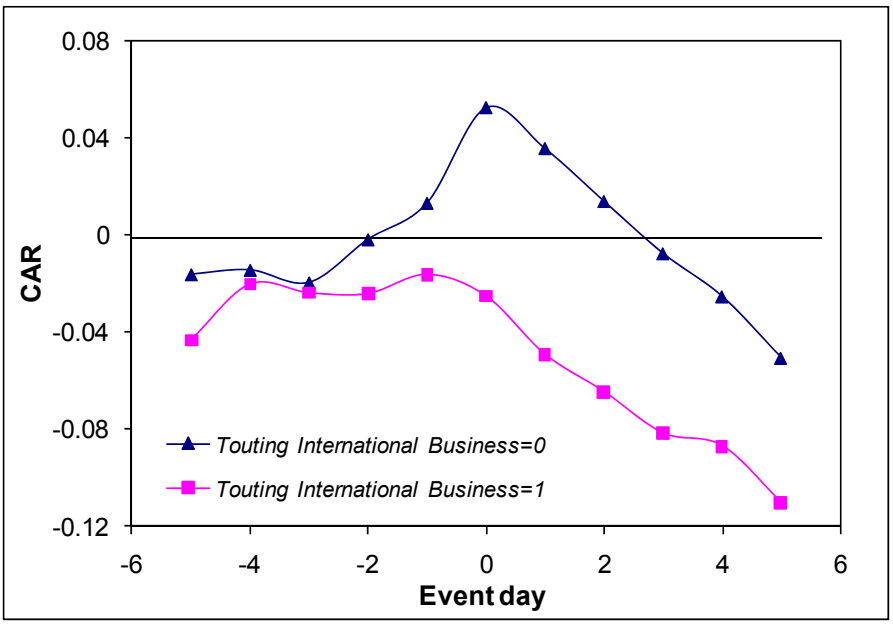

Figure 2. The effect of touting international business on cumulative abnormal returns (CAR) around Spam Campaigns (SCs).
An SC is defined as a period of spamming activity with no more than 5 consecutive days without a spam e-mail. Event days are relative to the PeakDay of the SC where PeakDay is the day within the SC with the maximum number of spam e-mails, taking the first such day for ties. Abnormal return (*AR*) is the difference between PeakDay stock return and the Russell 2000 return, which is a proxy for market return. CAR is the cumulative abnormal return from day -5 through the event day. *Touting International Business* is a dummy variable that equals 1 if the spam e-mail mentions either that the firm is headquartered outside the U.S. or is doing a business outside the U.S. and 0 otherwise.

Price_ST was an important factor to attract penny stock investors. The PeakDay *AR* was 4.16 percent for SCs with *Price_ST* = 1 and it was close to 0 for SCs with *Price_ST* = 0. Both types of SCs had an insignificant share price run-up prior to the PeakDay. From the PeakDay to the end of SC, the *AR*s were -3.55 percent and -4.08 percent, both statistically significant at the 1 percent level, for SCs with *Price_ST* = 1 and 0, respectively. Thus, the share price declined significantly after the PeakDay of the SC. The decline continued even after the SCs as seen from the negative *AR*s during the period from PeakDay to +5. If spammers purchased the stock prior to the start of an SC and sold at the PeakDay closing price, the *AR* was 5.85 percent for the SCs with *Price_ST* = 1. The illustration from Figure 1 reaffirmed our findings that spam e-mails containing with *Price_ST* = 1 were more effective in pumping up stock prices on the PeakDay.

Touting international location or business was not a good strategy for spammers as shown in Table 5. The *AR*s were 3.94 percent and -0.78 percent for SCs with *Touting International Business* = 0 and 1, respectively. But both *Touting International Business* = 1 and 0 had an insignificant share price run-up prior to the PeakDay. From the PeakDay to the end of SC, the *AR*s were -3.35 percent and -4.06 percent, both statistically significant, for SCs with *Touting International Business* = 0 and 1, respectively. The share price declined further even after the SC as seen from the negative *AR*s during the period from PeakDay to +5. Figure 2 provided further evidence supporting the home bias hypothesis. Spam e-

mails not touting international were more effective in attracting small investors and thus pushing up the stock prices on the PeakDay.

Table 5
Market adjusted cumulative abnormal returns around Spam Campaigns (SCs)

We present market reactions to stock spam e-mails with and without two key attributes: target price and touting international business. We use the Russell 2000 as our proxy for the market return. *Abnormal return* is the difference between the stock return and the Russell 2000 return. The reported numbers are *market adjusted cumulative abnormal returns*. "*Beg*" ("*end*") is the beginning (end) day of the SC. All data are for January 2004–December 2007.

	Price_ST				Touting International Business			
Period	0 (No)		1 (Yes)		0 (No)		1 (Yes)	
PeakDay	0.0005		0.0416	***	0.0394	***	-0.0078	
Beg-1 to PeakDay	0.0124		0.0169		0.0170		0.0113	
PeakDay to end+1	-0.0355	***	-0.0408	***	-0.0335	***	-0.0406	***
PeakDay to end+5	-0.0958	***	-0.1074	***	-0.1060	***	-0.0941	***
Beg-1 to end+1	-0.0353	***	0.0132		0.0142		-0.0482	***
Beg-1 to end+5	-0.0957	***	-0.0534	**	-0.0583	***	-0.1018	***

Note: *, **, and *** indicate significance at the 0.1, 0.05, and 0.01 level, respectively.

Premiums Implied in the Stock Spam E-mail

Price_ST emerged as the most important factor influencing market reactions. We further studied the premium implied in the stock spam e-mail. In 168 or about 30 percent of the 580 SCs, spammers provided both the current price and the target price. Table 6, Panel A, reported the descriptive statistics for the premium. The average premium was 1.392, an indication that the *Price_ST* was about ($e^{1.392}$ =) 4 times the current price on average. The median premium was 1.392, very close to the mean premium. The premium ranged from 0.057 to 5.991 and the dispersion was quite wide.

Table 6, Panel B, reported the Spearman correlation matrix of the premium, *AR*, Turnover, and Risk. There were strong positive correlations between the premium and market *AR* and *Risk*. These results suggested that the individual investors drove up the stock price higher when the return implied in the spam e-mail was higher. These results reinforced our findings on the *Price_ST* factor. The naïve individual investors were mainly attracted by the lottery type returns implied in the spam e-mails.

Table 6
Premium implied in the spam e-mail

Panel A reports the descriptive statistics for the *premium* implied in the spam e-mail. The *premium* is defined as: *premium* = ln (target price / current price), where both the target price and current price are retrieved from the spam e-mail. Panel B reports the Spearman correlation matrix of the *premium*, abnormal return (*AR*), *turnover*, and *risk*. We use the Russell 2000 as our proxy for the market return. *AR* is the difference between the stock return and the Russell 2000 return.

Table 6 Continued.

Panel A: Descriptive statistics

Variable	N	Mean	Median	Minimum	Maximum	Std. dev.	p-Value
Premium	168	1.392	1.126	0.057	5.991	0.948	<.0001

Panel B: Correlation matrix

	Premium		AR		Turnover		Risk
Premium	1.000						
AR	0.160	**	1.000				
Turnover	-0.034		0.258	***	1.000		
Risk	0.207	***	0.082		0.404	***	1.000

Note: *, **, and *** indicate significance at the 0.1, 0.05, and 0.01 level, respectively.

Robustness Check

We performed a variety of robustness checks. First, we checked the effect of the SEC Spam a lot operation on March 8, 2007. We found that after the SEC Spam a lot target price was no longer a significant factor. However, because there were only 23 observations left in the sample, we need to be cautious to conclude that the SEC Spam a lot operation was effective. Second, we partitioned the *Message Length* according to several cutoff points as no more than one scroll of the screen might be an important factor influencing consumers' decisions, but we did not find a meaningful difference in market reactions to various message length cutoff points. Third, we replaced *Touting International Business* with a country of incorporation dummy, which equaled 1 for domestic firms and 0 for firms incorporated outside of USA. We found similar results and the finding reinforced our conclusions on the home bias hypothesis. Lastly, we examined the relation between the *Source* and *Price_ST*. We found that the *Price_ST* were less extreme when the spam e-mail identified itself as a stock research report or newsletter (*Source* = 1). Spammers may want to be less aggressive in predicting the *Price_ST* and thus avoid potential litigations.

Discussion

Two key attributes emerged from the content analysis of spam e-mails in the present study. The first key attribute, price, was related to whether the spam message provided a target price for the touted stock. We found that small investors were attracted by the high target price mentioned in the spam message. Abnormal dollar volume on the PeakDay was about 5 times the average daily dollar volume for the SCs with a short term target price compared to 3 times the average daily dollar volume for the SCs with out a short term target price. The risk or intraday price range was also significantly higher when a target price was included in the spam e-mail. Some spam e-mails also had a long term target price. However, consistent with the penny stock literature, we found no significant difference between SCs with or without a long term target price. Hanson and Richards (2006) stated that investors replaced the logic and reason that applied in the rest of their daily life by zeal and prayer. Kumar (2009) also found that individual investors demanded

lottery type stocks. Roane (2007) attributed interest in penny stocks to the lure of quick gains. In summary, it was the short term target price, not the long term target price, which aroused penny stock investors' trading interest.

The second key attribute was related to whether the spam message touted international aspects of the underlying firm. We showed that small investors exhibited a home bias, preferring to invest in domestic firms. Touting international location or business was not a good strategy for spammers. The *AR*s on the peak day for SCs touting domestic firms were 3.94, much higher compared to -0.78 percent for SCs touting international. Furthermore, if spammers purchased the stock prior to the start of an SC and sold at the peak day closing price, the *AR* was 5.64 percent for SCs touting domestic firms, also much higher compared to 0.35 percent for SCs touting international. The share price declined significantly after the peak day of the SCs. The decline continued even after the SC. Thus, investors who bought the touted stocks lost money and became victims of the spam e-mail fraud.

Our findings suggest that stock spammers often set a very high target price in order to cash in on peoples' desire to make money easily and quickly. We documented a strong positive correlation between the premium implied by the target price and the market abnormal returns on the Peak Day of the SC. Thus, individual investors drove up the stock price when the return implied in the spam e-mail was higher.

A natural policy implication from the current research is how to regulate stock spam e-mails. The lack of regulation combined with the lack of meaningful enforcement both contributed to the proliferation of stock spam e-mails. Fortunately, the U.S. has started prosecuting spammers. For example, a Detroit stockbroker was charged on February 1, 2011 with alleged $33 million penny stock "pump and dump" schemes. If convicted, the stockbroker faces a quarter million dollar fine and up to 25 years in prison.[10] The SEC recommends that investors assume that "too good to be true" investment opportunities are scams unless diligent research shows otherwise.

Conclusions and Suggestions for Future Research

Stocks are a top target for spammers, largely due to the quick returns they can earn from touting penny stocks. Many countries have enacted laws to regulate spam e-mails. In addition, spam filters have been developed and widely installed. In this study, we investigated how the content of spam e-mails affected the price and trading volume of the touted stocks. We found that market reactions, such as abnormal return, turnover, and risk, were significantly higher for spam e-mails containing a target price, which was consistent with the evidence found in the analyst recommendations literature. Small investors tended to react naively to spammers' forecasts. Further, if the spam e-mail mentioned that the firm was headquartered outside the U.S. or was doing business outside the U.S., we found lower abnormal volume and insignificant abnormal returns. Hence, investors who are the targets of spam e-mails exhibit home bias. We did not find significant differences in market reactions for e-mail length, e-mail source, and or whether the spammers received incentives.

The present work focused on one Internet financial crime, stock spam e-mail fraud. In particular, the present work analyzed the content of the spam messages and identified several key attributes fraudsters employed. Findings provide guidance for both individual investors and regulators and can be extended to related areas. For example, perhaps there

[10] http://detroit.fbi.gov/dojpressrel/pressrel11/de020111.htm

is a need to regulate Twitter messages promoting stocks. Investigating investor behavior in respond to stock spam e-mails might also provide useful results. Another extension would be the use of the spam e-mail dataset for the study of greed and fear in financial markets.

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