Twitter Mood, CEO Succession Announcements and Stock Returns

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Abstract

This paper examines the relationship between Twitter sentiment on the announcement of Chief Executive Officer (CEO) succession and stock returns over the period 2010-2015. The study comprises data from 100 listed companies from the UK and the USA. A code was written to collect data from Twitter using the platform Python. We provide novel evidence on how Twitter reactions measured by the Twitter Sentiment Score (TSS) of CEO succession announcements are used to forecast stock returns, finding that Twitter sentiment has a negative contemporaneous relationship with stock returns and CEO succession announcements. Furthermore, we explore the influence of CEO demographic characteristics (e.g. age, tenure, education, gender and professional experience) on stock returns. We find a positive and highly significant relationship between CEO age at announcement and stock returns.

Keywords: Social Network Analysis; Twitter Sentiment Score (TSS); Sentiment Analysis; CEO Succession Announcements, Stock Returns
JEL Classification: G17; G32; J15; C53

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1. Introduction

Social media is an increasingly pervasive and influential force in modern civilisation. It is a key platform for communication in every aspect of life, from personal to economic, political, to computing data analysis. In the field of investing and data analysis, social media has become a popular venue for individuals to share the results of their own analysis on financial securities and provide a wealth of new data for exploration and exploitation (Pikulina et al., 2017; Salhin et al., 2016).

Studies in the relatively recently developing field of behavioural finance have presented empirical evidence that financial decisions are largely driven by emotions and mood, and can be identified by social-media such as Google Trends (Bijl et al., 2016; Gao et al., 2016), Facebook (Siganos et al., 2014) and Twitter (Bollen et al., 2011; Kearney and Liu, 2014; Liu et al., 2015; Rao and Srivastava, 2012). With the significant rise in sentiment studies, scoring and measuring sentiment and in particular Twitter Sentiment Score (TSS) has become a factor of importance.

With so much attention focused on the top executives in the Western economy, a focus which was further amplified following the financial crisis in 2008 (Kilpatrick, 2009), decisions related to CEO characteristics is vitally important. It is therefore not surprising there are so many opinions, discussions, news reports, and underlying sentiments about Chief Executive Officers (CEOs) of some of the largest companies in the world, who verge on celebrity and superstar status (Beatty and Zajac, 1987; Malmendier and Tate, 2009; Wade, Porac, Pollock, and Graffin, 2006). Consequently, the mood (feelings of happiness or anger) towards a newly selected CEO can be vented through social media formats such as Twitter in today's society. This has now been shown on numerous occasions to have a significant impact on stocks: especially in the Associated Press Twitter hack in 2013, where "the false tweet spotlighted the power of social-media in moving financial markets" (Lee and James, 2007). Moreover, Gao et al. (2016) recently illustrated (Figure 1) cumulative global sentiment from 2004, where it peaked in years such as 2007, and then nosedived in 2008 with the global financial crisis. With such volatility in sentiment even on weekly basis, there is a gap in the literature analysing per day for short-term events, specifically for CEO succession announcements. This study will explore this gap to complement the literature through an analysis of the relationship between CEO successions and stock

returns using Twitter as the source of sentiment.

[Insert Figure 1 here]

Although the relationship between sentiment and stock returns is well documented in numerous studies (Gao et al., 2016; Ranco et al., 2015) and is evidenced by the increasing number of academic papers as seen in Figure 2, this study adds a new and original dimension to the UK and US CEO announcement-based studies. According to Aguilera et al. (2006), the world is divided into two main corporate governance systems: the Anglo-American and the continental European-Japanese systems, and there is a lack of comparisons between the two systems. Therefore, our study further investigate similarities and difference in stock returns during the event of a CEO succession announcement by using data from both the UK and US. Furthermore, although classical finance theory suggests all information is incorporated in a stock price immediately (Fama, 1965), previous studies have evidenced that sentiment has an impact, questioning classical theory. Whilst there has been significant progress in recent years on sentiment studies and social-media (Bijl et al., 2016; Bollen et al., 2011; Gao et al., 2016; Kearney and Liu, 2014; Liu et al., 2015; Rao and Srivastava, 2012; Siganos et al., 2014), this is the first study to combine sentiment analysis stock returns with corporate governance perspectives. For example, Feldman (2013) indicates that Twitter sentiment is mostly used for marketing and production-based studies but lacks finance-related studies. In addition, we examine aspects such as gender (Allen et al., 1979; Lee and James, 2007), origin (Beatty and Zajac, 1987; Friedman and Singh, 1989; Grusky, 1963) against the aforementioned Twitter Sentiment Score (TSS) to test their association with stock returns predictive power and value (Liu et al., 2015).

[Insert Figure 2 here]

This paper aims to add to the literature as follows: First, this study seeks to contribute to the extant corporate governance (CG) literature by examining the extent to which CEO succession announcements comply with and disclose positive recommendations relating to their CG practices, and investigates whether sentiment associated with CEO succession announcements can explain observable stock return differences. To the best of our knowledge, this study atypically combines Twitter sentiment with the stock-market

reaction of a new CEO successor announcement. Although the evidence is well documented on CEOs succession topics such as executives leaving office (Gangloff et al., 2014); new leadership implications on firm performance (Allen et al., 1979) and; differences in successors (Friedman and Singh, 1989; Helmich and Brown, 1972; Lee and James, 2007; Shen and Cannella, 2003; Wade et al., 2006); there is a much less dense body of research covering the actual dates from press releases and news sources when companies make the announcement. Therefore, this study presents new evidence from the UK and the US, focusing specifically on the sentiment and announcement date of a new CEO for 100 of the largest (ranked by OSIRIS) and listed companies between 2010-2015, and their subsequent stock-market returns. Second, this study employs a sentiment analysis on social-media in an original way: generally, the reason for measuring CEO succession events is "the market reacts to how well, compared to their predecessors, new CEOs are suited to the demands of their roles, and to the potential for disruption in organisational performance attending leadership transitions" (Friedman and Singh, 1989, p.719). However, no previous studies have used the combination of sentiment analysis and event studies in the rich social media setting of Twitter.

This study, therefore, presents finance-oriented research that heeded calls from the literature to help fill these gaps, using the standard analytical technique of event-study and regression analysis, which has previously found ambiguous results depending on the area/location/organisational type studied (Lieberson and O'Connor, 1972), motivating this study of the UK and the US. With approximately 10%-15% of companies in the United States changing their CEO (Chung et al., 1987) each year, this type of event is a frequent occurrence in the Anglo/American/Western corporate world, which therefore in our opinion, has been greatly underinvestigated. For example, Beatty and Zajac (1987) suggested future literature should test other types of firms and time-periods, as well as, "expanding the collection of perceptual data to include performance estimates from groups other than stock-market participants which are influenced by the decision to change top managers" (Beatty and Zajac, 1987, p.315) - this study will therefore use the additional perception of sentiment from Twitter. Thirdly, whilst the UK has began publishing studies linking sentiment and stock returns (Siganos et al., 2014), this current study is the first to use Twitter as a source of sentiment to offer an original contribution on CEO succession announcements.

The remainder of this paper is structured as follows. Section 2 is a lit-

erature review of studies that have considered the social media sentiment, in particular on CEO succession and stock returns, which supports formulation of the hypotheses. Section 3 provides details of the data and methodology. Section 4 presents the models and empirical findings, and Section 5 concludes the paper, stating the significance of the main findings and suggesting avenues for future research.

2. Theory, Previous Empirical Literature and Hypotheses Development

Casual perception suggests that the substance of tweets about the stock trading system and market could be connected to investor psychology and sociology. However, it is unclear whether financial related news media incites, enlightens, or in essence purely mirrors financial investors' interpretations of stock market performance. Theoretically, there has been a long running argument in the academic literature with respect to the success of the efficient market hypothesis in explaining the predictability in asset returns. Classical theory assumes financial markets are efficient; investors are rational, and that they diversify their portfolios in order to optimize the statistical properties of their investments. In line with this theory, regardless of the possibility that some investors may be irrational, prices are brought back into equilibrium by the actions of arbitrageurs (Antoniou et al., 2013; Baker and Wurgler, 2006; Chen and Sherif, 2016). Accordingly, there is no role for investor irrationality on asset pricing.

However, research in behavioural finance confirms that investor sentiment influences stock prices and mispricing is persistent due to costly and non-productive profitable arbitrage (Lee et al., 1991). In contrast to the suggestions of classical theory, modern behavioral finance theory suggests that humans are in actual fact not rational machines; but rather they are emotional, rationally limited, and subjective performers, who are affected by things other than cold, hard facts (Bodie et al., 2011, p.356). Furthermore, behavioral theories posit that investors may frame erroneous stochastic beliefs, either with excessive optimism or pessimism, and in this way inaccurately evaluate asset values, causing asset prices to deviate from their intrinsic values (De Long et al., 1990; Kumar and Lee, 2006; Lee et al., 1991). This mispricing then becomes revised as the economic fundamentals are revealed

and sentiment wanes and disappears. The pricing correction thus results in a negative connection between investor sentiment and future stock returns.

Furthermore, theorists have long assumed that CEOs have heterogeneous talents and abilities that map onto firm performance. For example, Rosen (1981), Murphy and Zabojnik (2004), Bertrand and Antoinette (2003) and Adams (2005) find evidence that specific CEOs talents and abilities do indeed matter. However, to date, neither theoretical nor empirical studies have provided much guidance concerning which particular talents and abilities are important for corporate governance and performance. According to Allen et al. (1979), p179 "Although managerial succession has only a small impact on organisational performance, different types of managerial succession generally produce significant, albeit slight, differences in organisational performance". In addition, Zald (1970) and Friedman and Singh (1989) argue that certain CEO characteristics play a significant role in firm performance. In this vein, Lee and James (2007) have examined the determinants of CEO succession and found that external succession, CEO age and experience are the factors that positively determine CEO succession and stock returns. Further, Lieberson and O'Connor (1972) note that it is not possible to ascertain how another leader would have performed at the same time. This implies that markets react to new leadership very much depending on how speculators feel about their characteristics (Lee and James, 2007).

The empirical literature on sentiment associated with CEO succession announcement and stock returns is very thorough, but no prior studies have used the combination of sentiment analysis using twitter and CEO succession events. Empirically, our study is related to two strands of literature: (i) the impact of CEO succession announcements on firm performance and (ii) social media twitter as a source of sentiment to CEO succession announcement. With regard to (i), earlier studies have investigated the impact of CEO succession announcement on firm performance. In this context, Guest (1962) and Gouldner (1954) suggested a distinctive difference between how organisations react to new managers who either represent the workforce's best interests, or are bureaucratic and punishment-oriented; with the former having a more satisfied organisation. In another study, Allen et al. (1979) found that succession always disrupts organisations through, for example, workforce strikes. Later researchers have examined the relationship between top managerial succession and organisational performance (Friedman and Singh, 1989; Rowe, Cannella, Rankin, and Gorman, 2005). For example, Grusky (1963) suggested a 'common sense theory' for managerial succession,

orientating around effective team performance - when poor, effectiveness has a negative correlation with managerial succession. Similarly, other literature (Friedman and Singh, 1989; Salancik, 1980) suggests CEOs must be fired to correct poor performance. Other studies (Pfeffer and Davis-Blake, 1986; Rowe et al., 2005) found evidence supporting both 'ritual scapegoating theory' (succession does not impact performance) and 'vicious-circle theory' (succession worsens teams performance).

One further argument that has recently been given much attention is related to the impact of CEO succession announcement on stock returns. For example, Lieberson and O'Connor (1972) and Weiner and Mahoney (1981) found only an insignificant relationship between the information on the movement of CEOs and stock returns. Similarly, Beatty and Zajac (1987) and Chung et al. (1987) found a negative reaction to CEO succession announcements. This implies that a new manager is disruptive to an organisation (Friedman and Singh, 1989; Grusky, 1963). In contrast, Friedman and Singh (1989) found a positive stock reaction to the announcement of CEOs in large firms. This indicates that firms with poor performance have positive stock reactions, while well-performing firms have negative stock-market reactions. In addition, Chung et al. (1987) concluded that overall, new CEO's, regardless of origin, do have an impact on stock returns due to a combination of the momentum effect of good-firms-continuing-to-perform-well and vice-versa (Grusky, 1963). In line with Friedman and Singh (1989) and Allen et al. (1979), Reinganum (1985) demonstrates that higher succession frequency is often associated with poor performance. However, Kudla (1980) found no statistical differences in returns between firms who plan their future strategies compared to those who do not.

With regard to origin and internal/external CEO characteristics, successor origin is considered one of the most widely debated strands (Beatty and Zajac, 1987; Friedman and Singh, 1989; Shen and Cannella, 2003). This is, perhaps due to data transparency as it is generally clear where the CEO had previously worked (Friedman and Singh, 1989). For insider and outsider directors, (Beatty and Zajac, 1987; Shetty and Peery Jr, 1976) the literature tends to reveal a distribution swayed towards insiders replacing CEOs 88% of the time, yet finding that regardless of this, new CEO announcements are usually met with a negative reaction on the stock market. For example, Beatty and Zajac (1987) noted that for internal successors, day 1 and 2 had negative returns, and day 3 was positive. In another study Shen and Cannella (2003) found strong positive stock market reactions for external hires,

with negative reactions to insiders. Similarly, Chung et al. (1987) found stock prices increase when better performing firms replace a CEO with an outsider (4% abnormal return; 8.44% in the long-run), signaling company confidence and hope (Allen et al., 1979; Grusky, 1963; Guest, 1962; Helmich and Brown, 1972) as well as a deviation from poor current strategies (Chung et al., 1987). Further illustrative of this, a study of 477 large corporations saw the market react more favourably to better performing firms that were taken over by an outside successor, when broadly, announcements are perceived negatively (Lubatkin et al., 1989). In contrast, however, Reinganum (1985) found smaller firms hiring outsiders reacted more positively. Other studies (Friedman and Singh, 1989; Salancik, 1980) have found that companies are reluctant to hire an outsider as it is believed to show admittance of failure internally. This implies that insiders receive a less positive response, perhaps due to its signaling that current strategies are continuing, which provides no new distinctive prospects (Chung et al., 1987; Helmich and Brown, 1972). Countering this, however, is research which argues that insider appointments have the advantage of offering more inside-knowledge and have considerable networks inside the firm to use social-resources more efficiently (Beatty and Zajac, 1987; Chung, Rogers, Lubatkin, and Owers, 1987; Kotter, 1982; Lubatkin, Chung, Rogers, and Owers, 1989; Shetty and Peery Jr, 1976).

Another consideration is CEO tenure and age. In agreement with Friedman and Singh (1989), Salancik (1980) found that the longer a CEO was with a firm, the more negatively they were related to firm performance, suggesting that a board should initiate succession to a CEO who would provide a beneficial shift to positive performance. This implies that the longer tenure a CEO holds, the more homogenised an internal replacement would be. A variable seldom examined with sentiment analysis is CEO age (Lee and James, 2007). For example, some research (Serfling, 2014; Yim, 2013) has found that older CEOs are less likely to take risks such as risky acquisitions, which depending on the firm, may be suited to investors who may reflect the firm's risk-appetite. Similarly, Baysinger and Hoskisson (1990) found company performance is positively linked with CEO age, with a negative relationship discovered between CEO age and stock return volatility (Serfling, 2014). In contrast, Eduardo and Poole (2016) found no relationship of significance or even a general pattern for the age of the CEO having any impact on cumulative abnormal returns (CARs).

Regarding education and gender, King et al. (2016) examined the education-

level (MBA) of CEOs in terms of its affecting bank performances, finding that MBAs empower CEOs to deal with complex problems more efficiently. Similarly, Bhagat et al. (2010) found that CEOs with stronger educational backgrounds are related to positive and significant abnormal returns. However, this is in contrast with Gottesman (2006), who found that firms led by CEOs who have an MBA perform no better than firms who do not. In another study, Jalbert et al. (2002) found that CEOs with no academic background have less academic credentials(not attend college) earn more. While Lee and James (2007) found possible gender effects in CEO succession alarmingly highlighted when a female CEO is announced, the reaction of the stock-market is much more significantly negative. Indeed, Eduardo and Poole (2016) found female CEOs are associated with a marginally significant higher CAR than males. Also, Lee and James (2007) and Allen et al. (1979) findings indicate that females hired internally are associated with a more positive reaction, compared to their external counterparts, who are more linked to further deterioration in firm performance. Further, when females are in general executive positions, they usually have no relationship with company performance (Dezsö and Ross, 2008), although some findings suggest companies led by a female CEO are associated with a higher ROA (Peni, 2014). Generally, female CEOs are still relatively uncommon, so estimations are based on smaller sample sizes, although they induce a greater circle of attention (Lee and James, 2007). According to Shetty and Peery Jr (1976), p.23, "The chief executive officer (CEO) plays a crucial role in determining the efficiency of an enterprise... his decisions, his power and his leadership have vital consequences for the company as a whole". Here, Shetty and Peery Jr (1976) demonstrate how uncommon 'her' decisions, power, leadership was only 4 decades ago; although they are slightly more frequent today (Lee and James, 2007).

In terms of the effect of industry/company, Lieberson and O'Connor (1972) found approximately two-thirds of the variance in sales and earnings is company-specific and industry-dependent rather than related to the CEO. Similarly, Salhin et al. (2016) found an industry difference with sentiment analysis. In addition, Chung et al. (1987) argue that an external should be considered if they have experience in the industry to provide expertise. Indeed, Eduardo and Poole (2016) note a gap for future study is the number of years of experience a CEO has in the same industry.

Another key area of literature is that related to Sentiment in Social Media. Early research was based on an efficient market hypothesis that

claims stock prices are driven by new information and therefore follow a random path, as the occurrence of new information is random (Fama, 1965). Later research has increasingly focused on the impact of investor sentiment (Baker and Wurgler, 2006; Bodie et al., 2010; Boudoukh et al., 2012; Chen et al., 2013; Clarke et al., 2001; Gangloff et al., 2014; Henry, 2008; Kearney and Liu, 2014; Livnat and Petrovits, 2009; Oliveira et al., 2016; Rao and Srivastava, 2012; Salhin et al., 2016; Tetlock, 2007; Yang et al., 2015).

Following on from this, more recent research has started to utilize increasingly more available data from news articles (Tetlock, 2007), Twitter (Bollen et al., 2011), Wikipedia (Preis et al., 2013) and Google Trends (Bijl, Kringhaug, Molnár, and Sandvik, 2016; Bollen, Mao, and Zeng, 2011; Oliveira, Cortez, and Areal, 2016; Schniederjans, Cao, and Schniederjans, 2013; Siganos, Vagenas-Nanos, and Verwijmeren, 2014). For example, Kearney and Liu (2014) indicated that social media platforms are considered resourceful, as "many people spend a considerable amount of time every day reading and writing internet postings about stocks" (p174). One of the most pronounced events highlighting that social-media can influence the stock-market was the Associated Press Hoax in 2013 on Twitter (Yang et al., 2015), suggesting President Obama was injured, sending the Dow Jones index spiraling by 143-points, demonstrating "how tightly intertwined Wall Street has become with Twitter" (Yang et al., 2015, p.110). Similarly, Bijl et al. (2016) found a negative sentiment reaction to stock returns and noted that the most frequent topic searched by google is a price drop. In another study, Gao et al. (2016) in agreement with Baker and Wurgler (2006), found an inverse relationship between sentiment and stock returns. In contrast, Siganos et al. (2014) used Facebook, and found a significant positive relationship with stock returns, implying counterintuitively that optimism would decrease the stock price (De Long et al., 1990). However, Siganos et al. (2014) further found a negative relationship between sentiment and volatility and trading volume.

With regard to Twitter as another source of sentiment, Bollen et al. (2011) found that public mood and sentiment on Twitter drive stock-market prices, as Twitter can give a representation of the mood of the population. In addition, Bollen et al. (2011) used mood as a factor of sentiment analysis, finding that tweets can predict the stock-market with 86.7% accuracy, with significant correlation with the Dow Jones Industrial Average. Instead of one index, Liu et al. (2015) analysed co-movement between stocks and twitter sentiment using the two indexes of the NYSE and the NASDAQ. They found

that firms with an official Twitter account have a higher co-movement. In another study, Rao and Srivastava (2012) investigated the relationship between short-term performance and sentiment. They found a high correlation between stock returns and Twitter sentiment: "for short term trading decisions, short term sentiments play a very important role in short term performance of financial market instruments such as indexes, stocks and bonds". Similarly, Yu et al. (2013) examined the differences between Twitter and conventional media and found that social-media has a much stronger link with stock-markets than conventional media.

From the above analysis, we can conclude that "CEO succession announcements serve as signals to the investment community. However, it is not the signal sent which is of primary importance, but the investment community's perception of the signal" (Beatty and Zajac, 1987, p.316). In agreement with the most of the above-mentioned previous studies, it is consequently hypothesised that there is a significant relationship between Twitter Sentiment Score (TSS) and stock returns. Therefore, the first hypothesis is identified as:

H1: There is an inverse relationship between sentiment and stock returns.

The second hypothesis is related to which theory (common-sense, scapegoat and vicious circle) is supported (Allen et al., 1979; Beatty and Zajac, 1987; Grusky, 1963). In line with much of the literature (Allen et al., 1979; Chung et al., 1987; Friedman and Singh, 1989; Grusky, 1963; Lubatkin et al., 1989) on firm performance, those who replace their CEOs are associated with change of performance post-succession. Therefore, the second hypothesis is identified as:

H2: How a firm performs in the year prior to the succession will have a significant effect on stock returns when the new CEO is announced.

We study CEO characteristics and abilities and how those abilities relate to subsequent performance and stock returns. In addition, we note that neither the theoretical nor empirical studies have to date provided much guidance concerning which particular characteristics and abilities are important for corporate governance and performance due to their mixed results. Therefore, the next hypothesis is related to which characteristics or types are

more important for corporate performance, identified as:

H3: There is a positive relationship between CEO individual characteristics and subsequent CEO success.

3. Data and Methodology

3.1. Data

The data adopted in this study includes daily data from a total of 60,000 observations over the five year period from January 1st 2010 to December 31st 2015 and is selected to specifically examine the impact of the sentiment related to CEO succession announcement proposed by social media metrics. For stock returns, we used a sample of firms that are listed on the indexes of S&P100 and FTSE100 stock exchanges.[1] We first retrieved the list of the companies that are publicly traded on the two international markets from the OSIRIS and DataStream databases, which were sorted by size in order to analyse the largest companies. For data on CEOs in the UK and US, we use the BoardEx database. In addition, Yahoo Finance was used to source company stocks, and the indexes of S&P100 and FTSE100.[2] Stock-prices downloaded from Yahoo Finance were converted into returns following Ranco et al. (2015), as shown in equation 1:

$$\text{Stock Returns(R\_i,t)} = \frac{Price_t - Price_{t-1}}{Price_{t-1}} \tag{1}$$

We next constructed the Python code to extract the views of users including the media, news, analysts, companies, or anybody who would like to 'tweet' (micro-blog in less than 140 characters). Approximately 17,000 tweets were obtained and analysed for sentiment. We note that the Twitter API has been commonly used in previous studies (e.g. Ranco et al. (2015)) but that it has been criticised for being restricted by Twitter to sourcing tweets generally in the last 8/9 days from the search date. Consequently, a bespoke code, specifically for this study, was written to collect data from Twitter

[1] Most previous studies' samples were smaller than ours (Yu, Duan, and Cao, 2013).
[2] Data is only obtained from companies with CEO changes. The list of companies is available from the authors upon request.

using the platform's Python to search for the exact series of dates from the day of the announcement and post three days. Overall, with 100 companies each having their own unique code, Python was run over the course of 4 days to collect the tweets for each company. It collected a unique set of data including the values of the number of followers, number of followings, and number of tweets of each firm account at the parsing time. To generate the number of firm-followers, information about the users followed by each firm was also collected. The program began running on July 2, 2016. Because of the large amount of data, the program ran for four days (crawling ceased on July 5, 2016).

As databases currently provide no specific CEO succession announcement date, a significant portion of time was consumed investigating this through various sources such as company press releases, Google searches, and news reports (e.g. Yahoo Finance, CBS, Bloomberg). Each date was cross-referenced on Twitter search in order to ensure news agencies confirmed the date of announcement.

Along with Python specifications, another coding platform, *R*, was used to analyse the data. Selecting and acquiring a lexicon is one of the most important elements of sentiment analysis (Feldman, 2013). In line with other researchers (Boudoukh, Feldman, Kogan, and Richardson, 2012; Kearney and Liu, 2014; Oliveira, Cortez, and Areal, 2016), we use the finance-related lexicon from (Loughran and McDonald, 2011). This index was purposely created to be used in finance and stock-market related sentiment studies (Loughran and McDonald, 2011), which was obtained from the hyperlink in their study, uploaded and coded into the R Studio software, where their value weighting of finance-centric words have provided a more representative analysis of sentiment. Following other researchers (Boudoukh, Feldman, Kogan, and Richardson, 2012; Kearney and Liu, 2014; Rees and Twedt, 2012; Yu, Duan, and Cao, 2013), our study commonly features the sum of positive words less the sum of the negative words divided by a nominator of the overall number of positive words less the number of negative words; as identified in equation 2. We construct our sentiment index by averaging the sentiment score of all tweets for each individual company as:

$$\text{Sentiment Score} = \frac{\sum POS - \sum NEG}{\text{Number of POS - Number of NEG}} \tag{2}$$

The mean total Twitter Sentiment Score (TSS) for each company will then be used as an independent variable to explain returns around new CEO

announcements.

3.2. Methodology

In order to be consistent with earlier studies in this area, Brown and Warner's (1980) standard event study methodology was adopted to calculate the abnormal returns. This methodology draws on the actual ex-post return of the stock over the event window minus the normal return of the stock over the event window. The normal return is defined as the return that would be expected if the event did not take place. Following the approach of other research (Henderson, 1990; Li, Shin, and Moore, 2006), the estimation window used in this study is 200-days to 10-days prior to the announcement. For each company i and event date d, the expected return is identified as:

$$Exp(R_{i,t}) = \alpha_i + \beta_i * Rm_t + \epsilon \tag{3}$$

where $Exp(R_{i,t})$ is the expected return on a stock if the 'event' does not occur; R_m is the return on the market (i.e. S&P100 or FTSE100); α is the intercept between a stock and the market for the estimation period t_{-200} to t_{-10}; β is the slope of the regression; and ϵ is the zero mean error term.
The abnormal returns over the 4-day event window are then identified as:

$$Ab(R_{i,t}) = StockReturns_{i,t} - Exp(R_{i,t}) \tag{4}$$

Subsequently, the abnormal returns are aggregated over different periods of the event-window, creating a set of CARs.[3] Accordingly, CAR is identified as in equation 5:

$$CARs = (1 + Ab_0) * (1 + Ab_1) * ... * (1 + Ab_t) - 1 \tag{5}$$

In order to examine the impact of Twitter Sentiment Score (TSS) associated with the announcement of CEO succession on stock return, the following model is estimated, as in equation 6 and equation 7:

[3]This study calculates cumulative abnormal returns (CARs) immediately after (i.e. not prior to) the report of succession (Beatty and Zajac, 1987; Gangloff, Connelly, and Shook, 2014; Nofer and Hinz, 2015; Ranco, Aleksovski, Caldarelli, Grcar, and Mozetic, 2015).

$$CARs_{i,t} = \alpha + \beta Sent_{i,t} + \beta Loc_{i,t} + \beta Ind_{i,t} + \beta Y_{i,t} + \beta Suc_{i,t} + \beta Lage_{i,t} + \beta Gen_{i,t} + \beta Orig_{i,t} + \beta Deg_{i,t} + \beta MBA_{i,t} + \beta Exp_{i,t} + \beta Ten_{i,t} + \beta Prof_{i,t} + \beta LSal_{i,t} + \beta LEmp_{i,t} + \epsilon \quad (6)$$

where i denotes the firm number (1-100) and t is the time period (2010-2015); $Sent_{i,t}$ denotes the Sentiment Score; $Loc_{i,t}$ is the location of the company (UK or USA). *Gen_i,t* is CEO gender. *Orig* refers to the successor origin; *Deg* refers to the CEO successor first degree; *MBA* is the CEO successor MBA degree; *Exp* is the CEO successor industry experience; *Ten* is the CEO successor Tenure; *Ten* is the CEO successor Tenure; *Prof*, *Sal* and *Emp* refer to firm profitability, sales and number of employees respectively.

Similarly, for the model without the industries and years as equation 7:

$$CARs_{i,t} = \alpha + \beta Sent_{i,t} + \beta Loc_{i,t} + \beta Suc_{i,t} + \beta Lage_{i,t} + \beta Gen_{i,t} + \beta Orig_{i,t} + \beta Deg_{i,t} + \beta MBA_{i,t} + \beta Exp_{i,t} + \beta Ten_{i,t} + \beta Prof_{i,t} + \beta LSal_{i,t} + \beta LEmp_{i,t} + \epsilon \quad (7)$$

4. Empirical Findings

The empirical analysis begins with the descriptive statistics for the variables used in our tests. Tables 1 and 2 show CEO demographics and summary statistics, respectively. For the first cumulative abnormal return (0,1), there was a negative (yet small) average (-0.02%) when a new CEO was announced. Sprint Corporation had the lowest CARs at (0,2) event window (-22.742%). The highest CAR overall is associated with Serco Group Plc (14.800% , (0,2)). While the sentiment score is positive on average at 0.102, with the minimum company average being -0.435 (HCA Holdings Inc), and the maximum average of the sentiment score being 0.583, associated with Carnival Plc. Furthermore, the sentiment score is normally distributed, with a slight negative skewness (-0.097). A mean of 0.5 was expected for the Location, due to exactly 50 companies from each of the United States and United Kingdom, being similar to the industry and year dummy variables. A mean of 0.9 for succession indicates that 90% of the cases in the sample are voluntary turnovers, which negatively skewed to the left, with leptokur-

tic kurtosis (5.439).[4] With a much smaller distribution between the log of (CEO) age when they were appointed, the distribution is positively skewed to the right (0.204), with platykurtic kurtosis (0.857). For gender, it is similar in pattern to succession, with 92% of the data sample being male CEOs and only 8% female. The Origin has a mean of 0.680, indicating that 68% of the new CEOs are internally recruited. This indeed implies a reduction over approximately three decades (Lubatkin et al., 1989), and in line with other literature (Beatty and Zajac, 1987; Friedman and Singh, 1989; Shetty and Peery Jr, 1976) that found that outsiders accounted for roughly 12%-15%. For education level, whilst 93% have a degree, only 35% of the new CEOs hold a MBA, which is more common in the United States. Finally, our analysis shows that 61% of CEO successors have all of their experience in one industry.

To analyse fairly and to make inferences, a number of checks were conducted. Testing for autocorrelation revealed no issues and returned Durbin-Watson scores of 2.239; 2.242; and 2.250 respectively. Values around 2 indicate no serial correlation issues in any of these models (DeFusco et al., 2007). In order to confirm there is no heteroscedasticity in the model, the residuals are plotted against the CARs.

[Insert Table 1 here]

Table 2 presents a Pearson correlation matrix. The first dependent variable of CARs (0,1) shows a significant (at the 1%-level) correlation with the Sentiment Score (Pearson-coefficient of -0.261). In addition, there is a significant positive correlation with Log of Age (at 5%-level of significance), suggesting that the older the CEO is, the larger are the cumulative returns. There are a few significant relationships. For example, location is positively associated with Sentiment Score, suggesting that the sentiment Score is positively and significantly related at the 1%-level for the United States. The Twitter Sentiment Score (TSS) is negatively related to the Automobile Industry at the 5%-level; and has a positive relationship with the Log of Sales of the announcement year. The Location suggests that the United States is more positively associated (at the 1% level of significance) than the United Kingdom to several variables such as internal CEO replacements. Interestingly, the US is significantly (1%-level) more positive than the UK in both

[4]To save space, figure available from authors on request.

the Log of Sales and Log of number of employees, which could explain the significance of these variables in US literature. This finding is in agreement with Rao and Srivastava (2012) who found highly correlated returns with Twitter Sentiment Score (TSS).

[Insert Table 2 here]

Now we move on to test the impact of Twitter Sentiment associated with CEO succession and stock returns, and do so through regression analysis. Table 3 shows the empirical findings of OLS regression. As can be seen from Table 3, and as hypothesised, the Twitter Sentiment Score (TSS) has an inverse correlation (-4.978) with CARs when using event window (0,1) at the 5% significance level (P-value=0.012). This implies that the more positive the Sentiment, the lower are the cumulative returns that are expected from the market. For CARs (0,3), the Sentiment Score first becomes significant only at the 10%-level, suggesting the relevance of the sentiment becomes less important as the days go on from the initial reaction on the day of the event to the day following it.

For CEO age, we found a positive and significant relationship between age and stock returns (CARs) with different event windows for all three models. This is consistent across industries and years, and implies that the older a CEO is when she/he is announced, the larger the CARs will be on the day of the announcement and the day following it. This indicates that individual CEO characteristics do indeed have an impact on stock returns, hence Hypothesis 3 is accepted. This is in line with the findings of previous studies (Serfling, 2014; Yim, 2013), that found that as CEOs become older, they are less likely to take risks, reducing the volatility of stock returns. Also, this finding could possibly explain the CEO age and sentiment relationship. If investors realise that 'larger firms' are less volatile than 'new stocks' (Baker and Wurgler, 2006), hence investing for stability and dividends, then older CEOs are perhaps preferable and are better received than as they may be more risk averse in some respects (Yim, 2013).

Next, how the findings are associated with firm performance is considered. Table 3 shows that the coefficient is marginally negative (-0.005) for CARs (0,1). This implies that, conversely to the findings of Grusky (1963) and Friedman and Singh (1989), there is in fact an inverse relationship if a firm performs poorly the year prior to the announcement, as the returns will

actually be higher. Therefore, these results align more naturally with the ritual scapegoat theory (Gottesman, 2006), suggesting that the CEO can be fired to reduce anxiety, and that there is no relation between performance of the firm the year prior to the succession, and the performance as soon as the new CEO is announced (proxied through CARs). Similarly, we found a negative coefficient (-0.334) with Origin, but this was also insignificant. This is in line with a number of previous studies (Allen, Panian, and Lotz, 1979; Grusky, 1963; Helmich and Brown, 1972; Shetty and Peery Jr, 1976) and implies that external candidates are associated with a deterioration in performance, and are not considered as effective as an internal replacement. Indeed, hiring an outsider CEO suggested internal failure, the firm not being as effective at deploying social resources, or as being a disruptive move (Friedman and Singh, 1989; Kotter, 1982; Lubatkin, Chung, Rogers, and Owers, 1989; Salancik, 1980; Shetty and Peery Jr, 1976).

[Insert Table 3 here]

With regard to the type for succession (voluntary or forced), we found an insignificant relationship between succession type and stock returns. This implies that there are higher returns when succession is voluntary compared to when it is forced. This is in line with the findings of Friedman and Singh (1989), who found that the succession type had no significant effects on stock-prices, consistent with most of the successions being a result of the voluntary retirement of the predecessor.

In order to robustly check findings, and in line with a recent CEO Succession study (Brown and Caylor, 2009), we employed a Stepwise regression method. In order for variables to remain in the Stepwise model (which adds and removes variables on a per-model-basis), the significance of the variables must be at least at the 10%-level for two tailed variables (Brown and Caylor, 2009). Table 4 presents the estimations for three models/event windows (0,1),(0,2), and (0,3). We estimate the models using the significant variables obtained from the previous analysis (Twitter Sentiment Score (TSS), Log of Age, Year 2013, and the Business Services Industry), as other variables (gender, succession, origin, holding an MBA, experience in the one industry and Tenure) fail to yield as significant parameters as our initial findings robustly yielded.[5] We found further robust evidence supporting the relevance and significance of the four variables highlighted in Table 4.

[5]See equation 6 for different variable explanations.

[Insert Table 4 and Table 5 here]

5. Conclusion

This paper examined the effect of Internet information gathering regarding CEO succession announcements on subsequent stock returns, in particular, Twitter Sentiment Score (TSS). We find that high levels of TSS predict low future excess returns. The coefficients of the Sentiment Score variables are statistically significant when a new CEO is announced, which is in line with previous studies that have used sentiment analysis on other communications such as earnings announcements. We also find evidence that the predictive power of TSS is similar across industries. Importantly, TSS is particularly influential in short windows as it loses significance with each progressive day. In addition, our analysis shows that the age of the CEO when they are announced, and the year of announcement, are consistently positive and significant at the 1% level of significance, implying that the older a CEO is, the higher the stock returns. In terms of specific industries, we found that the CEO succession-sentiment is dominated by Business Services sector grouping as there is a positive relationship between the announcement of the CEO in this industry and stock returns. Other factors (gender, CEO origin, succession type, CEO tenure, education, location, and firm performance) fail to yield economically plausible predictive values. Table 5 shows the summary of our empirical findings. One practical implication of our results is that scope by mass media can play a role in reducing data issues and problems regardless of the possibility that it does not break real news. This has the further implication that companies-media relations activities can influence their cost of capital. Recently, regulatory changes in the securities industry have left many firms without expert scope and analyst coverage. Our findings recommend that the media (and firms' media relations offices) may offer a substitute or a supplement to classical channels of corporate information such as analyst coverage.

The findings of this study offer insights for investors, institutions and policy makers interested in sentiment tracking tools, in which individuals evaluate the extent to which they experience positive and negative affect, happiness, or satisfaction with life. Public mood analysis from Twitter feeds

on CEO successions in particular offers an automatic, fast, free and large-scale addition to this toolkit that may in addition be optimized to measure a variety of dimensions of the public mood state. Furthermore, our findings are critical for regulators. Cynics may argue that companies misuse social media by disseminating misleading and speculative information to investors, and thus call for regulating social media. However, our results demonstrate the inverse; the information in social media may help investors and companies in their investment-decision-making. Our findings also have important implications for the role social media plays in the contributing community, the individuals and companies use social media to share information with respect to companies' future prospects of their mutual benefits.

Our analysis does not acknowledge a number of important factors that should, however, be examined in future research. First, we note that our analysis is not designed to be limited to any particular geographical location or subset of the world's population. This approach is appropriate since the US stock markets are affected, and do in fact affect, individuals worldwide. However, for the particular period under observation, Twitter users were de facto predominantly English speaking and located in the US and the UK. As Twitter's user base becomes increasingly international and the use of smartphones equipped with geo-location increases, future analysis could factor in location and language to avoid geographical and cultural sampling errors. Second, future research may need to take into account social and cognitive effects in which individual agents are endowed with the ability to learn from past experiences and can adjust their trading behavior accordingly. The investigation of such phenomena in online social networking environments is part of an exciting new research front commonly referred to as "computational social science". Subsequently, future research may consider the direct assessment of public mood states against those derived from online communities of Twitter, to include metadata, for example, the number of followers, enables weighting of content producers in view of their impact and reach. Finally, future research should investigate the intraday level, as Tweets are recorded with a granularity of one moment. Intraday level investigation could uncover how rapidly the market responds to Tweets, considering possibly exceptionally detailed examinations of the connections between Twitter, CEO declaration and stock returns.

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Table 1
CEO Demographics

Gender	Percentage
Male	92%
Female	8%
Age at Announcement	**Percentage**
Less than 45	6%
Between 45 - 52	39%
Between 53 - 60	50%
Greater than 60	5%
CEO Origin	**Percentage**
Internal	68%
External	32%
MBA	**Percentage**
Hold an MBA	35%
No MBA	65%
Experience	**Percentage**
In Only One Industry	61%
In More Than One Industry	39%
Tenure with Firm Prior to Announcement	**Percentage**
External Successor (0 years)	29%
Between 1 - 5 years	13%
Between 6 - 15 years	23%
Between 16 - 30 years	26%
Greater than 30 years	9%

Table 2
Descriptive Statistics and Correlation Matrix

Variable	Mean	S.D.	1	2	3	4	5	6	7	8	9	10	11	12	13
CARs (0,1)	-0.023	3.65	1												
Sentiment Score	0.10	0.23	-0.261**	1											
Succession	0.90	0.30	0.064	0.035	1										
Log Age	3.96	0.10	0.249*	0.057	-0.125	1									
Gender	0.92	0.27	0.031	0.051	0.025	-0.017	1								
Origin	0.68	0.47	0.008	-0.044	0.057	0.107	-0.044	1							
Uni U/Grad Deg	0.93	0.26	-0.071	-0.007	0.039	0.127	-0.081	-0.020	1						
MBA	0.35	0.48	0.061	-0.033	0.035	0.021	-0.170	-0.261**	0.201*	1					
Experience in One Industry	0.61	0.49	0.109	0.029	-0.130	0.153	0.142	0.111	0.102	-0.058	1				
Tenure	11.92	11.73	0.058	0.049	0.089	0.232*	-0.056	0.621**	-0.012	-0.176	0.309**	1			
Profit Margin of Yr Prior to Anncnt	11.01	10.74	-.020	0.101	-0.036	-0.043	0.106	0.187	-0.003	0.085	0.052	0.145	1		
Log Sales of Anncnt Yr	17.07	1.26	-0.014	0.214*	-0.143	0.283**	-0.013	0.404**	0.187	-0.084	0.326**	0.497**	-0.061	1	
Log No. Employees of Anncnt Yr	10.98	1.33	0.041	0.052	-0.132	0.179	-0.175	0.237*	0.085	-0.074	0.137	0.383**	-0.015	0.601**	1

**significant at the 0.01 level, *significant at the 0.05 level

Table 3
OLS Estimations for all full Variables

Variables	CARs (0,1)	CARs (0,2)	CARs (0,3)
Constant	-46.232	-68.900	-77.156
Sentiment Score	-4.978**	-5.554**	-4.678*
Location	-0.469	-0.752	-1.650
IndTechnology	0.256	.469	1.016
IndPharmaceutical	0.159	0.366	1.007
IndAutomobile	0.979	2.008	2.349
IndAerospaceDef	-0.420	-0.581	-0.602
IndOilGas	1.179	1.174	2.128
IndBanking	-1.173	-1.854	-1.492
IndInsurance	3.281	2.396	2.829
IndFoodBeverage	2.022	3.049	3.984
IndLogistics	-2.425	-3.162	-3.329
IndAirline	2.147	5.111	6.766*
IndCommunications	0.868	1.612	3.367
IndAgriculture	2.763	4.075	6.199
IndConstructionMining	1.214	2.205	1.238
IndEnergy	1.696	1.462	2.267
IndBusinessServices	4.563*	7.007**	7.585**
Year2011	0.111	0.425	1.483
Year2012	0.121	1.134	2.785
Year2013	-2.401*	-2.098	-1.170
Year2014	0.632	1.622	2.699
Year2015	-0.463	0.076	1.341
Succession	0.557	0.996	1.192
Log Age at Anncnt	10.638**	14.591**	16.349***
Gender	0.762	0.853	1.150
Origin	-0.334	-0.429	0.023
Uni U/Grad Deg	-1.870	-1.543	-1.924
MBA	0.605	0.745	1.083
Exp in 1 Ind	0.962	1.615	1.749
Tenure	0.049	0.046	0.055
Profits of Yr Prior to Anncnt	-0.005	-0.020	-0.048
Log Sales of Anncnt Yr	0.014	0.420	0.130
Log No. Employees of Anncnt Yr	0.328	0.193	0.614
F	1.058	1.008	1.152
Durbin Watson	2.239	2.242	2.250
R2	0.346	0.335	0.366

***significant at the 0.01 level **significant at the 0.05 level *significant at the 0.10 level. See equations 2 and 6 for details about variable explanations.

Table 4
OLS Estimations and Stepwise Method

Variables	CARs (0,1)	CARs (0,2)	CARs (0,3)
Constant	-39.675	-55.315	-54.961
Sentiment Score	-5.125***	-5.156***	-4.736**
Year2013	-2.159***		
Year2014		2.215**	2.363**
IndustryBusinessServices	3.514**		
Log Age at Anncnt	10.24***	14.01***	13.87***
F	6.758***	6.605***	6.118***
R2	0.222	0.171	0.160

***significant at the 0.01 level **significant at the 0.05 level *significant at the 0.10 level. See equation 2 and 6 for details about variable explanations.

Table 5
Summary of Empirical Findings

Variable	Significant		Insignificant	
	Positive	Negative	Positive	Negative
Sentiment Score		✓		
Succession			✓	
Log Age at Anncnt	✓			
Gender			✓	
Origin				✓
Uni Degree				✓
MBA			✓	
Exp in 1 Ind			✓	
Tenure				✓
Profits of Yr Prior to Anncnt Yr			✓	
Log Sales of Anncnt Yr				✓
Log No. Employees of Anncnt Yr			✓	

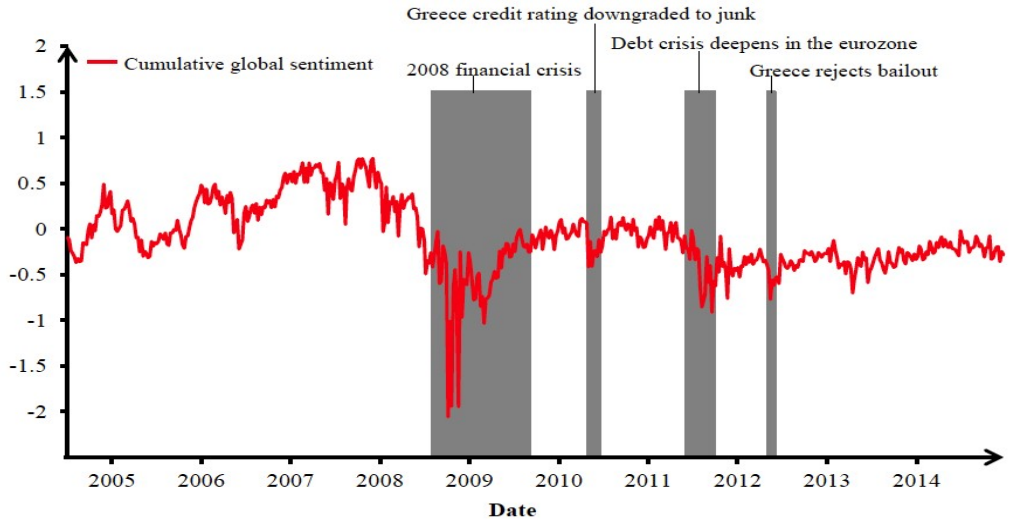

Figure 1: Cumulative Global Sentiment (Gao et al, 2016)

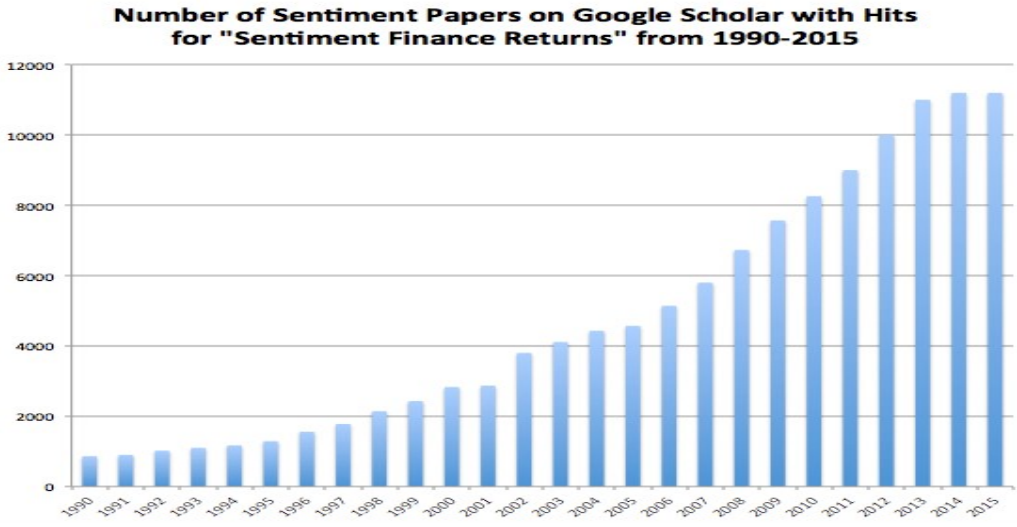

Figure 2: Number of Papers on Google Scholar with Hits for "Sentiment Finance Returns" (1990-2015)