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Abstract:

Purpose

Evidence from previous literature indicates that adopting a new innovative technology has a positive impact on a company's business performance. Much less work has been carried out into examining whether a technology adoption has impact on corporate reputation. This research examines the latter topic in a context where social media is the channel used to share news about the introduction of a new technology. The empirical setting of the study consists of five retail companies located in the USA that decided to include Bitcoin as a payment platform.

Design/methodology/approach

Twitter data were used to measure how sharing news about the adoption of new technology could affect the reputation of the companies selected, keeping a clear distinction between the volume of data relating to social media responses and the sentiment expressed in the tweets. A panel vector autoregression model was employed to incorporate series of data relating to news items, volume and sentiment.

Findings

The results show that the news about the adoption of a new technology has a positive impact on both the volume of tech-related tweets and the sentiment expressed in the tweets themselves, although the patterns of these two effects are different. The resulting impact decreases after a few days, both in volume and in sentiment.

Research limitations/implications

The analysis has limitations that future research could address by extending and diversifying the examined companies and the social media used as data sources. The research suggests that managers in medium-sized companies can leverage on the introduction of new technologies that have a direct impact on their customers and gain reputational benefits in terms of immediate visibility.

Originality/value

The research introduces an additional dimension of analysis to the current stream of corporate reputation. Although the literature has already covered the dynamics of response to events on Twitter, by focusing on the adoption of the new Bitcoin technology, the paper provides novel insights.

Keywords: Corporate Reputation, Technology Adoption, Bitcoin, Social Media Analysis, Sentiment Analysis, Vector Autoregression, Blockchain.

Introduction

Corporate reputation refers to the "admiration and respect a person holds of an organization at a point in time" (Dowling, 2016: p. 218). Previous literature agrees in considering it to be a strategic asset for sustaining a company's performance (Fombrun and Shanley, 1990; Benjamin and Podolny, 1999; Deephouse, 2000; Gatzert, 2015; Crespo and Inacio, 2018).

Corporate reputation is seen to contribute positively to a firm's activities through its ability to influence an organization's relationships with its stakeholders (Lange *et al.*, 2011; Burrows *et al*. 2018). In particular, corporate reputation is a key element of brand equity, when it transmits an accurate and positive company image to stakeholders (Caruana and Chircop, 2000; Heinberg *et al.*, 2018; Burke *et al.*, 2018). Brand-related and product-performance indicators, such as loyalty, sales and profit, can in fact all be influenced by corporate reputation (Gray and Balmer, 1998).

Several studies (e.g. Carter, 2006; Rindova *et al*., 2007) have examined the link between corporate reputation and innovation, covering the positive role played by corporate innovation. The main outcome emerging from these studies is the positive correlation found between perceived innovativeness and brand-related performance (Kunz *et al*. 2011). Technological innovation, however, could also be associated to an increase in customer-perceived risks (Johnson *et al*., 2008), with negative repercussions on the company's brand image.

A relevant body of literature has investigated the impact of a company adopting a new technology on its business performance (Ahuja and Katila, 2001; Grigoriou and Rothaermel, 2017), but relatively few studies have examined the influence of technology adoption on corporate reputation. The purpose of this work is to provide further insights into such a relationship by examining how a company's reputation is affected when news about a technology adoption is released on social media.

The empirical setting focuses on five companies which decided to introduce Bitcoin as a payment method. Bitcoin is a virtual currency based on blockchain technology and it is predicted to affect the way consumers and brands interact (Boukis, 2019). The interchange between firms and users on the social network "Twitter" was collected and analysed to evaluate the impact of the announcement of the company's adoption of Bitcoin on its reputation.

A panel vector autoregression (VAR) analysis was performed to investigate the volume and the sentiment of the exchanged messages, "tweets", such as the quantitative and

qualitative responses to the Bitcoin news. The results suggest that there is a positive impact on corporate reputation in terms of both volume and positive sentiment of the associated tweets.

This research contributes to the stream of branding literature (e.g. Fombrun and Shanley, 1990; Deephouse, 2000; Rindova *et al*., 2007; Lange *et al*., 2011; Kunz *et al*. 2011; Burke *et al*., 2018) by exploring how spreading the news about technology adoption events can have an impact on different facets of corporate reputation, which in turn is associated with consumer brands and product perception.

In terms of management implications, the results have consequences for brand managers. Executives could leverage on the fact that their company is going to introduce new technologies that impact directly on their customers. Managers could exploit such news releases and gain reputational benefits in the short term.

Research framework

Corporate reputation and technology adoption

The growing literature on corporate reputation (Dowling, 2016; Gürhan-Canli *et al*., 2018) shows that it is a determinant asset to be established and defended, and that it is connected to several business activity aspects. Corporate reputation does not merely emanate from a company's distinctive capabilities or expertise, but is the result of an intricate interplay with firm's stakeholders (Fombrun and Van Riel, 1997). Several factors can affect a company's reputation, from market strategies to employment policies (Cable and Graham, 2000; Basdeo *et al*., 2006; Lange *et al*., 2011; Ravasi *et al*., 2018).

Because of its complexity as a concept, different authors have presented their own various definitions (Fombrun, 1996; Barnett *et al*., 2006; Walker, 2010). In essence, corporate reputation can be defined as the "admiration and respect a person holds of an organization at a point in time" (Dowling, 2016: p. 218).

This study follows in the path proposed by Lange *et al*. (2011), for whom the concept of corporate reputation is characterized along three dimensions (Table 1). The first dimension refers to the collective perception/awareness of a company or its visibility, i.e. *Being Known*. The second, *Being Known for Something,* relates to the perception of a company's specific outcome or behaviour with respect to the beholders' own interests. The third dimension is called *Generalized Favourability* and refers to the perceptions and/or judgments made by those who observe the organization, as an aggregate of company attributes.

From the observer's viewpoint, the construct refers to either a *non-evaluative* or a manifestly *judgmental* perspective. The first case occurs when the observer is aware of the company but does not express an opinion, while the second case occurs when the observer sets out opinions about the whole company or its behaviour, or else focuses on one specific trait.

[Table 1 around here]

The way third parties perceive a company determines its corporate reputation (Gotsi *et al*., 2001). In this context, customers are a particular group of stakeholders and their evaluation shapes the company's overall brand image (Lamberti and Lettieri, 2009; Pedeliento and Kavaratzis 2019). Brand image, in turn, contributes to the construction of the company's

brand equity (Kayaman and Arasli, 2007; Davcik *et al.*, 2015; Brexendorf and Keller, 2017). For this reason, any action which can influence the customers' perception of a company in the short-term will have an impact on its corporate reputation in the mid-term. Hence, if customers discern improvements to a company's corporate reputation, their perception will contribute positively to its brand equity (Hur *et al.*, 2014). Enhanced brand equity is then expected to lead to higher performance in sales, market share and loyalty (Cretu and Brodie, 2007; Datta *et al.*, 2017).

A company's ability to innovate is considered to be an element of corporate reputation (Clayton and Turner, 2000; Ahuja and Katila, 2001; Brown and Turner, 2009; Safon, 2009; Lange, 2011; Padgett and Moura-Leite, 2012; Agarwal *et al.*, 2018) and is a common trait in most of the frequently used qualitative and quantitative methods to assess corporate reputation, such as Fortune's World's Most Admired Companies indicator and the reputation index RepTrak™ (Trotta and Cavallaro, 2012; Fombrun *et al.*, 2000; Ponzi *et al.*, 2011; Fombrun *et al.* 2015).

Customers' perceptions that relate to innovation, in fact, impact positively on attitudinal and emotional brand loyalty at both corporate and product levels (Kuntz *et al.*, 2011) and result in higher clients' satisfaction (Rubera and Kirca, 2017). Since technology adoption is inherently an innovation activity (Kim *et al.*, 2018), it can potentially deliver a positive effect on corporate reputation.

Social media and corporate reputation

Although adopting new technology is fundamental for companies operating in innovative and competitive environments, it is only when stakeholders become aware that the

innovation is in place that the relative impact on corporate reputation can be identified. The relevant scenario is when a newly adopted technology alters the company's product/service content and/or outcome, as has been pointed out in several studies (Meuter *et al*., 2000; Son and Han, 2011; Ayers *et al*., 2009; Yen, 2005; Wu *et al*., 2013; Rindova *et al*., 2007; Fleming *et al*., 2018). In this situation, the impact of adopting a technology emerges when stakeholders learn about the adoption and shift their evaluation of that technology onto the company (Hou *et al*., 2018).

While studies on how the release of news can influence corporate reputation are found in prior literature (Kiousis *et al*., 2007; Einwiller *et al*., 2010; Comyns and Franklin-Johnson, 2018), as yet there has been no research into the specific topic of sharing technology adoption undertakings on social media. This gap in research is surprising, given the role that social media play in corporate reputation and brand performance (Tuškej and Podnar, 2018).

Social media are a major channel for generating and spreading opinions about a company and its corporate quality throughout the public domain (Etter *et al*., 2019). The reaction on social media to news about an organization can amplify the stakeholders' ability to influence corporate reputation and, potentially, brand equity (Barnett and Pollock, 2012). For such reasons, companies strive to improve the effects of their presence on social media, where user- and firm-generated content are both provided (Kaplan and Haenlein, 2010; Kim and Chae, 2018). Organizations need to develop specific technical and management skills to reap the reputational benefits associated to user-generated content (e.g. flares - Blevins and Ragozzino, 2019) and extract value from these platforms, which are very different from

classic advertising channels (Peters *et al*., 2013).

Scholars have revealed the close link between brand reputation and social media. Social media management entails the systematic monitoring of social media to mitigate any risk to reputational assets (Montalvo, 2011; Hajli and Sims, 2015; He *et al*., 2017). Moreover, when brand reputation is established through effective media management, it can be a powerful resource for competitive advantage (Deephouse, 2000: Rindova *et al*., 2006). Research has also found that focusing on the preferential channels for electronic word of mouth from customer to customer is a meaningful way to evaluate how external beholders judge and perceive brands online (Xun and Guo, 2017; King *et al*., 2014). On the contrary, if a company is careless in managing its corporate social media profile, this circumstance can have a direct negative effect on its equity (Yu *et al*., 2013).

The internet has become a space for expressing opinions on a vast range of topics, and a number of information retrieval techniques are being developed to extrapolate and analyse relevant posts that refer to specific products or brands (Thelwall *et al*., 2010). A company can apply similar methodologies and evaluate its users'/customers' attitude toward its products and services. The techniques for retrieving information often involve algorithms that can work down to single text elements (Pang and Lee, 2008). The information embedded in social media streams can be investigated through methods that include sentiment analysis, the analysis of trending topics through keywords (*hashtags*) and the automated analysis of shared images combined with machine learning techniques (Tsytsarau *et al*., 2014; Jensen *et al*., 2015).

The empirical analyses in this study are based on data gathered from Twitter, one of the world's largest social networks. Sentiment analysis applied to Twitter texts can be used to investigate corporate reputation (Jansen *et al*., 2009) and a growing number of scientific articles now rely on Twitter data (e.g. Castillo *et al*., 2011; Lerman and Ghosh, 2010; Desmarchelier and Fang, 2016).

Research Objectives

Evidence from the previous section indicates three main factors. (i) The adoption of an innovative technology can have a significant impact on corporate reputation. (ii) The impact can relate to the resulting products and/or services, but can also be felt beforehand, when users/customers learn that a company is adopting a new technology, as this awareness can alter peoples' perceptions about innovativeness at corporate level. (iii) Social networks act as "news accelerators" and key levers that can be used to improve corporate reputation. The previous evidence paves the way towards setting the objective of this work, which is to evaluate, when users/customers learn that a company is adopting a new technology, how this fact stochastically affects the various dimensions of corporate reputation.

The framework proposed by Lange *et al*. (2011) has been adopted to evaluate the different aspects of corporate reputation and then define the appropriate measures for detecting the aforementioned impact. The framework is based on two parameters that underpin the concept of corporate reputation, i.e. the beholders' attitude (*judgmental* vs. *non-evaluative*) and the kind of relationship they have with the company (*particular* vs. *generalized*). However, it does not include a definition of corporate reputation that matches the desired configuration of *non-evaluative* and *particular* parameters. The required fourth

dimension has been, therefore, introduced to cover the entire definitional space and termed as *Being Known for Something (non-evaluative)*.

Table 2 sums up the concepts of corporate reputation used in this study. The "generalized" concepts address corporate reputation in broad terms, and "particular" concepts are specific to the actual technology adopted in the company. "Non-evaluative" measures refer to the volume of tweets, while "judgmental" measures refer to the sentiment expressed in the tweets.

The resulting combinations are the following:

- *Being Known* (non-evaluative – generalized) is measured through the "tech-unrelated volume" of tweets, which is the number of tweets about a company that do not mention the adopted technology (these tweets can refer to any aspect of the company, other than the adoption of the specific technology).
- *Generalized Favourability* (judgmental – generalized) represents "tech-unrelated sentiment", measured by examining the average sentiment of the tweets about the company that do not mention the adopted technology (general sentiment towards the company)
- *Being Known for Something (non-evaluative)* is an additional concept that analyses the specific "Something" (here, the technology adoption) in terms of volume; "tech-related volume" is the number of tweets that mention both the company and the adopted technology, regardless of the sentiment expressed by the users.

- *Being Known for Something (judgmental – particular)* is a proxy for "tech-related sentiment" and is the average sentiment of tweets that mention both the company and the specific "Something" which, in this framework, is the adopted technology.

Each configuration of parameters can be associated with a specific driver, as shown in Table 2.

[Table 2 around here]

The aim of this analysis is to determine, quantitatively, whether there was any impact on the four individual concepts of corporate reputation at the news that the company had adopted a new technology. A positive impact is expected because technology adoption is inherently an innovation activity (Kim *et al*., 2018) and innovation is a key asset of corporate reputation (Ponzi *et al*., 2011; Kuntz *et al*., 2011; Fombrun *et al*. 2015). However, the proposed framework makes it possible to provide more fine-grained results. It is also possible to distinguish between: i) whether the effect on reputation is limited to the specific event ("Being Known for Something", that is, the adopted technology) or whether it encompasses a perception of the company as a whole, and ii) whether the sentiment conveyed is significantly positive.

Methodology and data

The aim of this study is to investigate the relationship between the release of news about adopting innovative technology and corporate reputation. The technology adoption in question is the introduction of Bitcoin in five companies, as an additional method of

payment. These companies form a useful case study, as they were mentioned in the Twitter timeline before and after the date when their Bitcoin news was released.

Bitcoin as case of technology adoption

The Bitcoin protocol was released in autumn 2009, and from then on, the corresponding cryptocurrency has reshaped electronic payment systems and redefined the idea of money itself (Hughes *et al*., 2019; Morkunas *et al*., 2019).

Because it is based on blockchain technology, Bitcoin provides the necessary software tools to implement a completely decentralized infrastructure for the transfer of money. Transaction security is verified through cryptography and the fact that all transactions are recorded in shared electronic public ledgers, the blockchain. The users of this peer-to-peer architecture transact Bitcoins without the need for a trusted third party, such as a bank or any other financial institution. The advantages are associated with enhanced privacy and negligible transaction costs, compared to the current payment methods (credit cards, PayPal or the like). Bitcoin makes micropayments viable on a large scale, even for international transactions.

Among the negative aspects, financial speculation is a risk, because of its high volatility but, nevertheless, the continuously growing transactions and the constant support of venture capital in Bitcoin-related services suggest that it could play an important role in the future online payment landscape.

The adoption of Bitcoin is an interesting case for several reasons. First, a number of e-commerce companies have implemented this technology platform, and the precise date on

which they made the relative announcement is known or can be determined. Since the technology is quite recent, the implementation time frame in each company is narrow and a direct pre and post comparison can be made without too much difficulty. The companies that introduced Bitcoin added an additional payment platform as a plugin to their online shops. The work necessary to set up the technology is not complex but, while it is not a technical issue, it is a strategic, management and behavioural problem, similarly to the e-blog case described by Wu *et al*. (2013). In addition, customers who interact with the new technology are "e-clients", and hence they can be reasonably considered in the same category as the people who share their thoughts on Twitter.

Furthermore, there is no uniform opinion about the whole Bitcoin system. Critical comments have been made in the media about the risks of financial speculation and the privacy of the transactions, exposing the fact that the system could be exploited by criminals. The point is interesting, because an *a priori* negative sentiment in response to the introduction of Bitcoin cannot be excluded.

Twitter as data source

With more than 300 million active users a month, Twitter is one of the most useful social networks for analysing corporate reputation. As observed by Jansen *et al*. (2009), when they targeted Twitter corporate accounts, nearly 20% of all branding microblogs contained some expression of sentiment relating either to the company in general or expressing an opinion on one or more specific products. Among the previous studies that analysed Twitter data to investigate the importance of events and associated sentiment, Thelwall *et al*. (2010) mentioned the need to be cautious when carrying out sentiment analyses on Twitter

because the overall level of sentiment seems to be quite low. Nonetheless, when reporting on facts that generate a surge of tweets, including the launching of new products, the authors considered it reasonable to expect some kind of emotional reaction.

Over a short time, there has been an increase in number of scientific articles that rely on Twitter data. These works investigate platform characteristics (Naaman *et al.*, 2010), reliability, diffusion and newsworthiness of information (Castillo *et al.*, 2011; Lerman and Ghosh, 2010; Desmarchelier and Fang, 2016), market efficiency in terms of incorporating information (Sprenger *et al.*, 2014; Williams and Reade, 2016) and the ability to forecast a specific outcome (Treme and VanDerPloeg, 2014; Tumasjan *et al.*, 2010).

In this framework, corporate reputation concepts can be measured in terms of number of tweets and corresponding sentiment. Starting from the assumptions set out in Table 1, it was possible to translate reputation-type aspects into observable measures linked to the analyses carried out on the Twitter timeline for the selected companies, as shown in Table 2.

Sampling process

The five companies were selected through a purposive sampling process (as defined in Short *et al.*, 2002) to determine whether they satisfied specific requirements. The methodological approach is similar to that presented in the study by Xun and Guo (2017). The aim was to identify a sample of US companies which adopted Bitcoin as a form of online payment in 2013 and 2014. This was achieved by searching through the Google News repository using the keywords “Bitcoin” and “adopt” (or synonyms and derivations such as “adoption” or “acceptance”) and then screening the results manually.

As mentioned, the five companies analysed are all based in the US. The focus on a single market/country provides a coherent framework and reduces any variation in terms of regulations, economic conditions and the kind of Twitter users who potentially interacted with the companies. The US is an ideal choice for this purpose, because of its economic system, access to new technologies and diffusion of Twitter.

Only companies selling online were selected. These companies are particularly suited to the analysis because they expect to receive a relatively high level of attention from social media users and also to engage with them. In addition, internet vendors rely heavily on their reputation (Kim *et al*., 2008; Biswas and Biswas, 2004; Caruana and Ewing, 2010). Lastly, large corporations were excluded (companies such as Microsoft and Dell or listed on Fortune 500) because there would have been far too many tweets too trawl through, estimated in the millions, but only limited sample accuracy. The preliminary analyses on the retrieved news items and tweets have, in fact, indicated the non-negligible presence of false-positive associations (e.g. frequent cases where “Bitcoin” and “Microsoft” appeared in the same news item/tweet, despite being unrelated). As a consequence, the corresponding volume of traffic made it virtually impossible to carry out the manual consistency check during data processing.

The selection process identified five companies which were among the first to introduce the Bitcoin payment channel as part of their online sales process (see Table 3; further details in the appendix: Table 6). The small size of the sample is a clear limitation of the empirical exercise and, in future research, the analysis could be expanded to a larger set of companies in different countries and different sectors. However, the positive aspect of a small sample

is that it gave greater control over the data, as the number of examined records was kept at a level where it was still possible to carry out consistency checks by reading the text fields of the sampled tweets directly, and thereby improve the automated sentiment analysis.

[Table 3 around here]

Two sets of data were collected for each company. These were i) all online news items about the introduction of Bitcoin and ii) all the tweets mentioning the companies. The records in both datasets covered a four-month time frame, centred on the adoption date. The process only covered news items in English and tweets geo-localized in the USA.

The first dataset was created by retrieving news items from agencies, blogs and the aggregators available from the Google News repository and contained communications in which customers were told about the adoption of Bitcoin. The second dataset contained all the single tweets about the companies, which were provided by The Fool S.r.l., a company with expertise in social media analysis. The tweets collected mentioned either the company's account name (e.g. "@intuit", "@overstock", "@overstockCEO", etc.) or a corresponding hashtag (e.g. "#cheapair", "#tigerdirect", "#overstock", etc.). All tweets posted from the companies' official accounts or by executives and managers were excluded.

A second search was carried out on the contents of the tweets, looking for inherent keywords (e.g. "bitcoin", "BTC", "Coinbase", "BitPay", etc.) to extrapolate the tweets discussing Bitcoin technology. A "sentiment analysis" was then run on each tweet.

Sentiment analysis is a consolidated technique in scientific literature, and its application has soared with the diffusion of the internet and social media (among the several reviews and

taxonomies; see Singh and Dubey, 2014; Mäntylä *et al*., 2018). A "sentiment score" was assigned to each tweet, which was elaborated by combining the results of three different tools: MeaningCloud (https://www.meaningcloud.com/), Semantria (https://www.lexalytics.com) and SentiStrength (http://sentistrength.wlv.ac.uk/). Once all the tweets were processed and a sentiment score assigned by each tool, the results were standardized to deal with the different sentiment scales and define a single measure ranging from -1 to +1.

Sentiment analysis is used to process a large amount of data within a reasonable period of time. However, there can be difficulties in how it interprets ironic sentences, jokes, unusual terms or the use of slang (Mostafa, 2013; Bhuta *et al*., 2014). As an additional accuracy control, the sentiment score of a random sample of tweets was checked, which involved reading more than 10,000 tweets (25% of the sample). The positive and neutral sentiment scores were accurate in 97% and 80% of the cases, respectively. Only 1% of the tweets presumed to express a positive or neutral sentiment were marked-up wrongly and were, in fact, negative. The accuracy was slightly lower for the negative tweets (75%) and, since negative tweets were particularly relevant to the analyses, all the negative tweets were controlled and, when necessary, re-marked correctly.

The tweets collected were associated to the dimensions of corporate reputation (Table 2). For example, a tweet such as "Thanks to @Newegg for handling an issue quickly and professionally. Always a pleasure doing business with you :)" will increase Newegg.com's tech-unrelated volume, i.e. the dimension of *Being Known*. The same tweet also expresses a positive tech-unrelated sentiment that contributes to *Generalized Favourability*. The

message “Bitcoin being accepted by online retailers is a huge deal, especially with major retailers like @Overstock. I can't wait to see how this unfolds” is specific to the technology adoption (*Being Known for Something*) and so positively affects both volume (*non-evaluative*) and sentiment (*judgmental*).

The whole process identified a set of 7,766 news items and 43,497 tweets. Table 4 provides some basic statistics on the observations in total and broken down by company.

[Table 4 around here]

The two datasets (news items and tweets) were, lastly, combined and the data grouped into different time frequencies of 6, 12 and 24 hours. It was, therefore, possible to calculate the number of news items and a set of indicators, based on the identified tweets, for each company in any given period. The indicators represent how corporate reputation, as described in the “Research Objectives” section, is expressed operationally. Specifically, they are:

- the number of technology-related tweets (about Bitcoin) defined as tech-related volume; within corporate reputation, it is “*Being Known*” (generalized and non-evaluative);
- the number of other tweets (with no reference to Bitcoin) defined as tech-unrelated volume; within corporate reputation, it is “*Being Known for Something* (non-evaluative)” (particular and non-evaluative);

- the average sentiment score of the Bitcoin-related tweets defined as tech-related sentiment; within corporate reputation, it is "*Being Known for Something* (judgmental)" (particular and judgmental);
- the average sentiment score of all the other tweets defined as tech-unrelated sentiment; within corporate reputation, it is "*Generalized Favourability*" (generalized and judgmental).

The results reported in the next section refer to the analyses carried out with 12-hour data points. The other time frequencies showed coherent patterns and are available on request. Table 5 shows the summary statistics of the examined variables with a 12-hour interval.

[Table 5 around here]

VAR models

A "narrative method" based on a set of vector autoregressive (VAR) models was used to evaluate how adopting the Bitcoin technology - proxied by the number of related news items - impacts on a company's reputation (for a recent overview, see Ramey, 2016; Favero and Giavazzi, 2012). The models account for the linear interdependencies that occur among data series under specific assumptions related to the causal structure of the examined variables (Fernandez-Villaverde *et al*., 2007).

Two types of analyses were conducted. The first was carried out on volume drivers, which are the number of tweets that include the two reputational dimensions of *Being Known for Something (non-evaluative)* and *Being Known*, and the second examined the sentiment score of the tweets, measuring both *Being Known for Something (judgmental)* and

Generalized Favourability. A panel VAR model (Cagala and Glogowsky, 2014) was first applied to the whole sample and the analysis was then repeated on firm-specific subsamples to highlight the presence of different patterns at a company level.

VAR models are commonly applied when there is the need to analyse financial and macroeconomic variables (e.g. Blanchard and Perotti, 2002; Perotti, 2011). The first step of the method involves estimating the coefficients in the VAR model, which can be represented as the linear relation of a set of variables, depending on their value in the past, plus an innovation vector (Lütkepohl, 1991; Hamilton, 1994). In the model specification, rather than relying only on past values in the two "tweet" series, the "news" variable was introduced to improve the estimate of future expectations. The combination of tweet sentiment scoring and VAR models is similar to the method employed by Xun and Guo (2017) to study company financial performance. Here, the investigation relates to the companies included in the panel VAR model specification. The test was performed using the Stata "xtvar" command developed by Cagala and Glogowsky (2014), which applies a least-squares dummy variable estimator (Canova and Ciccarelli, 2013): the model fits a multivariate panel regression for each dependent variable on lags of itself and on lags of all the other dependent variables.

After having estimated the model, the news variable was shocked at equilibrium and the impulse response on corporate reputation drivers was then evaluated. The impact level was assessed stochastically by applying the Monte Carlo simulation algorithm, with 200 repetitions, to the estimated model (Bachmann *et al.*, 2010) and then by plotting the VAR Impulse Response Functions (IRF).

Various lags were used in the tests, but the results reported are those with lag 2, according to the Schwarz Bayesian Information Criterion associated to the VAR models (further information on the estimation of the panel VAR model can be found in Tables 7, 8, 9, 10 and 11 in the Appendix).

Results

The descriptive results in Table 4 show that 2.8% of all tweets expressed a negative sentiment, with small differences across the companies. The largest variations with respect to the sample average refer to TigerDirect (4.1%) and CheapAir.com (0.3%). With respect to the subset of tweets about Bitcoin technology, the share of negative messages was much lower (0.7%).

Concerning the econometric analyses, the IRFs of interest are those where the impulse variable consists of the number of news items. The IRFs resulting from the panel VAR are charted in Figure 1 and were calculated with reference to one-unit shocks. The figure plots the effect of the shock (i.e. the announcement of the adoption of Bitcoin) on the number of news items, and the volume of technology-related and -unrelated tweets, respectively.

[Figure 1 around here]

As expected, any additional news items covering the technology adoption has, on average, a positive effect on the number of Bitcoin tweets for each company. This is particularly true for the first interval after the news is released (first 12 hours). The effect declines progressively and loses significance after three and a half days (that is, at step 7), with a

95% confidence interval. The effect of the news on the number of tech-unrelated tweets is not significant.

The IRFs of the other impulse variables (number of tech-related and tech–unrelated tweets) are given in the Appendix (Figures 3, 4, 5 and 6). It should be noted that the number of tech-related tweets impacts positively on the number of news items from step 1 onwards, while the effect on the number of tech-unrelated tweets is negative, a fact that suggests a substitute relationship (the Twitter discussion on the company's timeline shifts towards the adoption of Bitcoin).

The same approach is replicated for the sentiment analysis and the results are shown in the following charts. The number of news items was normalized between 0 and 1 to improve the readability of the results. Figure 2 plots the effect on the number of news items and on the average sentiment for the technology-related and -unrelated tweets, respectively. Any additional news about the technology adoption has, on average, a positive effect on the average sentiment of Bitcoin tweets at a company level. The effect increases until step 3 after the release of the news (the first 36 hours) and then declines over the following time intervals (although it is possible to see a small but significant positive effect in step 15). The effect of the news on the average sentiment of tech-unrelated tweets is not significant.

The IRFs of the other impulse variables (average sentiment of tech-related and –unrelated tweets) are given in the Appendix; no significant relationship is found.

[Figure 2 around here]

Specific VAR models were tested on each company. The IRFs for volume and sentiment drivers are given in the Appendix. The results show some differences in the level of significance and in the pattern of the IRFs, but they are coherent with the result of the panel VAR, when considering the concept of *Being Known for Something (non-evaluative)* (tech-related volume). One partial exception concerns CheapAir.com, which shows a similar but not significant curve at the 95% confidence interval. *Being Known for Something (judgmental)* shows similar results across the companies, but those for Intuit and TigerDirect are not significant. When the analyses were carried out on one company at a time, the level of significance for the results concerning the tech-unrelated drivers (both *Being Known* and *Generalized Favourability*) was low.

Discussion and Conclusions

Previous works dealing with corporate reputation have focused on understanding the impact of perceived innovativeness on brand-related performance (Kunz et al. 2011). However, no previous study had focused on the role played by a company's decision to adopt a technology as an event that could affect its corporate reputation. The aim of this research was to fill the gap by modelling an empirical experiment based on data collected from Twitter. The social media response experienced by five US-based companies when they introduced the Bitcoin cryptocurrency provided quantitative measures of corporate reputation.

The results show that adopting a Bitcoin payment platform had a positive impact above all on the tech-related aspects of corporate reputation. In particular, as consumers become aware of the news, *Being Known for Something (non-evaluative)* immediately has a high

positive impact, which then decreases until it loses significance after about three and a half days. This kind of behaviour is consistent with the concept underlying the examined dimension of corporate reputation of being event-triggered and circumscribed. *Being Known for Something (judgmental)* is positively affected, with an increasing response function that peaks after 36 hours and then decreases.

The effect on the tech-unrelated drivers is less significant, with only a potential spill-over for *Being Known,* which shows an immediate positive response to the news. Global perception with judgment, that is, *Generalized Favourability,* does not seem to register any significant impact as a result of the event.

The analyses were repeated for each company. Coherent results were observed when looking at the tech-related drivers, while the effects on the tech-unrelated drivers showed low significance and different patterns. These differences call for further investigation because they could depend on sector and company specificities (e.g. size, performance, other events that occurred over the timeline in question).

The results suggest that the volume of messages about technology adoptions does not replace the general traffic on social media about the companies, but adds to it favourably. Although the news and the associated phenomenon on social media have a short lifecycle, the analyses found evidence that adopting a new technology has an immediate positive effect on corporate reputation and contributes to the company's brand image.

These findings have potential managerial implications for other companies similar to those examined in this study. With respect to medium-sized companies introducing a new

technology that will have a direct effect on customers, management can leverage on the undertaking to the benefit of their corporate reputation, gaining a direct response immediately and an indirect contribution in the longer term. The event could be seen as a trigger for gaining short-term momentum, as well as being a driver for the longer-term goal of building a positive reputation. Companies with a positive reputation signal their trustworthiness, thereby reducing transaction costs and customer perceived risk (Walsh et al., 2016). The technology adoption can also help them to raise their brand image in the short term and their brand equity in the mid to long term (Ogba and Tan, 2009). The expected effect is not negligible, since perceptions about a company's reputation for non-financial aspects can create more shareholder value in the longer term than perceptions about previous financial performance (Raithel and Schwaiger, 2015).

Given that it has been demonstrated that sharing news on social media about technology adoptions has an impact on corporate reputation - which is, in turn, an antecedent of brand performance - managing public relations correctly when a new technology is introduced onto the market is a fundamental brand building activity. A proactive approach to online brand management is, thus, recommended (Cooper et al., 2019). Although literature shows that the long-term effects of adopting a new technology on reputation are caused by changes to the outcome of products or services that arise from the new technology (e.g. Son and Han, 2011; Wu *et al.*, 2013), this study highlights that there is also an immediate effect that is driven by news of an event/undertaking.

The identified dynamics can interest both brand management literature and also corporate communication studies (e.g. Ageeva *et al.*, 2018; Dijkmans *et al.*, 2015), which deal with

learning about the timing of technology adoption announcements and that of possible communication follow-ups.

The analyses on the selected sample confirm that perceived innovativeness can increase customer engagement (Henard and Dacin, 2010) and suggest that reputational dimensions follow distinct patterns. The impact of the news about a technology adoption on the particular dimension of reputation is higher than its effect on general aspects. The findings suggest a potential dichotomy between the customers' perception of innovation, at a company level (i.e. stand alone, made before a specific product/service evaluation) and at a product level (i.e. derived from the specific evaluation of a product/service) (e.g. Cavazos and Rutherford, 2015).

Previous literature indicates that product/service innovation can introduce paradoxes and ambiguity with regards as to how the brand is perceived (e.g. Johnson *et al*., 2008; Parker and Krause, 2018), caused by, for instance, a certain level of performance ambivalence induced by novelty. This stream of literature has mainly analysed the "encounter" between customers/consumers and new technology, i.e. product-level perception. Interestingly, other literature has shown that perceived innovativeness (at a corporate level) has a positive impact on both product-level and corporate-level brand performance (Kunz *et al*., 2011). The results of the present study support the latter view, although they do not encompass the customers' actual "encounter" with technology. It should be noted that recent studies (e.g. Pappu and Quester, 2016) put forward the view that actual positive perceived quality, i.e. product-level performance, is a mediator between perceived brand innovativeness and brand loyalty.

This study suffers from some limitations that could be addressed in future research. Other studies could expand the scope and robustness of the analyses and consider a larger number of companies, other technologies and different types of corporate news. They could also introduce a larger data set that could focus on longer time windows. It would also be useful to examine a wider set of sentiment tools, including any new and more advanced instruments, as this exercise should result in the sentiment scores being more accurate.

References

Agarwal, J., Stackhouse, M. and Osiyevskyy, O. (2018), "I Love That Company: Look How Ethical, Prominent, and Efficacious It Is—A Triadic Organizational Reputation (TOR) Scale", *Journal of Business Ethics*, Vol. 153 No. 3, pp. 889-910.

Ageeva, E., Melewar, T. C., Foroudi, P., Dennis, C. and Jin, Z. (2018), "Examining the influence of corporate website favorability on corporate image and corporate reputation: Findings from fsQCA", *Journal of Business Research*, Vol. 89, pp. 287-304.

Ahuja, G. and Katila R. (2001), "Technological Acquisitions and the Innovation Performance of Acquiring Firms: A Longitudinal Study", *Strategic Management Journal*, Vol. 22 No. 3, pp. 197-220.

Ayers, D. J., Menachemi, N., Ramamonjiarivelo, Z., Matthews, M. and Brooks, R. G. (2009), "Adoption of electronic medical records: the role of network effects", *Journal of Product & Brand Management*, Vol. 18 No. 2, pp. 127-135.

Bachmann, R., Elstner, S. and Sims, E.R. (2010), "Uncertainty and Economic Activity". *NBER Working Paper 16143*, Cambridge, MA: National Bureau of Economic Research. Available at http://www.nber.org/papers/w16143.

Barnett, M. L. and Pollock, T. G. (2012), *The Oxford handbook of corporate reputation*. Oxford University Press.

Barnett, M. L., Jermier, J. M. and Lafferty, B. A. (2006), "Corporate Reputation: The Definitional Landscape", *Corporate Reputation Review*, Vol. 9 No. 1, pp. 26-38.

Basdeo, D. K., Smith, K. G., Grimm, C. M., Rindova, V. P. and Derfus, P. J. (2006), "The impact of market actions on firm reputation", *Strategic Management Journal*, Vol. 27, pp. 1205-1219.

Benjamin, B. A. and Podolny, J. M. (1999), "Status, Quality, and Social Order in the California Wine Industry", *Administrative Science Quarterly*, Vol. 44 No. 3, pp. 563-589.

Bhuta, S., Doshi, A., Doshi, U. and Narvekar, M. (2014), "A review of techniques for sentiment analysis Of Twitter data". *2014 International Conference on Issues and Challenges in Intelligent Computing Techniques (ICICT),* pp. 583-591. IEEE.

Biswas, D. and A. Biswas (2004), "The diagnostic role of signals in the context of perceived risks in online shopping do signals matter more on the web?", *Journal of Interactive Marketing*, Vol. 18, pp. 30–45.

Blanchard, O. and Perotti, R. (2002), "An Empirical Characterization of the Dynamic Effects of Changes in Government Spending and Taxes on Output", *NBER Working Paper 7269,*

Cambridge, MA: National Bureau of Economic Research. Available at http://www.nber.org/papers/w7269.

Blevins, D.P. and Ragozzino, R. (2019), "On social media and the formation of organizational reputation: How social media are increasing cohesion between organizational reputation and traditional media for stakeholders", *Academy of Management Review*, Vol. 44, No. 1, pp. 219-222.

Boukis, A. (2019), "Exploring the implications of blockchain technology for brand–consumer relationships: a future research agenda", *Journal of Product & Brand Management*.

Brexendorf, T. O. and Keller, K. L. (2017), "Leveraging the corporate brand: the importance of corporate brand innovativeness and brand architecture", *European Journal of Marketing*, Vol. 51, No. 9/10, pp. 1530-1551.

Brown, M. and Turner, P. (2012), "Innovation and Corporate Reputation: Britain's Most Admired Company Surveys 1999-2009". In Nobre, F. S., Walker, D. and Harris R.J. (Ed.), *Technological, Managerial and Organizational Core Competencies: Dynamic Innovation and Sustainable Development*, Hershey, PA: Business Science Reference, pp. 264-277.

Burke, P. F., Dowling, G. and Wei, E. (2018), "The relative impact of corporate reputation on consumer choice: beyond a halo effect", *Journal of Marketing Management*, Vol. 34 No. 13-14, pp. 1227-1257.

Burrows, S., Jaskiewicz, P. and Deephouse, D. (2018), "The Stakeholder Identification Handcuff: The Case of Anheuser-Busch", In *Academy of Management Proceedings.* Vol. 2018, No. 1, p. 12656, Briarcliff Manor, NY 10510: Academy of Management.

Cable, D. M. and Graham, M. E. (2000), "The Determinants of Job Seekers' Reputation Perceptions", *Journal of Organizational Behavior*, Vol. 21 No. 8, pp. 929-947.

Cagala, T. and Glogowsky, U. (2014), "Panel vector autoregressions for Stata (xtvar)", Software package available at https://EconPapers.repec.org/RePEc:boc:bocode:s457944.

Canova, F. and Ciccarelli, M. (2013), "Panel Vector Autoregressive Models: A Survey". *European Central Bank, Working Paper Series NO 1507* / January 2013, ISSN 1725-2806.

Carter, S. M. (2006), "The interaction of top management group, stakeholder, and situational factors on certain corporate reputation management activities", *Journal of Management Studies*, Vol. 43 No. 5, pp. 1145-1176.

Caruana, A. and Chircop, S. (2000), "Measuring corporate reputation: a case example", Corporate Reputation Review, Vol. 3 No. 1, pp. 43–57.

Caruana, A. and M. T. Ewing (2010), "How corporate reputation, quality, and value influence online loyalty", *Journal of Business Research*, 63, pp. 1103–1110.

Castillo, C., Mendoza, M. and Poblete, B. (2011), "Information credibility on twitter", in *Proceedings of the 20th international conference on World wide web*, pp. 675–684. ACM.

Cavazos, D. E. and Rutherford, M. A. (2015), "Examining How Product and Corporate Reputation Impacts Political Responses to Product Ratings", in *Academy of Management Proceedings,* Vol. 2015, No. 1, p. 10771, Briarcliff Manor, NY 10510: Academy of Management.

Clayton T. and Turner G. (2000), "Brands, Innovation and Growth: The Role of Brands in Innovation and Growth for Consumer Businesses", In Tidd, J. (Ed.) *From knowledge management to strategic competence: measuring technological, market and organizational innovation*, pp. 77-93, London, UK: Imperial College Press.

Comyns, B. and Franklin-Johnson, E. (2018), "Corporate reputation and collective crises: A theoretical development using the case of Rana Plaza", *Journal of Business Ethics*, Vol. 150 No. 1, pp. 159-183.

Cooper, T., Stavros, C. and Dobele, A. R. (2019), "Domains of influence: exploring negative sentiment in social media", *Journal of Product & Brand Management*.

Crespo, C. F. and Inacio, N. (2018), "The influence of corporate social responsibility associations on consumers' perceptions towards global brands*", Journal of Strategic Marketing*, pp. 1-17.

Cretu, A. E. and Brodie, R. J. (2007), "The influence of brand image and company reputation where manufacturers market to small firms: A customer value perspective", *Industrial marketing management*, Vol. 36 No. 2, pp. 230-240.

Datta, H., Ailawadi, K. L. and van Heerde, H. J. (2017), "How well does consumer-based brand equity align with sales-based brand equity and marketing-mix response?", *Journal of Marketing*, Vol. 81 No. 3, pp. 1-20.

Davcik, N. S., Vinhas da Silva, R. and Hair, J. F. (2015), "Towards a unified theory of brand equity: conceptualizations, taxonomy and avenues for future research", *Journal of Product & Brand Management*, Vol. 24, No. 1, pp. 3-17.

Deephouse, D. L. (2000), "Media Reputation as a Strategic Resource: An Integration of Mass Communication and Resource-Based Theories", *Journal of Management*, Vol. 26 No. 6, pp. 1091-1112.

Desmarchelier, B. and Fang, E. S. (2016), "Social Media and the Diffusion of Information: A Computational Experiment on the Emergence of Food Scares", *Kyklos*, Vol. 69, pp. 559–583.

Dijkmans, C., Kerkhof, P., Buyukcan-Tetik, A. and Beukeboom, C. J. (2015), "Online conversation and corporate reputation: A two-wave longitudinal study on the effects of exposure to the social media activities of a highly interactive company", *Journal of Computer-Mediated Communication*, Vol. 20 No. 6, pp. 632-648.

Dowling, G. R. (2016), "Defining and measuring corporate reputations", *European Management Review*, Vol. 13, No. 3, p. 207-223.

Einwiller, S. A., Carroll, C. E. and Korn, K. (2010), "Under what conditions do the news media influence corporate reputation? The roles of media dependency and need for orientation", *Corporate Reputation Review*, Vol. 12 No. 4, pp. 299-315.

Etter, M., Ravasi, D. and Colleoni, E. (2019), "Social Media and the Formation of Organizational Reputation", *Academy of Management Review*, Vol. 44, No. 1, pp. 28-52.

Favero, C. and Giavazzi, F. (2012), "Measuring Tax Multipliers. The Narrative Method in Fiscal VARs", *American Economic Journal: Economic Policy*, Vol. 4 No. 2, pp. 69-94.

Fernandez-Villaverde, J., Rubio-Ramirez, J. F., Sargent, T. J. and Watson M. W. (2007), "ABCs (and Ds) of Understanding VARs", *American Economic Review*, Vol. 97 No. 3, pp. 1021-1026.

Fleming, D. E., Artis, A. B., Harris, E. G. and Solomon, P. J. (2018), "The impact of perceived corporate affinity for technology on service outcomes: a signaling theory perspective", *Journal of Marketing Theory and Practice*, Vol. 26 No. 3, pp. 230-245.

Fombrun C.J. and Shanley M. (1990), "What's in a name? Reputation building and corporate strategy", *Academy of Management Journal,* Vol. 33 No. 2, pp. 233–258.

Fombrun, C.J. (1996), *Reputation: Realizing Value from the Corporate Image*, Harvard Business School Press, Boston.

Fombrun, C. and Van Riel, C.,(1997), "The Reputational Landscape", *Corporate Reputation Review*, Vol. 1 No. 1-2, pp. 5-13.

Fombrun, C. J., Gardberg, N. A. and Sever, J. M. (2000), "The Reputation Quotient SM: A multi-stakeholder measure of corporate reputation", *Journal of brand management*, Vol. 7 No. 4, pp. 241-255.

Fombrun, C. J., Ponzi, L. J. and Newburry, W. (2015), "Stakeholder tracking and analysis: The RepTrak® system for measuring corporate reputation", *Corporate Reputation Review*, Vol. 18 No. 1, pp. 3-24.

Gatzert, N. (2015), "The impact of corporate reputation and reputation damaging events on financial performance: Empirical evidence from the literature", *European Management Journal*, Vol. 33 No. 6, pp. 485-499.

Gotsi, M. and Wilson, A. M. (2001), "Corporate reputation: seeking a definition", *Corporate communications: An international journal*, Vol. 6 No. 1, pp. 24-30.

Gray, E. R. and Balmer, J. M. (1998), "Managing corporate image and corporate reputation", *Long range planning*, Vol. 31 No. 5, pp. 695-702.

Grigoriou, K. and Rothaermel, F. T. (2017), "Organizing for knowledge generation: Internal knowledge networks and the contingent effect of external knowledge sourcing", *Strategic Management Journal*, Vol. 38, No. 2, pp. 395-414.

Gürhan-Canli, Z., Sarial-Abi, G. and Hayran, C. (2018), "Consumers and brands across the globe: research synthesis and new directions", *Journal of International Marketing*, Vol. 26 No. 1, pp. 96-117.

Hajli, N. and Sims, J., (2015), "Social commerce: The transfer of power from sellers to buyers", *Technological Forecasting and Social Change*, Vol. 94, pp. 350-358.

He, W., Wang, F. K., Chen, Y. and Zha, S. (2017), "An exploratory investigation of social media adoption by small businesses", *Information Technology and Management*, Vol. 18 No. 2, pp. 149-160.

Heinberg, M., Ozkaya, H. E. and Taube, M. (2018), "Do corporate image and reputation drive brand equity in India and China? Similarities and differences", *Journal of Business Research*, Vol. 86, pp. 259-268.

Henard, D. H. and Dacin, P. A. (2010), "Reputation for product innovation: Its impact on consumers", *Journal of Product Innovation Management*, Vol. 27 No. 3, pp. 321-335.

Hou, Y., Velthof, G. L., Case, S. D. C., Oelofse, M., Grignani, C., Balsari, P. ... and Trindade, H. (2018), "Stakeholder perceptions of manure treatment technologies in Denmark, Italy, the Netherlands and Spain", *Journal of cleaner production*, Vol. 172, pp. 1620-1630.

Hughes, A., Park, A., Kietzmann, J. and Archer-Brown, C. (2019), "Beyond Bitcoin: What blockchain and distributed ledger technologies mean for firms", *Business Horizons*, Vol. 62 No. 3, pp. 273-281.

Hur, W. M., Kim, H. and Woo, J. (2014), "How CSR leads to corporate brand equity: Mediating mechanisms of corporate brand credibility and reputation", *Journal of Business Ethics*, Vol. 125 No. 1, pp. 75-86.

Jansen, B.J., Zhang, M., Sobel, K. and Chowdury, A. (2009), "Twitter Power: Tweets as Electronic Word of Mouth", *Journal of the Association for Information Science and Technology*, Vol. 60 No. 11, pp. 2169-2188.

Jensen, R. W., Limbu, Y. B. and Spong, Y. (2015), "Visual analytics of Twitter conversations about corporate sponsors of FC Barcelona and Juventus at the 2015 UEFA final", *International Journal of Sports Marketing and Sponsorship*, Vol. 16 No. 4, pp. 3-9.

Johnson, D. S., Bardhi, F. and Dunn, D. T. (2008), "Understanding how technology paradoxes affect customer satisfaction with self-service technology: The role of performance ambiguity and trust in technology", *Psychology and Marketing*, Vol. 25 No. 5, pp. 416-443.

Kaplan, A. M. and Haenlein, M. (2010), "Users of the world, unite! The challenges and opportunities of Social Media", *Business horizons*, Vol. 53 No. 1, pp. 59-68.

Kayaman, R. and Arasli, H. (2007), "Customer based brand equity: evidence from the hotel industry", *Managing Service Quality: An International Journal*, Vol. 17 No. 1, pp. 92-109.

Kim, D. J., Ferrin, D. L. and Rao, H. R. (2008), "A trust-based consumer decision-making model in electronic commerce: the role of trust, perceived risk, and their antecedents", *Decision Support Systems*, Vol. 44, pp. 544–564.

Kim, W. H. and Chae, B. (2018), "Understanding the relationship among resources, social media use and hotel performance: The case of Twitter use by hotels", *International Journal of Contemporary Hospitality Management*, Vol. 30 No. 9, pp. 2888-2907.

King, R. A., Racherla, P. and Bush, V. D. (2014), "What we know and don't know about online word-of-mouth: A review and synthesis of the literature", *Journal of interactive marketing*, Vol. 28 No. 3, pp. 167-183.

Kiousis, S., Popescu, C. and Mitrook, M. (2007), "Understanding influence on corporate reputation: An examination of public relations efforts, media coverage, public opinion, and financial performance from an agenda-building and agenda-setting perspective", *Journal of Public Relations Research*, Vol. 19 No. 2, pp. 147-165.

Kunz, W., Schmitt, B. and Meyer, A. (2011), "How does perceived firm innovativeness affect the consumer?", *Journal of Business Research*, Vol. 64 No. 8, pp. 816-822.

Lange, D., Lee, P.M. and Ye, D. (2011), "Organizational Reputation: A Review", *Journal of Management*, Vol. 37 No. 1, pp. 153-184.

Lerman, K. and Ghosh, R. (2010), "Information Contagion: An Empirical Study of the Spread of News on Digg and Twitter Social Networks", in *Proceedings of the Fourth International AAAI Conference on Weblogs and Social Media*, pp. 90–97

Lütkepohl, H. (1991) "Periodic VAR Processes and Intervention Models", in *Introduction to Multiple Time Series Analysis,* Springer, Berlin, pp. 391-414.

Mäntylä, M. V., Graziotin, D. and Kuutila, M. (2018), "The evolution of sentiment analysis—A review of research topics, venues, and top cited papers", *Computer Science Review*, Vol. 27, pp. 16-32.

Meuter, M. L., Ostrom, A. L., Roundtree, R. I. and Bitner, M. J. (2000), "Self-service technologies: understanding customer satisfaction with technology-based service encounters", *Journal of marketing*, Vol. 64 No. 3, pp. 50-64.

Montalvo, R. E. (2011), "Social Media Management*", International Journal of Management and Information Systems*, Vol. 15 No. 3, pp. 91-96.

Mostafa, M. M. (2013), "More than words: Social networks' text mining for consumer brand sentiments", *Expert Systems with Applications*, Vol. 40 No. 10, pp. 4241-4251.

Morkunas, V. J., Paschen, J. and Boon, E. (2019), "How blockchain technologies impact your business model", *Business Horizons*, Vol. 62 No. 3, pp. 295-306.

Naaman, M., Boase, J. and Lai, C.H. (2010), "Is it really about me? Message content in social awareness streams", in *2010 ACM Conference on Computer Supported Cooperative Work, New York*, pp. 189–192.

Ogba, I. E. and Tan, Z. (2009), "Exploring the impact of brand image on customer loyalty and commitment in China", *Journal of Technology Management in China*, Vol. 4 No. 2, pp. 132-144.

Padgett, R.C. and Moura-Leite, R.C. (2012), "The impact of R&D intensity on corporate reputation: Interaction effect of innovation with high social benefits", *Intangible Capital*, Vol. 8 No. 2, pp. 216-238.

Pappu, R. and Quester, P. G. (2016), "How does brand innovativeness affect brand loyalty?", *European Journal of Marketing*, Vol. 50 No. 1/2, pp. 2-28.

Parker, O. N. and Krause, R. A. (2018), "How Product Quality and Affinity toward the Firm Influence Reputation for Quality", in *Academy of Management Proceedings*, Vol. 2018, No. 1, p. 11021, Briarcliff Manor, NY 10510: Academy of Management.

Pedeliento, G. and Kavaratzis, M. (2019), "Bridging the gap between culture, identity and image: a structurationist conceptualization of place brands and place branding", *Journal of Product & Brand Management*, Vol. 28, No. 3, pp. 348-363.

Perotti, R. (2011), "The Effects of Tax Shocks on Output: Not So Large, But Not Small Either", *American Economic Journal: Economic Policy,* 2012, Vol. 4 No. 2, pp. 214-237.

Peters, K., Chen, Y., Kaplan, A. M., Ognibeni, B. and Pauwels, K. (2013), "Social media metrics—A framework and guidelines for managing social media", *Journal of interactive marketing*, Vol. 27 No. 4, pp. 281-298.

Ponzi, L. J., Fombrun, C. J. and Gardberg, N. A. (2011), "RepTrak™ pulse: Conceptualizing and validating a short-form measure of corporate reputation", *Corporate Reputation Review*, Vol. 14 No. 1, pp. 15-35.

Raithel, S. and Schwaiger, M. (2015), "The effects of corporate reputation perceptions of the general public on shareholder value", *Strategic Management Journal*, Vol. 36, pp. 945–956.

Ramey, V. (2016), "Macroeconomic Shocks and Their Propagation*", NBER Working Paper No. 21978*, February 2016.

Ravasi, D., Rindova, V., Etter, M. and Cornelissen, J. (2018), "The formation of organizational reputation", *Academy of Management Annals*, Vol. 12, No. 2, pp. 574-599.

Rindova, V. P., Pollock, T. G. and Hayward, M. L. A. (2006), "Celebrity Firms: The Social Construction of Market Popularity", *The Academy of Management Review*, Vol. 31 No. 1, pp. 50-71.

Rubera, G. and Kirca, A.H. (2017), "You gotta serve somebody: the effects of firm innovation on customer satisfaction and firm value", *Journal of the Academy of Marketing Science*, Vol. 45 No. 5, pp. 741-761.

Safon, V. (2009), "The moderating effect of the technological level of industry on the relationship between innovation and corporate reputation", *International Entrepreneurship and Management Journal*, Vol. 5 No. 4, pp. 515-526.

Short, J.C., Ketchen, D. J. and Palmer, T.B. (2002), "The role of sampling in strategic management. Research on performance: A two-study analysis", *Journal of Management*, Vol.28 No. 3, pp. 363–385.

Singh, V. and Dubey, S. K. (2014), "Opinion mining and analysis: A literature review", in *2014 5th International Conference-Confluence The Next Generation Information Technology Summit (Confluence)*, pp. 232-239, IEEE.

Son, M. and Han, K. (2011), "Beyond the technology adoption: Technology readiness effects on post-adoption behavior", *Journal of Business Research*, Vol. 64 No. 11, pp. 1178-1182.

Sprenger, T. O., Sandner, P. G., Tumasjan, A., and Welpe, I. M. (2014), "News or Noise? Using Twitter to Identify and Understand Company-specific News Flow", *Journal of Business Finance and Accounting*, *Vol.* 41 No. 7-8, pp. 791–830.

Thelwall, M., Buckley, K. and Paltoglou, G. (2010), "Sentiment in Twitter Events*", Journal of the American Society for Information Science and Technology*, Vol. 62 No. 2, pp. 406-418.

Treme, J. and VanDerPloeg, Z. (2014), "The Twitter Effect: Social Media Usage as a Contributor to Movie Success", *Economics Bulletin,* Vol. 34 No. 2, pp. 793–809.

Trotta, A. and Cavallaro, G. (2012), "Measuring corporate reputation: A framework for Italian banks", *International Journal of Economics and Finance Studies*, Vol. 4 No. 1, pp. 21-30.

Tsytsarau, M., Palpanas, T. and Castellanos, M. (2014), "Dynamics of News Event and Social Media Reaction", *Proceedings of the 20th ACM SIGKDD International Conference on Knowledge Discovery and Data Mining*, pp. 901-910.

Tumasjan, A., Sprenger, T. O., Sandner, P. G. and Welpe, I.M. (2010), "Election forecasts with twitter: How 140 characters reflect the political landscape", *Social science computer review*, Vol. 29 No. 4, pp. 402-418.

Tuškej, U. and Podnar, K. (2018), "Consumers' identification with corporate brands: Brand prestige, anthropomorphism and engagement in social media", *Journal of Product & Brand Management*, Vol. 27, No. 1, pp. 3-17.

Walker, K. (2010), "A systematic review of the corporate reputation literature: Definition, measurement, and theory", *Corporate reputation review*, Vol. 12, No. 4, p. 357-387.

Walsh, G., Albrecht, A. K., Kunz, W. and Hofacker, C. F. (2016), "Relationship between Online Retailers' Reputation and Product Returns", *British Journal of Management*, Vol. 27, pp. 3–20.

Williams, L.V. and Reade, J.J. (2016), "Prediction Markets, Social Media and Information Efficiency", *Kyklos*, Vol. 69, pp. 518–556.

Xun, J. and Guo, B. (2017), "Twitter as customer's eWOM: an empirical study on their impact on firm financial performance", *Internet Research*, Vol. 27 No. 5, pp. 1014-1038.

Yen, H. R. (2005), "An attribute-based model of quality satisfaction for internet self-service technology", *The Service Industries Journal*, Vol. 25 No. 5, pp. 641-659.

Yu, Y., Duan, W. and Cao, Q. (2013), "The impact of social and conventional media on firm equity value: A sentiment analysis approach", *Decision Support Systems*, Vol. 55 No. 4, pp. 919-926.

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Figure 1 IRFs resulting from panel VAR where the impulse is the number of Bitcoin news. Clockwise from top left: effect on the number of news, on the number of tech-related tweets and on the number of tech-unrelated tweets. Red and green lines represent the 95% lower and upper bounds of percentile confidence interval, respectively.

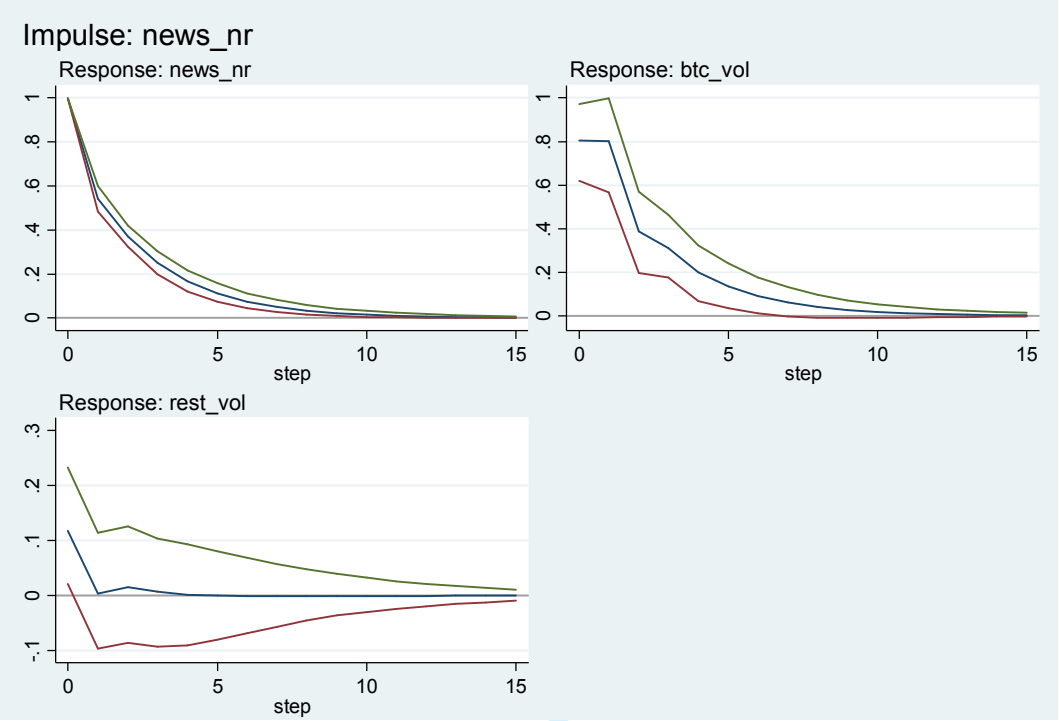


Figure 2 IRFs resulting from panel VAR where the impulse is the number of Bitcoin news. Clockwise from top left: effect on the number of news, on the average sentiment of tech-related tweets and of tech-unrelated tweets. Red and green lines represent the 95% lower and upper bounds of percentile confidence interval, respectively.

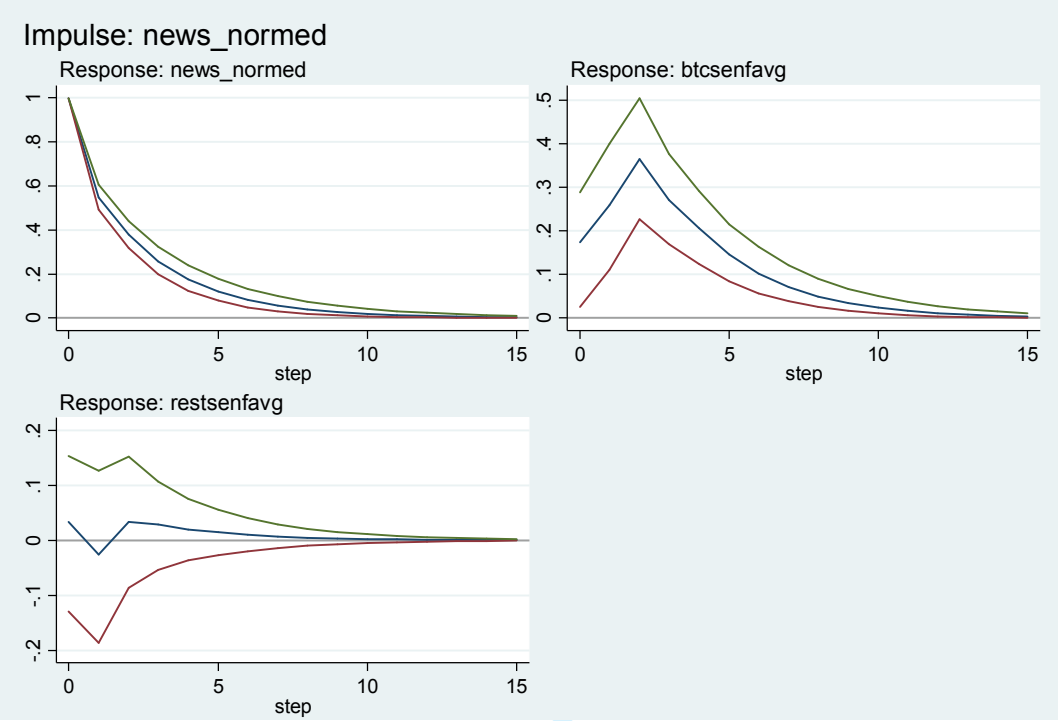


Figure 3 IRFs estimated from the panel VAR where the impulse is the number of tech-related tweets. Clockwise from top left: effect on the number of news, on the number of tech-related tweets and on the number of tech-unrelated tweets. Red and green lines represent the 95% lower and upper bounds of percentile confidence interval, respectively.

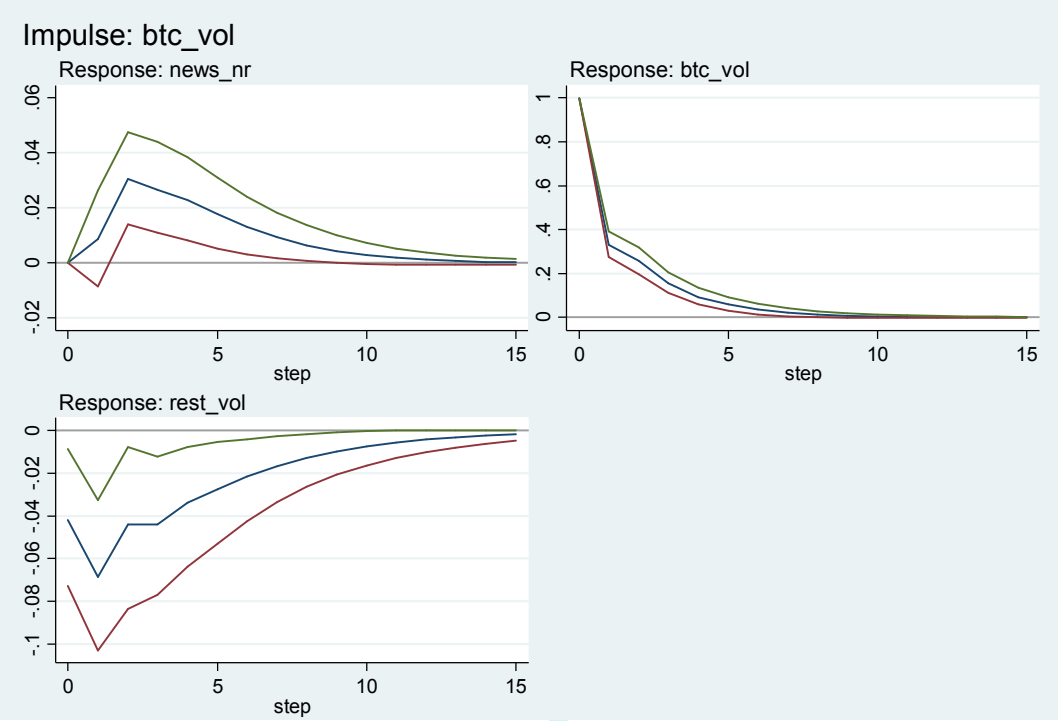


Figure 4 IRFs estimated from the panel VAR where the impulse is the number of tech-related tweets. Clockwise from top left: effect on the number of news, on the number of tech-related tweets and on the number of tech-unrelated tweets. Red and green lines represent the 95% lower and upper bounds of percentile confidence interval, respectively.

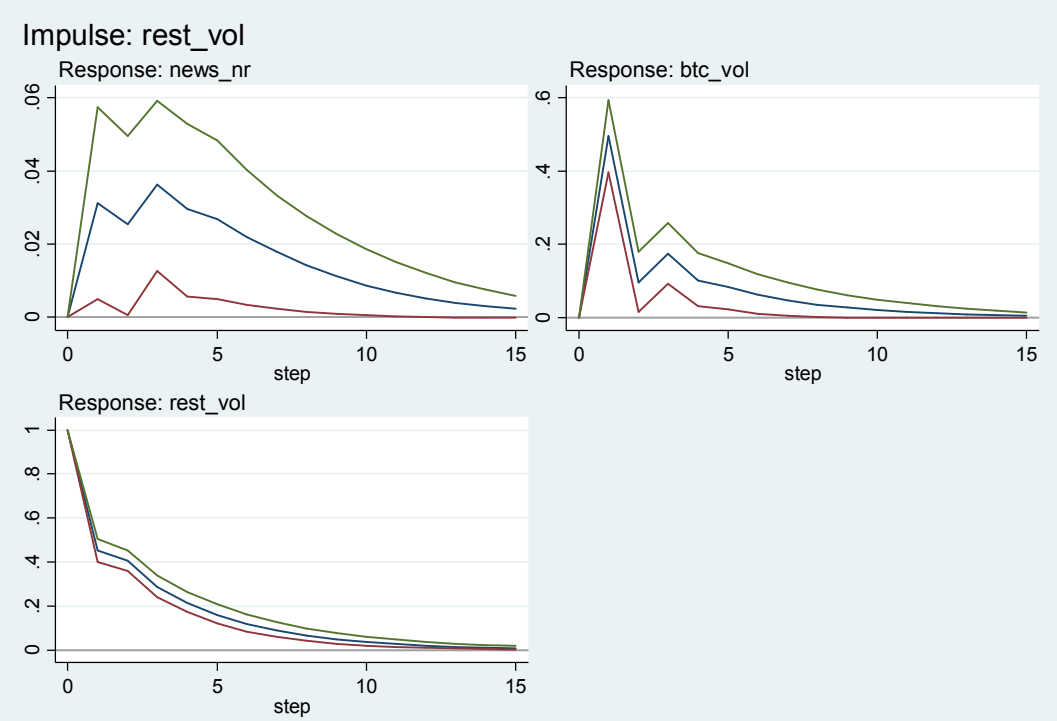


Figure 5 IRFs estimated from the panel VAR on sentiment drivers where the impulse is the average sentiment of tech-related tweets. Clockwise from top left: effect on the number of news, on the average sentiment of tech-related tweets and of tech-unrelated tweets. Red and green lines represent the 95% lower and upper bounds of percentile confidence interval, respectively.

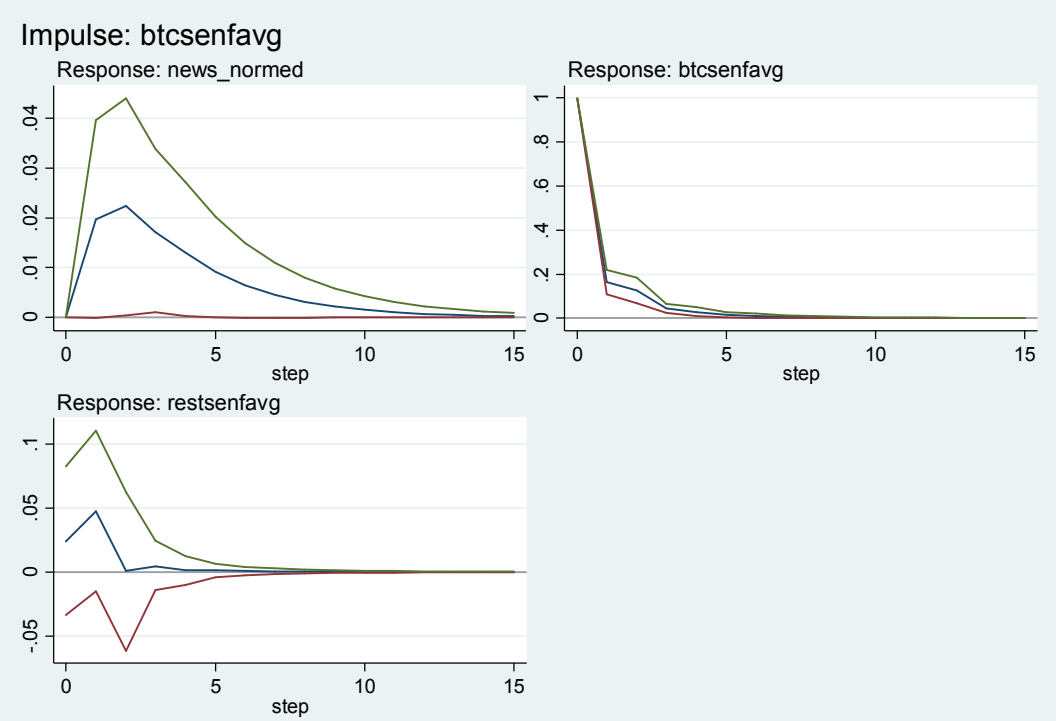


Figure 6 IRFs estimated from the panel VAR on sentiment drivers where the impulse is the average sentiment of tech-related tweets. Clockwise from top left: effect on the number of news, on the average sentiment of tech-related tweets and of tech-unrelated tweets. Red and green lines represent the 95% lower and upper bounds of percentile confidence interval, respectively.

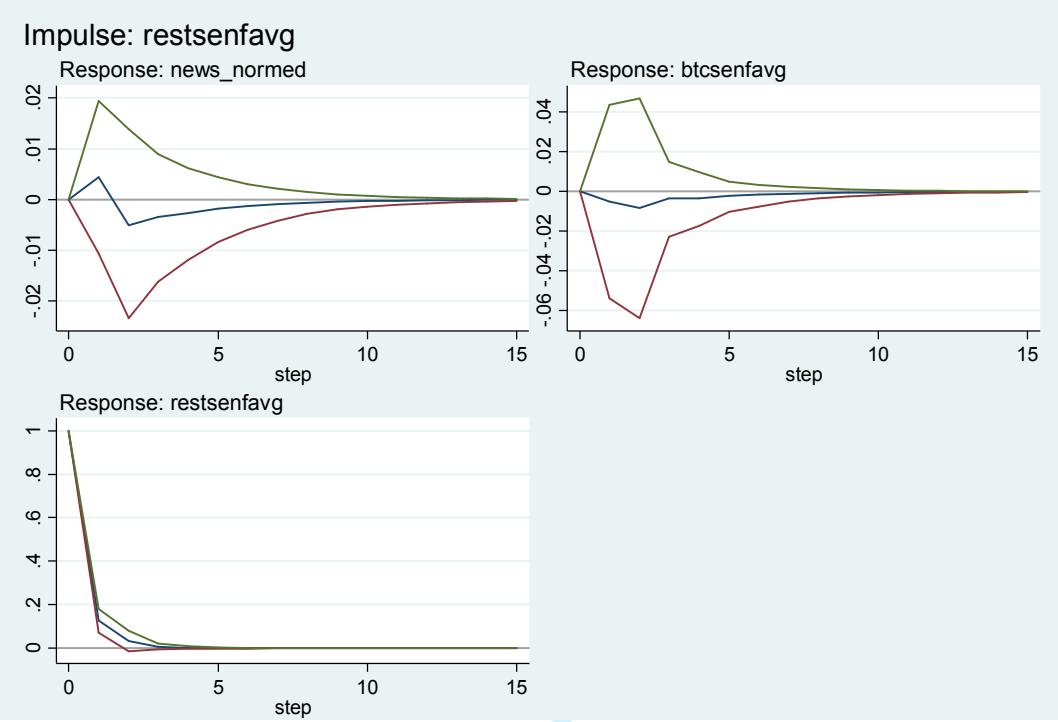


Table 1 Distinguishing among the three dimensions of corporate reputation (source: Lange et al., 2011)

Parameters	Conceptualizations of corporate reputation		
	Being known	Being known for something	Generalized favorability
Particular vs. Generalized	Generalized	Particular	Generalized
Judgment vs non evaluative	Non-evaluative	Judgment	Judgment

Table 2 Corporate reputation conceptualizations and operationalized drivers in Twitter

Conceptualizations	Parameters		Driver (Tweets)
	Particular vs. Generalized	Judgment vs. Non-evaluative	
Being known	Generalized	Non-evaluative	tech-unrelated volume
Generalized favorability	Generalized	Judgment	tech-unrelated sentiment
Being known for something (non-evaluative)	Particular	Non-evaluative	tech-related volume
Being known for something (judgment)	Particular	Judgment	tech-related sentiment

Table 3 Selected companies, main information

Company	Industry	Founded	Turnover (billions USD)	Employees	Bitcoin adoption date	Bitcoin Provider
CheapAir.com	Travel agency	1989	Not available	90	22/11/2013	Coinbase
Intuit	IT services	1983	4.2 (2013)	8,200	25/06/2014	Coinbase
Newegg.com	Retailing (Electronics)	2001	2.7 (2013)	2,600	01/07/2014	BitPay
Overstock.com	Retailing (General)	1997	1.5 (2014)	1,500	09/01/2014	Coinbase
TigerDirect	Retailing (Electronics)	1987	Not available	Not available	23/01/2014	BitPay

Table 4 Number of news and tweets, percentage of tweets by sentiment (positive, neutral, negative) and about Bitcoin on total tweets. Values provided by company and as total

Company	News	Total Tweets	Positive tweets	Neutral tweets	Negative tweets	Tweets About Bitcoin Perc. on Tot. tweets
CheapAir.com	271	1,773	20.6%	79.1%	0.3%	19.5%
Intuit	225	6,523	18.8%	78.4%	2.8%	3.2%
Newegg.com	584	20,036	17.0%	80.2%	2.8%	18.0%
Overstock.com	6,087	9,602	11.2%	86.5%	2.3%	50.5%
TigerDirect	599	6,013	9.7%	86.2%	4.1%	40.7%
TOTAL	7,766	43,947	15.1%	82.1%	2.8%	26.1%

Table 5 Summary statistics of the variables employed in the econometric analyses, when aggregation frequency is 12 hours

Variable	Description	Obs.	Mean	Std. Dev.	Min	Max
$btc\_vol_{i,t}$	Number of tweets related to the technology (Bitcoin) for firm *i* at time *t*	1,310	8.754	54.988	0	895
$rest\_vol_{,t}$	Number of tweets un-related to technology for firm *i* at time *t*	1,310	24.782	40.399	0	483
$news\_nr_{,t}$	Number of news related to technology (Bitcoin) for firm *i* at time *t*	1,310	5.928	19.548	0	222
$btcsenfavg_{,t}$	Average sentiment score of the tweets related to the technology (Bitcoin) for firm *i* at time *t*	1,310	0.056	0.185	-1	1
$Restsenfavg_{,t}$	Average sentiment score of the tweets un-related to the technology for firm *i* at time *t*	1,310	0.105	0.184	-0.66	1

Table 6 Selected companies, main information

Company	Founded
CheapAir.com	Californian online travel agency founded in 1989. A proprietary algorithmic engine provides the cheapest travel solution available online. CheapAir's online service offers a search interface that makes also possible to purchase flights and accommodation. On November 22nd, 2013, CheapAir announced to be the first travel agency in the world to accept Bitcoin. In 2014, the company announced to have surpassed $1.5 million sales in bitcoin.
Intuit	Californian software company founded in 1983. Intuit provides financial software for corporate accounting, income tax preparation, personal finance and expense tracking. Intuit services have reached more than 45 million customers, with an annual turnover exceeding $4 billion. The company is publicly traded on the NASDAQ Stock Market (INTU). On June 25th, 2013, the company integrated bitcoin payments into one of its main accounting software (QuickBooks): since then merchants can convert and receive payments in bitcoin.
Newegg.com	Newegg Inc. is a Californian leading online retailer, founded in 2001. The typical products sold in Newegg's website are computer hardware, software, peripherals, gaming and mass electronics. On June 1st, 2014, Newegg announced to have integrated Bitcoin as a form of payment, in response to the increasing demand from customers.
Overstock.com	Overstock is a publicly listed company on NASDAQ. Overstock was launched in 1999, quickly becoming an online market leader in the e-commerce space, counting over one million products in its catalogue, with product categories varying from home accessories to furniture, health & beauty, electronics and garden tools. The company started accepting bitcoin on January 9th, 2014. In August 2014, the CEO declared that about 0,25% Overstock's sales were in bitcoins.
TigerDirect	TigerDirect was founded in 1987. It started as a software developer then turned to online retailer of electronics, computer hardware and software. The company was acquired in 2015, closed the online sales but the website was relaunched in 2016. TigerDirect announced the bitcoin adoption during the end of January 2014, together with a tutorial about the cryptocurrency and some incentives for GPU card buyers in order to start mining bitcoins with their own devices. Bitcoin transactions were limited to online purchases and not accepted inside the physical stores. 18 months later, TigerDirect reported that orders purchased with bitcoins were 30% larger than the expected order value.

Table 7 Results of the panel VAR model concerning volumes

Equation	Parms	RMSE	R-sq	F	P > F
News	11	13.943	0.499	128.549	0.000
Bitcoin related tweets	11	46.416	0.298	86.406	0.000
Other tweets	11	28.090	0.523	124.570	0.000

Table 8 Panel VAR model on volumes: contemporary coefficients.

Contemporary coefficients	News	Bitcoin related tweets	Other tweets
News	1	0	0
Bitcoin related tweets	0.806	1	0
Other tweets	0.118	-0.042	1

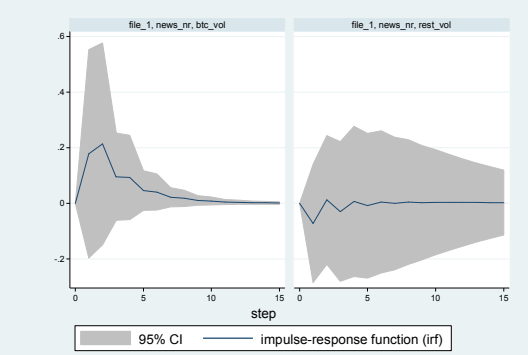
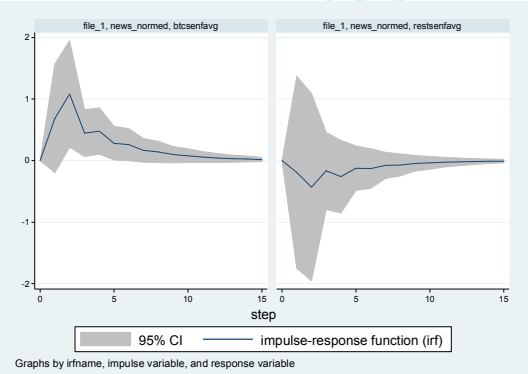
Table 9 Results of the panel VAR model concerning sentiment

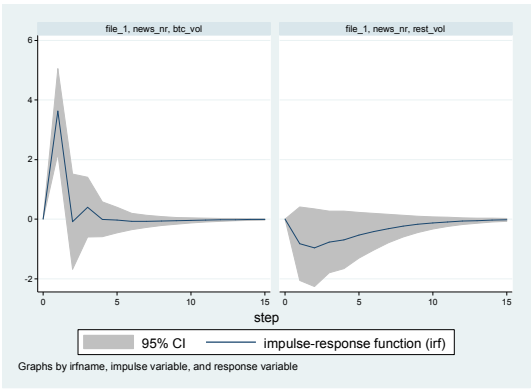
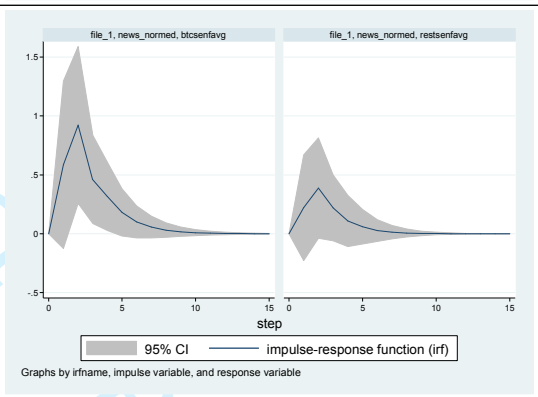
Equation	Parms	RMSE	R-sq	F	P > F
News	11	0.063	0.493	124.871	0.000
Bitcoin related tweets	11	0.175	0.116	19.675	0.000
Other tweets	11	0.178	0.079	4.210	0.000

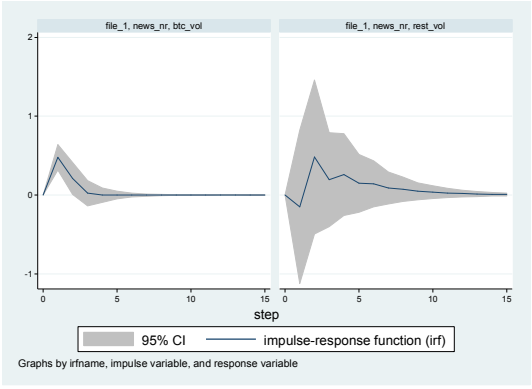
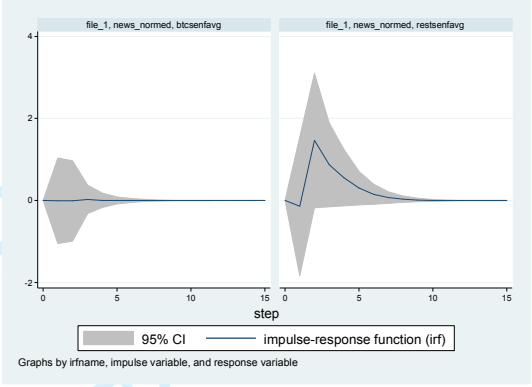
Table 10 Panel VAR model on sentiment: contemporary coefficients.

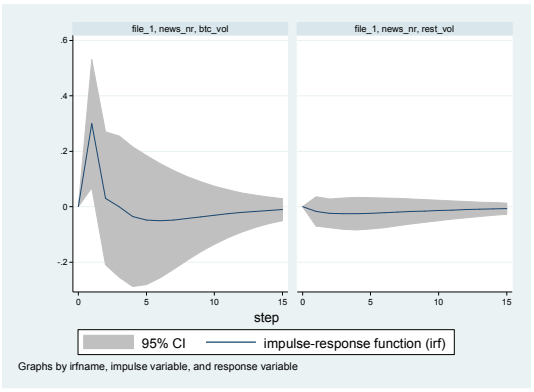
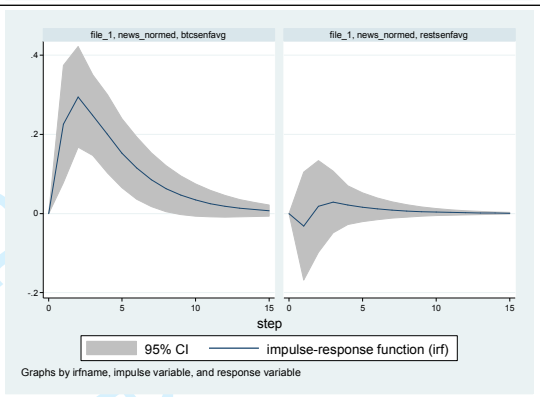
Contemporary coefficients	News	Bitcoin related tweets	Other tweets
News	1	0	0
Bitcoin related tweets	0.174	1	0
Other tweets	0.033	0.024	1

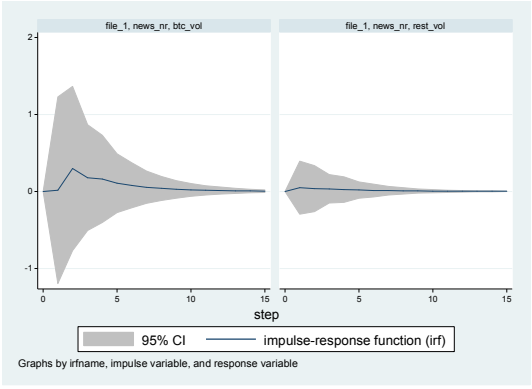
Table 11 IRFs resulting from VAR models limited to each company. The impulse is the number of Bitcoin news. The plotted effects are respectively on the number of tech-related and -unrelated tweets ("Volume" rows) and on the average sentiment of tech-related and -unrelated tweets ("Sentiment" rows)

Company	Measure	Technology-related / Technology-unrelated
CheapAir.com	Volume	
	Sentiment	

Company	Measure	Technology-related / Technology-unrelated
Newegg	Volume	
	Sentiment	

Company	Measure	Technology-related / Technology-unrelated
Intuit	Volume	
	Sentiment	

Company	Measure	Technology-related / Technology-unrelated
Overstock.com	Volume	
	Sentiment	

Company	Measure	Technology-related / Technology-unrelated
TigerDirect	Volume	
	Sentiment