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Business performance and social media: Love or hate?

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Abstract   The social media space has become a common place for communication, networking, and content sharing. Many companies seek marketing and business opportunities via these platforms. However, the link between resources generated from these sites and business performance remains largely unexploited. Both managers and financial advisors can profit from the lessons learned in this study. We conceptualize four channels by which social media impacts financial, operational, and corporate social performance: social capital, customers' revealed preferences, social marketing, and social corporate networking. An empirical test of our framework shows that 'followers' and 'likes' positively influence a firm's share value, but only after a critical mass of followers is attained. Our estimates suggest that Twitter is a more powerful tool to enhance business performance than Facebook.
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1. The value of social chatter

In 2010, American Express conceived and promoted the first Small Business Saturday, an American shopping holiday held on the Saturday after Thanksgiving. The advertising campaign for Small Business Saturday involved mainly social media, generating more than 1 million Facebook 'like' registrations and nearly 30,000 tweets. After the campaign, 40% of the general public was aware of Small Business Saturday and revenues for small businesses jumped 28% (Markowitz, 2013). Three years later, Small Business Saturday drove sales of $5.5 billion and became a global initiative (Umunna, 2013). Since then, American Express share prices have surged 74%. In July 2012, multiple re-tweets of a user impersonating a Russian minister caused crude oil futures to bounce up over $1 (The Economist, 2013). A few months later, in October 2012, Google halted trading of its shares after a leak of the company's earnings report went viral (Efrati, 2012). These incidents exemplify how interactions through weak social network ties, such as social media platforms Facebook and Twitter, can have a strong influence on business activities (Granovetter, 1973; Jansen, Zhang, Sobel, & Chowdury, 2009). This provides a

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conceptual and empirical framework for the relationship between social media and business performance.

Social consumers are dexterous, willing to pay and participate. Their preferences are broadcast and magnified by social media, with increasing connections to corporations and brands (Berthon, Pitt, McCarthy, & Kates, 2007; Hanna, Rohm, & Crittenden, 2011; Parent, Plangger & Bal, 2011). Thus, social media has become a high corporate priority; the vast majority of traded companies are actively present on some kind of social platform. Companies are only now starting to realize the business implications and nature of this new user-generated content. Along with the challenges and opportunities that social media offers, there is a significant degree of uncertainty among managers with respect to allocating effort and budget to social media (DesAutels, 2011; Kaplan & Haenlein, 2010; Weinberg & Pehlivan, 2011). As a result, practitioners often find themselves on social media quicksand, undertaking decisions without a clear understanding of the effects of social media on business performance.

This article contributes to reducing the social media guesswork for practitioners. First, we conceptualize the mechanisms by which social media impacts business performance. Social media has a broad impact on all spheres of business performance, such as finance, operations, and corporate social performance. Drawing from the review of previous work in this subject, we identify four distinct channels: corporate social responsibility, marketing, corporate networking, and customers' revealed preferences. Second, we construct an empirical model based on customers' revealed preferences to quantify the influence of social media on the share value of traded firms. We found a positive influence of social media on business performance, but only after a critical threshold of followers is reached.

2. From social media resources to business performance capabilities

Resource- and capability-based views argue that a firm's business performance is determined by its effectiveness at converting resources (e.g., assets, knowledge, processes) into capabilities (e.g., customer links, sales abilities, reputation placement) to achieve a competitive advantage (Barney, 1991; Day, 1994). Social media consists of seven functional resources: identity, conversations, sharing, presence, relationships, reputation, and groups (Kietzmann, Hermkens, McCarthy, & Silvestre,

Figure 1. Social media and business performance channels
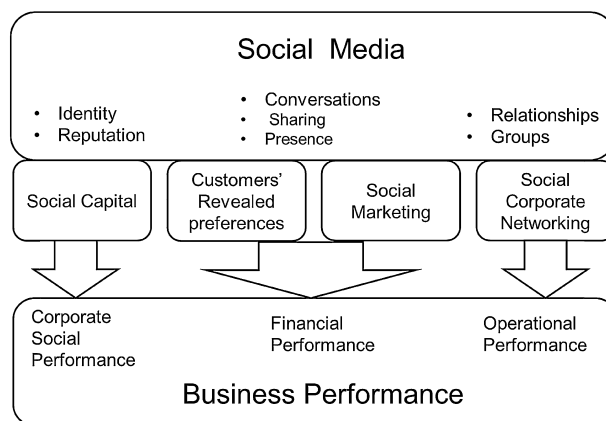
2011). The conceptual framework in Figure 1 identifies the channels by which social media resources are transformed into business performance capabilities. Business performance focuses on financial, operational, and corporate social performance capabilities (Carroll, 1979; Venkatraman & Ramanujam, 1986). Financial performance indicators generally include sales level and growth, profitability, and stock price, whereas operational performance focuses on share position, new product introduction, product quality, operating efficiency, and customer satisfaction. Corporate social performance (CSP) depends largely on the firm's ability to establish honest relations with society, with special attention to reputation and brand.

Social media affects business performance through four channels: social capital, revealed preferences, social marketing, and social corporate networking. Each channel funnels a set of social media resources into a business performance domain. These social media performance channels are neither mutually exclusive nor all simultaneously present. They are constructs that allow us to unravel the specific performance domain affected by social media and implications for firms.

2.1. Social capital

The social capital channel represents the extent to which social media affects firms' relationships with society. Identity and reputation resources are transformed into CSP capabilities through the social capital channel. The firm's social capital (i.e., trustworthy relations through corporate identity and reputation) is modeled through activity on platforms like Wikipedia, blogs, and search engines. Although companies are now less constrained by a single social order, corporations face unrecorded

public scrutiny through social media (Falck & Heblich, 2007; Fieseler, Fleck, & Meckel, 2010). In today's environment, companies must not only have transparency, but also engage socially to build trustworthy relations that impact CSP. Previous studies have shown that social media has a direct impact on CSP. Brammer and Pavelin (2006) tie corporate reputation to online platforms and CSP. For example, by examining user-generated content on TripAdvisor, O'Connor (2010) demonstrated that a hotel's image can be managed by customer opinions on the Web. In addition, Fieseler et al. (2010) showed how the blogosphere adds value to CSP and stakeholder engagement.

Notwithstanding, the social capital channel directly affects CSP; however, it may have an indirect effect on financial or operational performance in the long run. This channel has implications on the areas of brand management and institutional relationships with stakeholders. It is a passive channel, meaning that companies generally cannot allocate specific budgets to control this channel, as it depends on the perception that social media builds around the company.

2.2. Revealed preferences

The revealed preferences channel represents the extent to which social media exposes customers' likings. Conversation, sharing, and presence resources are conveyed into financial capabilities through the revealed preferences channel. Through sites like Twitter or Facebook, potential customers express their likes or the tastes that rationalize an agent's observed actions (Beshears, Choi, Laibson, & Madrian, 2008). Active social customers set social trends and agendas in a varied range of topics, from economics to the environment and the entertainment industry (Shirky, 2011).

The revealed preferences channel impacts mostly financial performance. Financial indicators (e.g., share prices) depend largely on the market's information and expectations on the firm (Fama, 1965; Froot, 1989). Social media increases information about the company, with implications for corporate finance. Researchers have found empirical evidence of how non-financial information is a leading indicator of financial performance (Ittner & Larcker, 1998; Puah, Wong, & Liew, 2013). The collective wisdom from social media has been used to forecast real-world outcomes such as unemployment rates (Ettredge, Gerdes, & Karuga, 2005); human tie strengths (Gilbert & Karahalios, 2009); disease tracking (Pelat, Turbelin, Bar-Hen, Flahault, & Valleron, 2009); box-office revenues (Asur & Huberman, 2010); and economic indicators including automobile sales,

unemployment claims, travel destination planning, and consumer confidence (Choi & Varian, 2012). To the best of our knowledge, no previous research has explored the relationship between social media and financial performance.

This channel has implications on the areas of strategic management and new product introduction. Through likes and 'follows,' companies pulse the market and anticipate demand for products and services. This channel is especially relevant for shareholders and investment portfolio managers, as it will have a direct impact on share value. The revealed preferences channel is largely passive, meaning that management actions and budget have a limited effect on customers' likes.

2.3. Social marketing

The social marketing channel represents the extent to which social marketing resources (e.g., conversations, sharing, presence) are transformed into financial performance capabilities (e.g., sales). Through conversations, sharing, and presence on Facebook, YouTube, or Twitter, firms actively market their products and services. Firms have adopted social media as an essential part of their marketing mix (Mangold & Faulds, 2009); however, the tactics and objectives of advertising tools of traditional media (e.g., television, radio, print, billboard) differ substantially from those of social media. Traditional media marketing is delivered directly from the marketer and involves awareness, knowledge, and recall. On the other hand, social networks, blogs, microblogs, and communities approach customers with interactive objectives such as conversation, sharing, collaboration, and engagement (Weinberg & Pehlivan, 2011).

Social media increases revenue in basically the same way as traditional marketing; tools are aimed at increasing sales of the company's products or services by heightening notoriety. In this sense, the use of social media in marketing is only innovative in its means, not in its goals. The new marketing tools do not assess as clear a return on investment when applied to social media marketing as compared to traditional unicast advertising: A 20-second television spot broadcast during the Super Bowl has a clear, controlled, and quantified business impact (Yelkur, Tomkovick, & Traczyk, 2004). Social media marketing also has a greater reputational risk than traditional marketing (Aula, 2010).

Although the social marketing channel has the greatest impact on financial performance through the creation of sales-related capabilities, past research shows how investing in online marketing relates to operational performance such as customer

linkage and commitment (Hulland, Wade, & Antia, 2007; Nath, Nachiappan, & Ramanathan, 2010). Social marketing is an active channel, and therefore requires careful budget allocation (Weinberg & Pehlivan, 2011).

2.4. Social corporate networking

The social corporate networking channel represents the extent to which social corporate resources (e.g., relationships, groups) are transformed into operational performance capabilities. Social corporate networking refers to the informal ties of corporate staff through social networks. This channel involves a different set of social networks, such as LinkedIn or ResearchGate, targeted toward professional and academic networking. Online social platforms provide a low-cost, highly accessible way of communicating, which enables relationships with people both inside and outside the organization; online social platforms also support tasks through online discussion, sharing knowledge, and finding clients (Korzynski, 2012). Inter-corporate networking increases labor mobility among firms, providing efficient ways to target the best professionals for job vacancies. Intra-company networking helps to identify valuable skill sets from within the company.

While many researchers have examined corporate networking tools (e.g., CRM, e-business) as an asset to increase operational performance (Rapp, Trainor, & Agnihotri, 2010; Trainor, Andzulis, Rapp, & Agnihotri, 2014), few have specifically studied how social media enhances business performance. Trainor et al. (2014) demonstrated how social media usage relates positively to customer relationship performance through the creation of firm-level capabilities. Social corporate networking is an active channel that impacts relationships with customers and providers. It is relevant to the creation of customer and human resources-related capabilities.

3. A room for socializing in the stock market

The empirical model stems directly from the conceptual framework. Focusing on customers' revealed preferences, we show how user-generated content in social media (i.e., Twitter followers and Facebook likes) explains stock price variations of publicly traded companies. In this section, we discuss the analytical strategy and implications of our findings.[1]

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[1] Those interested in a more technical analysis can refer to the Technical Appendix in Section 6.

The revealed preferences channel offers clear and direct means to analyze how social media impacts business performance. One of the most basic and objective indicators of financial performance is price per share of traded firms. However, according to the efficient market theory, stock prices reflect all market information regarding the traded firm (Malkiel, 1973); stock prices will settle accordingly. In efficient markets, there is no room for socializing.

Behavioral economists have long challenged the efficient market theory. Viewing markets as a collection of individual decisions, stock prices are prone to human flaws in the interpretation of market information (Lo & MacKinlay, 2001). In this case, social connections can substitute for missing or expensive legal structures in facilitating financial transactions (Arrow, 1972).

One of the first signals an average investor interprets is demand for the goods and services a particular company might offer. Behavioral scholars have shown that stock prices can be predicted by anticipating the decisions average investors are likely to make (Shiller, 2000). For example, anticipated demand for iPhone or Windows software will increase the share of Apple and Microsoft stocks in investors' portfolios, pushing up the stock price. Historically, these signals have been interpreted using eclectic information collected from the press, companies' ratings, and past trends.

Today's social media is a powerful and reliable advanced indicator of customers' preferences. Consider that a potential investor in soft drinks detects that the new Coca-Cola flavor has an exorbitant number of Facebook likes. She might reason that in the short term Coca-Cola will experience higher demand for the new beverage. With all things considered, she will be prone to invest in Coca-Cola rather than in Pepsi. Following this reasoning, the first research hypothesis is as follows:

[H1]. *The number of social media followers has an effect on stock prices of publicly traded companies.*

We would expect that a positive variation in the number of social followers will positively affect share prices. However, it is a well-known fact that social media networks encounter positive network externalities (Kaplan & Haenlein, 2010). The utility of networks isn't fully reached until a critical mass of agents uses the system. The fax machine is a textbook example of this herd behavior: if only two parties own a fax, its utility is limited to both peers. Not until a critical mass owns fax machines do they become useful. Previous research in the social context has determined that the number of peers has a

strong influence on the usage of social networking sites (Lin & Lu, 2011).

The social media learning curve is expensive; initial assets and knowledge needed to manage social media (e.g., creating content, hiring a social media manager) represent a non-trivial cost. With relatively few followers, this cost is sunk, negatively affecting the company's financial statements. However, after a certain threshold when a critical mass of followers is attained, this social asset is amortized over many connections. We would then expect a positive correlation between share prices and virtual followers only when enough customers have expressed their likes, as reflected in hypothesis 2:

[H2]. *Social media followers have a positive association with share prices after a critical mass is attained.*

To test both research hypotheses, we selected a group of traded companies that are early in their social network experience, such as the Spanish IBEX firms traded on Madrid's stock exchange. Spanish-traded companies are relatively new to social media and constitute a suitable set of companies to test both hypotheses.

H1 was tested with the explicatory power of the number of corporate followers on social networks. To capture the effect of social media and to calculate the critical mass of followers, we used a quadratic panel with fixed effects. Our data was collected over a 28-day period, starting on November 29, 2012. It was culled daily from the Spanish stock exchange, Twitter, and Facebook sites for each company listed in Table 1.

### 3.1. Results of the empirical analysis

By using four different estimation techniques, we found strong empirical evidence to support both of our research hypotheses. Social media has a significant impact on stock prices of publicly traded companies; however, the impact is only positive for a critical mass of followers. Our model performs well, explaining more than 99% of the daily variation in

stock prices of IBEX firms. The estimation results of the social media variables are statistically significant and reflect the expected signs. Since we controlled for time and company fixed effects, the estimation results of the variables of interest captured the effect of variation of social media chatter.

The relationship between share prices and Twitter followers and Facebook likes are depicted in Figures 2 and 3, respectively. The minimum point of each curve (i.e., the critical mass) is highlighted in both figures. We observed three differences:

1. Twitter has a smaller critical mass than Facebook. Using various estimation techniques, we found that critical mass estimates of Facebook likes vary from 178,048 to 241,865. Traded companies in the sample must accumulate Facebook likes in this range to benefit from a positive impact in their stock price performance. In contrast, the threshold of Twitter followers ranges from 4,141 to 4,316.

2. Facebook has a steeper curve than Twitter. To increase the average share price by 1%, companies on the IBEX need approximately 1,000 extra daily Twitter followers; the same increase in share price requires approximately 5,000 new Facebook likes per day.

**Figure 2.   Average IBEX share price vs. Twitter followers**
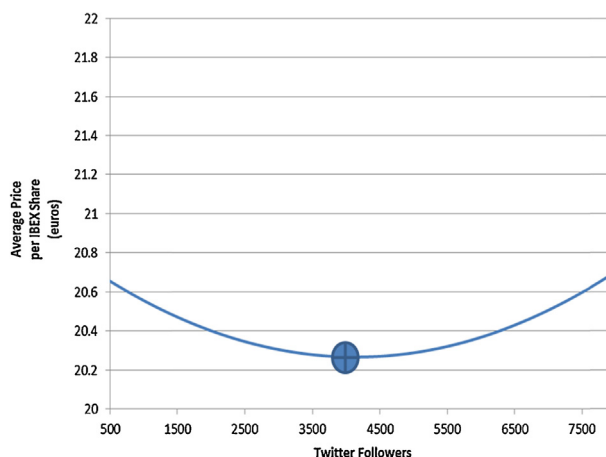
Figure 3. Average IBEX share price vs. Facebook 'likes'
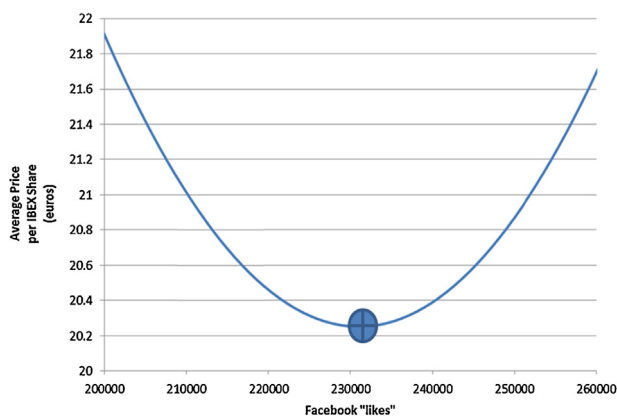
3. The slope of the curve for very few followers or likes is steeper for Facebook than for Twitter. This means that the initial social media cliff is higher for Facebook, implying that the initial resources allocated to increase social media awareness are more expensive for Facebook than for Twitter.

The result of the combining effect of Twitter followers and Facebook likes is shown in Figure 4. In the social media skate-bowl, firms can slide down different paths to achieve business performance. Facebook is steeper and farther away than Twitter. Consequently, our results imply that a Twitter follower has greater impact than a Facebook like on business performance. The difference can be

Figure 4. Combined effect on IBEX share prices
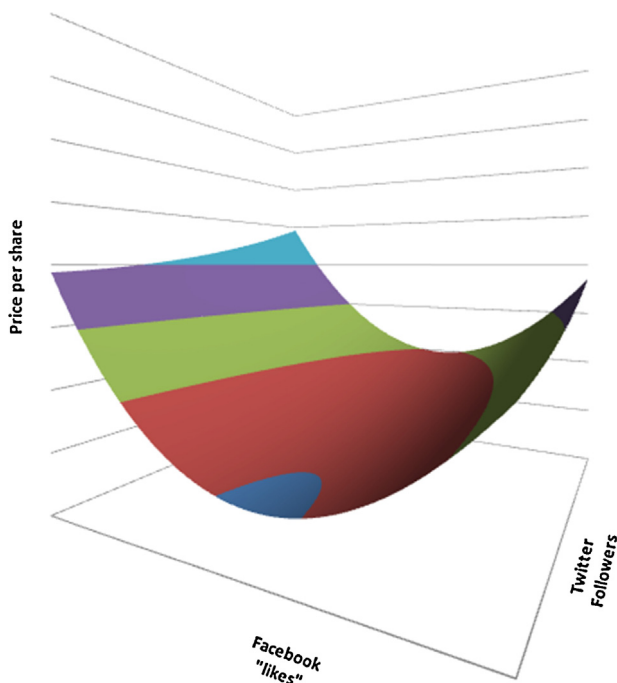
explained by the nature of social media and user profiles. Twitter functions as a simple service for complex relationships and Facebook functions as a complex service for simple relationships.

Twitter is a relatively simple micro-blogging service via which interactions are normally based on mutual affinities. Facebook, conversely, is a complex networking tool via which relationships are constructed on friendship or acquaintance. Twitter has become an extremely popular service that generates value for businesses due to the specific characteristics of micro-blogging, such as ambient awareness and a push-and-pull communication format (Kaplan & Haenlein, 2011). These characteristics not only attract a different profile of users (Webster, 2010), but also have a different impact on business performance.

3.1.1. A test for robustness using NASDAQ firms

We performed a sensitivity analysis by replicating our regressions in a more mature social market. We chose nine random companies from the NASDAQ index (see Table 2) because firms on the NASDAQ are much more exposed to social media than firms on the Spanish IBEX. Our data came from Twitter and Facebook sites of each of these companies during a 28-day period that began on November 29, 2012.

Using NASDAQ firms, our model performs well, explaining around 99% of the daily stock price variation of the sampled companies. We found few differences with respect to our original specification. However, one of the first differences is that Facebook likes are only statistically significant in companies with a critical mass of more than 17,000,000 followers. As expected in a more mature market, the critical mass for NASDAQ companies is beyond the threshold. We observed a change in the critical mass from a novel (IBEX) to a mature (NASDAQ) market with higher social media penetration. As predicted by theory, network externalities erode after the critical mass has been reached. This might currently be the case for the NASDAQ companies, but not for Spanish IBEX firms.

Focusing on Twitter results, we found a critical mass in all four regressions; once again, in this scenario, Twitter has proven to be more effective than Facebook. However, the numbers are significantly higher than in the Spanish case. American firms in our sample needed 200,000 followers to positively impact financial performance. For

Table 2. Companies in the NASDAQ sample

NASDAQ (U.S.A.)	Microsoft Adobe	Facebook Nvidia	Apple Dell	Yahoo! Google	Ebay

Table 3. Key implications for managers

Channel	Social Resource	Platforms	Business Performance Capabilities	Areas	Budget Allocation
Social Capital	Identity Reputation	Blogs Wikipedia	CSP	Brand Stakeholders	No
Revealed Preferences	Conversation Sharing Presence	Twitter Facebook	Financial Shares	Shareholders New product introduction Strategic management	No
Marketing	Conversation Sharing Presence	Facebook YouTube	Financial Sales	Sales Marketing	Yes
Corporate Networking	Relationship Groups	LinkedIn ResearchGate	Operational CRM	Customers HR	Yes

markets with little social media exposure, a single social follower is much more valuable compared to mature markets.

4. Lessons learned

After deciding to pursue social media, a main concern for practitioners entails how best to use it to foster business performance. This study provides useful hints for managers in determining which social media resources are appropriate to enhance performance capabilities. Additionally, this research uncovers lessons that practitioners can exploit as a strategic lever for increasing corporate performance market opportunities.

The major insight gained from this research is the link between social media and business performance. Empirical evidence suggests that financial performance is affected by user-generated content in social media. We show that Twitter followers are more effective than Facebook likes at positively impacting share prices. The effect of social media on performance depends on the penetration of social media in the stock market.

Key implications for management are summarized in Table 3. Both managers and financial advisors can profit from the lessons learned in our research. Managers can use our findings to identify the impact of social media on operational, corporate, and financial performance as measured by stock variation. Financial advisors and brokers can build well-researched portfolios following the variations of user-generated content. Business development practitioners find in our results an alternative way to inspect new markets based upon social media patterns.

Table 4. Descriptive statistics

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
Stock price (IBEX) P_{it}	902	15.78217	20.14845	0.55	109.3
Facebook (IBEX) FB_{it}	896	14223.1	38903.06	27	235689
Twitter (IBEX) TW_{it}	812	3186.665	3293.905	12	12154
Stock price (NASDAQ) P_{it}	171	159.6614	253.7812	10.43	741.48
Facebook (NASDAQ) FB_{it}	171	1.40E+07	2.50E+07	88147	8.48E+07
Twitter(NASDAQ) TW_{it}	171	1479841	2345943	3861	6303122

Table 5. Results

Regressand Variable	P_{it}	P_{it}	P_{it}	P_{it}	P_{it}	P_{it}	P_{it}	P_{it}
Stock price (lagged) $P_{it}(-1)$				0.9991735 *** (0.0018779)				1.00377 *** (0.0151106)
Facebook FB_{it}	-0.0007948 *** (0.0002148)	-0.0004252 ** (0.0001494)	-0.0000627*** (0.0000147)	-0.0000438*** (0.0000152)	-1.76e-06 (0.0000104)	0.0000165 *** (4.99e-06)	-9.59e-08 ** (4.89e-08)	-2.55e-06 (1.84e-06)
Facebook FB_{it}^2	1.72e-09 *** (4.98e-10)	8.79e-10*** (3.50e-10)	1.43e-10 *** (3.40e-11)	1.23e-10 * (7.57e-11)	-4.90e-13 *** (5.11e-14)	-4.59e-13*** (4.27e-14)	6.69e-17 (2.24e-16)	2.15e-14 (2.10e-14)
Twitter TW_{it}	-0.0002427** (0.0000981)	-0.0001943** (0.000096)	-0.0000158 *** (5.10e-06)	0.0000467 (0.0000451)	-0.000026 *** (6.99e-06)	-0.0000214 *** (7.20e-06)	-2.37e-08 * (1.44e-08)	0.0000167** (0.0000451)
Twitter TW_{it}^2	2.93e-08*** (9.27e-09)	2.33e-08*** (8.93e-09)	1.83e-09 ** (7.10e-10)	-2.20e-09 (3.89e-09)	6.80e-11 *** (9.27e-09)	5.04e-11*** (4.23e-12)	1.15e-13 ** (1.70e-14)	-2.39e-12 ** (1.21e-12)
Constant β_0	20.76938 *** (0.9821337)	18.9955*** (4.675363)	3.116736 *** (0.0666983)	.0870259 (0.1636321)	39.7742 *** (2.000259)	-49.29859 (87.01807)	3.624282 *** (0.008077)	11.36747 * (6.389094)
Wald Test [H1]	F(3,703)=5.83 {0.0006}	χ^2(3) = 11.95 {0.0075}	χ^2(3) = 27.77 {0.0000}	χ^2(3) = 11.27 {0.0084}	F(3,703)=7.14 {0.0011}	χ^2(3) = 18.91 {0.0001}	χ^2(3) = 5.54 {0.0658}	χ^2(3) = 5.64 {0.0596}
Facebook Critical Mass $FB_{crit} = -\hat{\beta}_2/2\hat{\beta}_2$	231,046	241,865	219,230	178,048	-	17,973,856	-	-
Twitter Critical Mass $TW_{crit} = -\hat{\beta}_2/2\hat{\beta}_4$	4,141	4,169	4,316	-	191,176	212,301	103,043	3,493,723
Market	IBEX				NASDAQ			
Observations	762	762	762	734	171	171	171	162
R^2	0.9977	0.0172 (overall)	.9987	-	0.9998	0.6557 (overall)	.9987	-
Time fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
Company fixed effects	yes	no	yes	no	yes	no	yes	no
Estimation Method	OLS	Random-effects GLS	PML	Dynamic panel - GMM	OLS	Random-effects GLS regression	PML	System dynamic panel - GMM

Notes: Standard errors in parenthesis, p-value for Wald tests in brackets ***p<0.01 **p<0.05 *p<0.1.

5. Moving forward

While this article examined the effect of Twitter and Facebook on stock prices, the comprehensive approach of our conceptual framework may have other applications. Future studies could capture, for example, the effect of social corporate networking (e.g., LinkedIn) on operational performance or how social marketing affects sales.

6. Technical appendix

The regression equation we used is as follows:

$$P_{it} = \beta_0 + \beta_1 FB_{it} + \beta_2 FB_{it}^2 + \beta_3 TW_{it} + \beta_4 TW_{it}^2$$
$$+ \gamma_i + \lambda_t + \varepsilon_t \quad [1]$$

Whereby i denotes a publicly traded company on the Spanish stock exchange, IBEX; t denotes time (day); P_{it} represents daily stock price; FB_{it} represents daily Facebook likes; TW_{it} represents daily Twitter followers; and ε_t is a stochastic error term. In order to capture endogenous firm-specific variations on stock prices, we introduced company fixed effects with a dummy variable, γ_i, for each company in the dataset. Similarly, to isolate exogenous daily shocks on stock prices, we introduced time fixed effects with a dummy variable, λ_t, for each day in the sample.

In order to sustain H1, we would expect the estimated coefficients of the variables of interest to be jointly significantly different from zero. We performed standard joint Wald tests to determine if $\beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$. To test H2 we inspected the sign of the estimated coefficients of the social media variables. In our hypothesis, social media followers subtracts stock price until a critical mass is reached. Therefore, we would expect that $\hat{\beta}_1 < 0$ and $\hat{\beta}_2 > 0$ for Facebook likes and $\hat{\beta}_3 < 0$ and $\hat{\beta}_4 > 0$ for Twitter followers. The descriptive statistics can be found in Table 4 and the estimation results are shown in Table 5.

For robustness, we ran regressions on equation [1] with various techniques. In particular, we used Ordinary Least Squares (OLS) in column 1; Random-effects Panel with Generalized Least Squares (GLS) in column 2; a non-linear Poisson Maximum Likelihood (PML) regression in column 3; and a Dynamic Panel using Generalized Method of Moment (GMM) with one lag to account for stock price persistence in column 4. We calculated this critical mass by minimizing the stock price in [1] with respect to the Facebook likes and Twitter followers respectively:

$$\frac{\partial P}{\partial FB} = \hat{\beta}_1 + 2\hat{\beta}_2 FB_{crit} = 0 \rightarrow FB_{crit} = \frac{\hat{\beta}_1}{2\hat{\beta}_2} \quad [2]$$

$$\frac{\partial P}{\partial TW} = \hat{\beta}_3 + 2\hat{\beta}_4 TW_{crit} = 0 \rightarrow TW_{crit} = \frac{\hat{\beta}_3}{2\hat{\beta}_4} \quad [3]$$

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