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When entrepreneurial rhetoric meets strict regulations: Implications for the valuation of health science firms

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Abstract

Research Summary: Health science firms have long product development horizons and need regulatory approval for market entry. In communicating with investors, they may use entrepreneurial orientation (EO) rhetoric to emphasize their strategic and behavioral commitment to product innovation and market entry. However, because EO rhetoric constitutes a soft-information signal rather than evidence of substantive commitment, investors may suspect firm insiders using such rhetoric of impression management. The solution, we argue, is EO rhetoric sustained *over time*, which produces more reliable information for investors—in contrast to occasional increases in EO rhetoric, which invite skeptical scrutiny. Nevertheless, investors' potential concerns regarding changes in EO rhetoric can be mitigated by concurrent hard-information signals that carry signaling costs or penalty costs for false signaling.

Managerial Summary: Entrepreneurial orientation (EO) rhetoric can reduce information asymmetry between managers and investors. In strictly regulated contexts such as health science industries, using such rhetoric may be

challenging. For firms embracing entrepreneurial strategies and behaviors, maintaining EO rhetoric over time is critical to overcoming skepticism that it is merely "cheap talk." For investors, this study also suggests that health science firms maintaining higher EO rhetoric over time deserve higher valuations, given the variety of benefits an EO can have for health science firms. If a health science firm aims to ramp up its EO rhetoric, managers should be aware that investors may interpret the increase as impression management and should confront this interpretation head-on—for instance, by simultaneously increasing entry commitment or corporate social responsibility.

KEYWORDS
corporate social responsibility, entrepreneurial rhetoric, entry commitment, health science firms, strict regulations

1 | INTRODUCTION

There is growing consensus that "efficient" regulations provide economic freedom and ensure a level playing field for all companies seeking innovation and growth (Bradley & Klein, 2016; McMullen, Bagby, & Palich, 2008; Scott, 2013). Ideally, regulations correct market failures so that firms find it rewarding to enter new markets with innovative offerings that can ultimately improve overall economic growth and prosperity (Acs, Astebro, Audretsch, & Robinson, 2016; Bradley & Klein, 2016; Sobel, 2008). However, in reality, stringent regulations erect entry barriers that may unintentionally increase firms' motivations for political rent-seeking over product innovation in competition with new entrants (Bessen, 2016; Djankov, McLiesh, & Ramalho, 2006; Gutiérrez & Philippon, 2017; Klapper, Laeven, & Rajan, 2006).

Research examining regulation and entrepreneurship has mainly focused on the entry behaviors and outcomes of new ventures. However, all firms, incumbents included, may actively seek and exploit opportunities to enter new product markets. Such firms are said to have an entrepreneurial orientation (EO), which reflects the extent to which their strategies and behaviors embrace and enable product innovation, market entry, and risk-taking (Covin & Slevin, 1988, 1989). Since the seminal work of Miller (1983), EO has become one of the most important concepts in entrepreneurship research (Covin & Lumpkin, 2011; Miller, 2011; Wales, Covin, & Monsen, 2020). The EO literature has traditionally examined EO as manifest in a firm's product innovation and market entry (i.e., launching a product to a market), and how these actions influence its financial performance (Lumpkin & Dess, 1996).

Recent EO scholarship has incorporated rhetoric—the discretionary use of language to convey the firm's innovativeness, proactiveness, and risk-taking to outsiders (Watson, Dada, Wright, & Perrigot, 2019)—with an increasing emphasis on whether investors value such rhetoric (Engelen, Neumann, & Schmidt, 2016; Short, Broberg, Cogliser, & Brigham, 2010). Although these studies have demonstrated that investors do pay attention to EO language in published communications, little is known about how they interpret and react to EO rhetoric when it is used by firms operating in strictly regulated industries, including pharmaceuticals and medical devices, military and national defense, air and aerospace travel, nuclear energy, and some petroleum sectors. There is a common belief that innovation and entrepreneurship are important drivers for economic and social development, indeed that most businesses and industries must innovate or die (Christensen, 1997). However, it is often costly and difficult to obtain

regulatory approval when implementing entrepreneurial strategies (Guo, Tang, & Su, 2014; Wang, Thornhill, & De Castro, 2017), so in strictly regulated industries investors may interpret EO rhetoric with greater caution.

This study examines how investors interpret and react to EO rhetoric used by health science firms operating in the United States, where regulations stringently enforced by the U.S. Food and Drug Administration (FDA) constrain already lengthy and costly innovation processes. Health science firms' success depends on their long-term commitment to product innovation and solution development (Gittelman, 2016; Mohs & Greig, 2017). However, medical product development has long horizons (e.g., more than 10 years) (Mohs & Greig, 2017) involving various phases of clinical studies of human and animal subjects (Gittelman, 2016), which are necessary to obtain the FDA's approval for market entry (Briggeman, Roberts, & Gulfo, 2016).

Investors face a dilemma in interpreting and reacting to such firms' EO rhetoric. On the one hand, the rhetoric may provide useful information about the firm's strategies and behaviors to embrace and enable product innovation and market entry; on the other hand, the rhetoric could simply be "cheap talk" (Farrell & Rabin, 1996)—impression management by firm insiders bent on advancing their own short-term interests. In order to solve this dilemma, we argue that sustaining EO rhetoric *over time* in published communications such as annual reports and CEO shareholder letters makes it possible for investors to identify and penalize false signaling (Kaya, 2009; Manelli, 1996). Health science firms that are willing to bear the consequence are likely to evoke stronger investor confidence. Therefore, a between-firm difference in average EO rhetoric over time should influence investors' valuation of the firm.

In contrast, an occasional increase in EO rhetoric—that is, a within-firm difference—could be interpreted as self-interested impression management aimed at securing bonuses, options, and promotion by directing the market's attention to (away from) positive (negative) information related to potential new products that will increase financial performance (Merkl-Davies & Brennan, 2007). As a result, investors will lower their valuation of health science firms inflating EO rhetoric. Drawing on signaling theory (Bergh, Connelly, Ketchen, & Shannon, 2014; Connelly, Certo, Ireland, & Reutzel, 2011), we posit that the extent to which investors adjust their valuation depends on whether the firm has sent other, hard-information signals that involve greater entry commitment (e.g., irreversible investments in seeking FDA approval) or higher penalty costs for false signaling (e.g., losses of reputation and trustworthiness).

This study contributes to entrepreneurship and regulation research in three ways. First, we answer Miller's (2011) call for industry-specific EO research by focusing on the distinctive characteristics of health science firms with long product development horizons due to strict multistage regulations. Second, we decompose the signaling mechanism of EO rhetoric into the effects of *average EO rhetoric* and *change in EO rhetoric* over time, thus distinguishing between-firm and within-firm differences as recommended by Certo, Withers, and Semadeni (2017). Finally, we show how soft- and hard-information signals can jointly affect investor reactions, an influence that is particularly important in regulated industries with high information asymmetry between firm insiders and outsiders.

2 | EO RHETORIC OVER TIME AND HEALTH SCIENCE FIRM VALUATION

2.1 | Signaling theory

Firm insiders (e.g., top managers and board directors) possess more private information than outsiders (e.g., potential investors) about strategies and behaviors that can determine the firm's potential (Cohen & Dean, 2005; Connelly et al., 2011). To increase market efficiency, it is necessary but costly to reduce this "information asymmetry" (Stiglitz, 2000). Signaling theory (Spence, 1973, 2002) reveals mechanisms that can mitigate it by explicating how outsiders "search for clues about a firm, interpret those clues, and are guided by their interpretations when formulating their own actions" (Bergh et al., 2014, p. 1335).

Generally speaking, an effective signal contains hard information, that is, information that cannot be sent without costly and irreversible commitment (Bergh et al., 2014; Connelly et al., 2011; Williamson, 1983). For example, patent applications serve as a quality signal for new ventures because developing patentable technologies requires

knowledge and resources, and new ventures do not possess alternative ways to demonstrate their value to outsiders because they lack historical data about operations and performance (Hoenen, Kolympiris, Schoenmakers, & Kalaitzandonakes, 2014; Hsu & Ziedonis, 2013). Put differently, a credible signal needs to be more difficult and costly for a lower-quality firm to imitate (Bergh et al., 2014; Connelly et al., 2011). While recent developments in signaling theory suggest that soft information provided by firm insiders (narratives, statements, and expressions in communication materials) can also serve as a signal (Gutiérrez, Papiashvili, Tribó, & Vazquez, 2020), outsiders often construe soft information as manipulation by insiders seeking their own interests at the cost of outsiders (Abrahamson & Park, 1994; Merkl-Davies & Brennan, 2007). It is also possible that firm insiders purposely send misleading information to confuse outsiders such as competitors (Ofek & Turut, 2013). Therefore, soft information can even increase information asymmetry between firm insiders and outsiders.

2.2 | EO rhetoric

As one of the most important concepts in the entrepreneurship literature (Rauch, Wiklund, Lumpkin, & Frese, 2009; Soares & Perin, 2020), EO has been conceived in two ways: as a unidimensional and a multidimensional construct (for a more systematic discussion, see Covin & Lumpkin, 2011). As originally conceived by Miller (1983) and developed by Covin and Slevin (1988, 1989), the unidimensional conceptualization posits that an entrepreneurial firm manifests innovativeness, proactivity, and risk-taking concurrently (Covin & Lumpkin, 2011). The multidimensional conceptualization of EO adds autonomy and competitive aggressiveness, and posits that these five dimensions can "vary independently" to influence how a firm launches a new product in a market (Lumpkin & Dess, 1996, p. 152). In essence, the unidimensional EO focuses on "what is *common* among entrepreneurial firms," while the multidimensional EO emphasizes "how entrepreneurial firms can be *different*" (italics original) (Covin & Wales, 2019, p. 4). As Covin and Lumpkin (2011, p. 863) note, "researchers will be well served by acknowledging the distinctiveness of these two conceptualizations and by explicitly recognizing and defending the particular conceptualization being employed in their research." We examine how investors interpret a health science firm's EO rhetoric as a unitary signal, rather than how they compare different dimensions of that signal, and therefore treat EO as a unidimensional construct.

Whereas survey-based EO research captures entrepreneurial attitudes *and* behaviors (Covin & Slevin, 1988, 1989), studies of EO rhetoric focus on top managers' *expressions* of those attitudes and their *statements* about those behaviors (McKenny, Short, Ketchen, Payne, & Moss, 2018; Watson et al., 2019). These expressions constitute "the strategic use of words in organizational narratives" (Watson et al., 2019, p. 752) and do not necessarily mean that the firm has made substantive commitment to innovative, proactive, and risk-taking decisions and behaviors. Building upon content analysis of firm communications (McKenny et al., 2018; Short et al., 2010), researchers have started to explore how outsiders interpret and react to firms' EO rhetoric (Short, Zachary, & Ketchen, 2018; Watson et al., 2019), especially how that rhetoric affects a firm's valuation (Engelen et al., 2016; McKenny et al., 2018; Short et al., 2010).

Firm value is generally defined from the perspective of investors owning the firm's assets and residual value (Wang & Thornhill, 2010). For example, in financial interactions, firm value is essentially the price at which potential investors are willing to buy the company and current investors are willing to sell it. In this situation, the firm's market value is collectively determined by potential and current investors, and can be higher or lower than the book value of its assets. Whereas book value captures the asset replacement costs if the firm is rebuilt, market value can be thought of as its expected future returns to investors. The ratio of market value to book value, which serves as the foundation for calculating different forms of Tobin's *Q*, reflects investors' perception of the firm's value. The higher the ratio of market to book value, the higher the valuation that investors have for the firm (Chung & Pruitt, 1994). As a result, Tobin's *Q* has been increasingly used to examine the effect of EO rhetoric on firm valuation (Engelen et al., 2016; McKenny et al., 2018; Short et al., 2010).

Given the soft-information character of EO rhetoric, can investors use health science firms' EO rhetoric to facilitate their valuation of these firms? To answer this question, we posit that investors will pay attention to health science firms' EO rhetoric *over time* and derive implicit information for their valuation. Firms communicate with outsiders through periodic documents and materials (e.g., annual reports and CEO shareholder letters). Such repeated signaling creates an opportunity for false signals to be detected and penalized (Kaya, 2009; Manelli, 1996), thereby creating an assurance that a repeated signal is credible. In other words, one can get more reliable information by looking at EO rhetoric over time rather than merely at a cross-sectional data point.

2.3 | Average EO rhetoric over time and health science firm valuation

We first argue that *average EO rhetoric over time*, or the extent to which firms differ in their average EO rhetoric during an observation window, helps investors identify health science firms with substantive commitment to product innovation and market entry, and thus increases their confidence in the firms.

As we note above, the development horizons of health science products are lengthy (Gittelman, 2016; Mohs & Greig, 2017), partly because the strict regulations of the U.S. FDA can reduce success rates and increase the time needed to reach each of the milestones in product development (Hay, Thomas, Craighead, Economides, & Rosenthal, 2014). Consequently, health science firms must sustain their strategies and behaviors to embrace and enable product innovation and market entry over long periods of time, and it is reasonable to believe that such firms will demonstrate a high level of EO rhetoric over time.

This sustained EO rhetoric, in turn, lengthens the time window during which investors can verify the reliability and credibility of the signal (Connelly et al., 2011). Pure impression management to manipulate outsiders has a high likelihood of being discovered over time (Connelly et al., 2011; Merkl-Davies & Brennan, 2007), as investors will eventually notice the discrepancy between what the firm says and does. In contrast, investors are more likely to consider consistent EO rhetoric over time that matches objective criteria as a credible signal and value the firm accordingly. Therefore,

Hypothesis 1: *Average EO rhetoric over time has a positive relationship with health science firm valuation, so that health science firms with higher average EO rhetoric over time have higher valuations.*

2.4 | Change in EO rhetoric and health science firm valuation

If investors favor health science firms that maintain a high average level of EO rhetoric over time, how might they interpret and react to a sudden increase in that rhetoric? We argue that investors are likely to interpret such an increase as indicating that the firm is overestimating the potential of its opportunities and underestimating its risks (Kreiser, Anderson, Kuratko, & Marino, 2020). First, notable increases in EO rhetoric may indicate overconfidence on the part of top managers (Engelen, Neumann, & Schwens, 2015). An occasional increase in strategic and behavioral inclinations toward product innovation and entry opportunities does not always foreshadow returns, given the uncertainty and high failure rates associated with the lengthy product development process (Hay et al., 2014).

Second, investors are well aware that firm insiders may intentionally manipulate information in the firm's communications with outsiders to present a more favorable image. For example, firms may use more positive language in their communications before selling new equity (Lang & Lundholm, 2000). This manipulation benefits top managers and current owners at the expense of potential investors (Merkl-Davies & Brennan, 2007). Innovation is key to addressing both endemic and sudden public health problems (Gittelman, 2016), so it stands to reason that an EO in health science firms can be socially desirable. However, investors must discern whether the top management is

emphasizing EO rhetoric as an impression management tool to further short-term self-interests rather than long-term commitment to the development of more innovative products that can solve health problems.

Third, a sudden increase in EO rhetoric may also be perceived as an attempt to draw investors' attention away from potential adverse events of the firm (Abrahamson & Park, 1994; Merkl-Davies & Brennan, 2007). One of the most critical negative events for health science firms is related to product failures, which can pose great risks to patients and society, and significantly affect top managers' personal wealth (Wowak, Mannor, & Wowak, 2015). Since product failures are inevitable at some point given human fallibility and bounded rationality (Reason, 1990, 2016), investors may suspect that an increase in EO rhetoric is being used to distract them from some negative information of the business.

Finally, an increase in EO rhetoric may be interpreted as an attempt to mislead competitors rather than reflecting the firm's real decisions about product innovation and market entry. For example, the firm may use a vaporware strategy, announcing plans to pursue a new product opportunity when it does not believe in the product's potential and has no real intention to develop it (Ofek & Turut, 2013).

Taken together, an occasional increase in EO rhetoric allows a multitude of possible interpretations, thereby increasing the perceived uncertainty of returns from investing in the firm. Investors have long been found to lower their valuation of firms with higher perceived uncertainty (Miller & Reilly, 1987). Therefore,

Hypothesis 2: *After accounting for average EO rhetoric over time, change in EO rhetoric has a negative relationship with health science firm valuation, so that as health science firms increase their EO rhetoric, their valuations decrease.*

2.5 | Signaling complementarity of entry commitment

Investors valuing a health science firm are unlikely to rely on a single signal but tend to derive important implications from the combination and configuration of different signals (Wang, Qureshi, Deeds, & Ren, 2019). Therefore, complementary hard-information signals, which involve signaling costs (e.g., irreversible investments) or penalty costs (e.g., reputation losses), should temper investors' speculation toward changes in EO rhetoric. One kind of signaling cost relates to entry commitment, the extent to which firms have committed irreversible investments (Williamson, 1983) toward product-market entry (Surdu, Mellahi, & Glaister, 2019).

Entry commitment, while not theorized sufficiently in the entrepreneurship literature, has profound implications for research on EO rhetoric. As Lumpkin and Dess (1996: 136) have clarified, "new entry explains *what* entrepreneurship consists of, and entrepreneurial orientation describes *how* new entry is undertaken" (italic original). Traditional EO studies have included both managerial attitudes toward *and* firm behaviors of new entry within the conceptualization and measurement of EO as a whole (Covin & Slevin, 1989; Miller, 1983). Focusing on EO rhetoric (Allison, McKenny, & Short, 2013; Watson et al., 2019), however, scholars have begun to disentangle managerial attitudes and style from the organizational resources committed to new entry (Wales et al., 2020). Such resource commitment can be conceived as a signal that complements EO rhetoric.

Since a change in EO rhetoric does not necessarily imply corresponding substantive resource commitment, investors' doubts will be mitigated if the firm has made irreversible investments toward product-market entry, using assets that cannot be redeployed (Balakrishnan & Fox, 1993; Williamson, 1983). In essence, entry commitment offers critical, complementary behavioral evidence to investors about the firm's change in EO rhetoric. Given that obtaining regulatory approval for medical products is an increasingly costly process (Hoang & Rothaermel, 2010), resource commitment to that process signals that an increase in EO rhetoric reflects the firm's real strategies and behaviors to foster product innovation and market entry (Covin & Wales, 2019), rather than being an artifact of impression management. Therefore,

Hypothesis 3: *Entry commitment moderates the relationship between change in EO rhetoric and health science firm valuation, so that this relationship is less negative for firms with a concurrent change in entry commitment.*

2.6 | Signaling complementarity of corporate social responsibility

To differentiate among health science firms regarding their use of hard-information signals that involve substantial penalty costs, we examine the contingent effect of corporate social responsibility (CSR), which refers to "the firm's consideration of, and response to, issues beyond the narrow economic, technical, and legal requirements of the firm" (Davis, 1973, p. 312). Although researchers have extensively studied the relationship between CSR and firm financial performance, the signaling function of CSR has recently gained scholarly attention (Flammer, 2018; Su, Peng, Tan, & Cheung, 2016). Firms with a high level of CSR support local communities, donate to charities, engage with advocacy groups, provide equal employment and promotion opportunities for employees, place women and minority members on boards, and so on. These activities help a firm establish a reputation as a good corporate citizen and as being trustworthy (i.e., not behaving opportunistically) (Flammer, 2018).

A positive reputation and trustworthiness can be considered valuable assets that enable an organization to achieve competitive advantages and realize insurance-type benefits (Flammer, 2018; Su et al., 2016). The more the firm has invested in CSR, the more valuable its reputation and trustworthiness will be (Vanhamme & Grobben, 2009). Although CSR instills trust in a variety of stakeholders, that trust can be lost easily through as few as two adverse events (e.g., disputes and scandals) (Shiu & Yang, 2017). False signaling by top management to further self-interests, hide negative news, or mislead stakeholders, if being discovered, can be important negative events and thus damage the firm's reputation and trustworthiness.

For a signal to be credible, a high-quality signaler often needs to bear higher penalty costs for false signaling than a low-quality signaler (Bergh et al., 2014). Losses in reputation and trustworthiness (Bergh et al., 2014; Certo, Daily, & Dalton, 2001) can cost a firm its legitimacy (O'Riordan & Fairbrass, 2014; Wang et al., 2019). Because firms with a high level of CSR tend to have a more valuable reputation and trustworthiness than those with a low level of CSR (Flammer, 2018; Vanhamme & Grobben, 2009), the former have more to lose through false signaling—they would pay a higher penalty cost. Knowing this, investors are likely to place credit in an increase in EO rhetoric by a health science firm that concurrently emphasizes CSR. Therefore,

Hypothesis 4: *CSR moderates the relationship between change in EO rhetoric and health science firm valuation, so that this relationship is less negative among firms with a concurrent change in CSR.*

3 | METHODS

3.1 | Sample

We used the Compustat North America annual fundamental database to calculate Tobin's *Q*, our dependent variable, and the related control variables. From the Compustat database, we identified all the firm-year observations in the health science industries defined by three-digit standard industrial classification (SIC) codes 283 (drugs) and 384 (surgical, medical, and dental instruments and supplies). Although their primary SIC codes were not 283 or 384, some other companies had conducted clinical studies, suggesting that their products were also subject to regulation by the U.S. FDA (U.S. FDA, 2016). We included these firms, which we identified by their clinical research records from the U.S. National Library of Medicine (www.clinicaltrials.org).

CEOs' shareholder letters reflect their strategic directions for their firms (Gamache, McNamara, Mannor, & Johnson, 2015). We used the CEO shareholder letters of the sampled firms to measure EO rhetoric (McKenny et al., 2018; Short et al., 2010), in line with upper-echelons theory (Hambrick, 2007). The Sarbanes-Oxley Act, enacted on July 30, 2002 (Zhang, 2007), gradually enhanced the accuracy of statements in these letters, which are

normally attached to firms' annual reports, so we included CEO shareholder letters from 2004 onward. We collected these letters from www.morningstar.com, www.annualreports.com, and the official websites of the sampled firms, and found that a significant number of our sampled firms had stopped providing CEO shareholder letters through these websites since 2013. We thus collected letters for the years 2004–2012.

To measure CSR, we drew data from KLD's universe C sample (Ioannou & Serafeim, 2015; Perrault & Quinn, 2018; Short, McKenny, Ketchen, Snow, & Hult, 2016), which includes the original 400 social index firms and the 1,000 largest U.S. companies (MSCI ESG Research Inc, 2013). We excluded firms with fewer than 100 employees, given that such small firms may lack the resources to commit to CSR (Wang & Bansal, 2012). By matching firms across the data sources, we obtained a final sample of 212 firms with 926 firm-year observations over 2004–2012 (both inclusive). Out of the 212 firms, 114 primarily produced drugs and 98 mainly produced medical devices.

3.2 | Measures

3.2.1 | Firm valuation

We measured firm valuation using *Tobin's Q* (Chung & Pruitt, 1994):

$$Tobin's\ Q = (MVE + PS + DEBT)/TA \quad (1)$$

In Equation (1), *MVE* is the product of the firm's average stock price and the number of outstanding common shares, *PS* is the liquidation value of its outstanding preferred stocks, *DEBT* is the value of its long-term debt plus its short-term liabilities net of short-term assets, and *TA* is the book value of its total assets. Signaling theory assumes information asymmetry between participants in a market transaction (Spence, 1973, 2002), and Tobin's *Q* is determined by the transaction between current and potential investors at a certain stock price. In order to mitigate the influence of firms with extremely high or low valuations, we winsorized Tobin's *Q* by specifying 1% of observations in each tail (i.e., scores lower than the 1st percentile or higher than the 99th percentile were replaced by the next scores counting inwards from these extremes) (Gnanadesikan & Kettenring, 1972).

3.2.2 | EO rhetoric

Short et al. (2010) developed a measure of EO rhetoric by searching a firm's official documents for keywords related to EO dimensions, on the assumption that the appearance of these keywords reflects the top managers' attention to particular strategies (Abrahamson & Hambrick, 1997; Sapir, 1944; Whorf, 1956). Building on Short and colleagues' dictionary of keywords, McKenny et al. (2018) added other keywords that may be used by technology firms to demonstrate their EO. We adopted this new dictionary of EO keywords because our sampled firms mainly operate in industries defined by SIC codes 283 and 384, which are widely considered high-tech industries (Wang et al., 2017). We used CAT Scanner, a specialty tool designed to capture keywords for content analysis (McKenny et al., 2018), by counting the appearance times of EO keywords included in the CEOs' shareholder letters of the sampled firms. As we note above, we adopt the unidimensional conceptualization of EO because we examine how investors interpret a health science firm's EO rhetoric as a unitary signal rather than how they compare different dimensions of that signal. Therefore, we measured EO rhetoric by summing the instances of EO keywords related to innovativeness, proactiveness, and risk-taking. In order to mitigate the influence of extremely high and low uses of EO keywords in these letters, we winsorized EO rhetoric by specifying 1% of observations in each tail (Gnanadesikan & Kettenring, 1972).

3.2.3 | Entry commitment

By definition, entry commitment captures a firm's investments and actions that serve as behavioral evidence of irreversible resource commitment toward innovation and new product-market entry and therefore provide a more concrete, hard information signal to investors. We measured entry commitment using these firms' submissions for new drugs and applications for premarket approval of new medical devices, collected from the official website of the U.S. FDA. For drugs, we included all applications classified as "original submissions" by the U.S. FDA. For medical devices, we included all premarket approval applications required for new medical devices. Both original submissions for new drugs and applications for premarket approval of new devices indicate that the firm has conducted rounds of preclinical research and clinical studies, which require investments in developing labs, enrolling patient participants, and collaborating with organizations with the needed knowledge and expertise (Deeds, Decarolis, & Coombs, 1997; Gittelman, 2016). In general, these investments are irreversible and the assets cannot be redeployed (Balakrishnan & Fox, 1993; Williamson, 1983). Therefore, they serve as a hard-information signal of entry commitment (Bergh et al., 2014; Connelly et al., 2011).

For each sampled firm, we counted the number of original submissions for new drugs and applications for premarket approval of medical devices over a 3-year window.[1] On average, the 212 firms during a three-year window had 0.42 original submissions for drugs and 0.09 premarket approval applications for medical devices. Because a firm may enter both new drug and new device markets and the two procedures often differ in cost, we calculated a standardized score of entry commitment by using the following equation:

$$EC = N/SD_N + M/SD_M \quad (2)$$

In Equation (2), EC is the firm's entry commitment, N is the number of 3-year accumulated original submissions for new drugs, SD_N is the standard deviation of N in the sample, M is the number of 3-year accumulated applications for premarket approval of medical devices, and SD_M is the standard deviation of M in the sample.

3.2.4 | Corporate social responsibility

We measured CSR by using the seven social assessments from the KLD database: community, diversity, employee treatment, environment, products, corporate governance, and human rights (Short et al., 2016). The KLD database has assessed strengths and concerns in each of these areas (Perrault & Quinn, 2018). The use of the KLD database to measure CSR has been evolving, with increasing acknowledgment that it is problematic to aggregate all the items (Parks & Cardinal, 2018) and that researchers need to distinguish between CSR and corporate social irresponsibility (CSiR) (Fu, Tang, & Chen, 2019; Strike, Gao, & Bansal, 2006). The KLD strengths and concerns in the seven areas are not necessarily opposite, and firms may be responsible in some areas and irresponsible in some other areas simultaneously (Clark & Crawford, 2012; Entine, 2003; Oikonomou, Brooks, & Pavelin, 2014; Strike et al., 2006). For these reasons, we used KLD strengths to measure a firm's CSR (Fu et al., 2019; Strike et al., 2006), and controlled for the effect of CSiR using KLD concerns.

A potential problem with the KLD data is that different items were adopted in different years. Following Short et al. (2016), we standardized a firm's strength in each of the seven areas by dividing its number of strengths by the total number of items being assessed in the given area and given year. For example, if firm A has two strengths in employee treatment and the KLD evaluators assessed six items of employee treatment in the given year, the firm's standardized strength in employee treatment would be 0.33. We then summed the standardized strengths in all the seven areas to measure the firm's CSR (Short et al., 2016). The larger the summed score, the more the firm demonstrates its commitment to CSR.

3.2.5 | Control variables

Although our sampled firms were all strictly regulated, they still differ in the regulatory exposure of their primary products. For example, compared with pharmaceutical firms, medical device companies in general face fewer strict regulations. The U.S. FDA categorizes medical devices into three classes (general controls, general controls and special controls, and general controls and premarket approval) (Zuckerman, Brown, & Nissen, 2011). For most medical devices, only registration was needed before launching (i.e., there was no need to obtain premarket approval). In contrast, drug companies need to conduct a variety of stricter clinical studies (Gittelman, 2016), take longer development time (Mohs & Greig, 2017), and have a higher rate of failure to obtain FDA approval (Hay et al., 2014). To control for these differences, we used RegData 3.1 to measure these firms' *regulatory stringency*, as other researchers have suggested (Audretsch, Belitski, & Desai, 2019; Bailey & Thomas, 2017). RegData 3.1 captures the stringency, by industry, of the Code of Federal Registrations (Bradley & Klein, 2016; Goldschlag & Tabarrok, 2018), which compiles all federal regulations in the United States. We measured regulatory stringency at the three-digit NAICS industry level. Each industry in RegData 3.1 has a restriction score; the larger the score is, the more stringent the regulations in that industry. The regulatory stringency score is a continuous variable that changes over time, and thus can capture refined differences in these firms' regulatory restrictions over the observation period.

An EO consumes resources (Wiklund & Shepherd, 2003, 2005). Because larger firms often have more resources, we controlled for *firm size* by using the firm's total assets (in thousand U.S. dollars, log-transformed). The possession of slack resources is also related to innovativeness (Nohria & Gulati, 1996), a key EO dimension (Rauch et al., 2009). We thus controlled for the effect of *financial slack*, measured by the ratio of cash to current liabilities (Bourgeois, 1981). As discussed above, we measured a firm's EO rhetoric by counting the instances of EO keywords in a CEO shareholder letter. However, the longer the CEO shareholder letter, the more likely that such keywords would appear. We thus controlled for *letter length* measured by the number of total sentences in a letter. In order to mitigate the influence of firms that have extremely long or short CEO shareholder letters, we winsorized letter length by specifying 1% of observations in each tail (Gnanadesikan & Kettenring, 1972).

A firm's valuation may move in tandem with its financial performance (Blanchard, Rhee, & Summers, 1993). Thus, we controlled for financial performance by including *return on assets* (i.e., the ratio of earnings before tax and interest to total assets) in our regression models. A firm's R&D investments have been widely considered an important factor that can reflect the firm's specific assets (Wang & Thornhill, 2010), which can ultimately influence the firm's valuation. Therefore, we also controlled for the effect of *R&D ratio*, measured by R&D investment divided by the firm's total revenue. Because some firms did not generate a large amount of revenue but still invested significant capital in R&D, R&D ratio is skewed to the right. To mitigate this issue, we assigned a value of 1 to R&D ratio for observations that had higher R&D investments than total revenue.

Firms with an EO may borrow heavily (i.e., risk-taking) (Lumpkin & Dess, 1996; Miller, 1983). For this reason, we controlled for *debt ratio*, measured by dividing the firm's long-term debt by its total assets. Firms may be socially responsible and socially irresponsible at the same time (Fu et al., 2019; Strike et al., 2006). Therefore, we also controlled for *CSiR* using KLD "concerns" in the areas of community, diversity, employee treatment, environment, products, corporate governance, human rights, and involvement in stigmatized businesses (i.e., alcohol, tobacco, gambling, weapons, and nuclear energy) (Hillman & Keim, 2001; Waddock & Graves, 1997). Again, we standardized a firm's items of concern within an area by dividing the total number of concern items by the total number of items evaluated by KLD (Short et al., 2016), and then measured CSiR by summing all the standardized concern scores. Finally, to control for the temporal differences over 2004–2012, we included eight binary variables in our regression models (i.e., year-fixed effects).

3.3 | Analysis

By focusing on the effect of average EO rhetoric over time on firm valuation, Hypothesis 1 investigates a between-firm relationship. Hypothesis 2 examines the effect of change in EO rhetoric over time on firm valuation and

essentially focuses on a within-firm relationship. Although the between-effects and the fixed-effects models for panel data can test the two hypotheses separately, each has its own limitations. The fixed-effects models have an advantage in controlling for the effects of unobserved factors at the firm level but cannot estimate the effect of any variable that does not change over time (Certo et al., 2017).

To overcome the limitations of the between-effects and the fixed-effects models, researchers propose that the hybrid approach is a better alternative for disentangling the between- and within-firm relationships of a predictor and an outcome variable (Certo et al., 2017; Schunck, 2013). More specifically, the hybrid approach can combine the advantages of both effects by splitting the predictor into two factors: a firm-mean score that captures the between-firm relationship and a firm-mean deviation score that captures the within-firm relationship in the random-effects models (Certo et al., 2017; Schunck, 2013). Furthermore, the hybrid approach enables testing for equivalence of the between- and within-firm relationships (Schunck, 2013), thus offering extra evidence for Hypotheses 1 and 2.

We adopted the hybrid approach by following the procedure recommended by Schunck (2013). We first calculated the firm-mean and firm-mean deviation scores of EO rhetoric, entry commitment, and CSR. In order to test the moderation effects of entry commitment and CSR (Hypotheses 3 and 4), we obtained the interaction (product) terms of EO rhetoric and entry commitment and of EO rhetoric and CSR. For both interaction terms, we then calculated their firm-mean and firm-mean deviation scores. As explained by Schunck (2013), in order to obtain the correct estimates of an interaction effect using the hybrid approach, both firm-mean and firm-mean deviation scores of the interaction term need to be included in the random-effects models. Because the firm-mean deviation score of the interaction term reflects the change in both the predictor and the moderator (Schunck, 2013), we used the estimates of the firm-mean deviation scores of the interaction terms as evidence for Hypotheses 3 and 4, with the firm-mean scores of the interaction terms controlled in the random-effects models (Schunck, 2013).

Our empirical model can be described as follows:

$$Tobin's\ Q_{i(t+1)} = \beta_0 + \beta_{1i}\, EO\ rhetoric\_mean_i + \beta_{2it}(EO\ rhetoric\_deviation_{it}, entry\ commitment\_deviation_{it}, CSR\_deviation_{it}) + \beta_{1i}(controls\ variables_{it}) + u_i + \epsilon_{it} \quad (3)$$

In Equation (3), the 1-year lag between the predictors and Tobin's *Q* helps reduce concerns about reverse causality.

4 | RESULTS

Table 1 reports the descriptive statistics and bivariate correlations of all variables except the 8 year dummies. The mean value of EO rhetoric was 30.251, indicating that within a CEO's shareholder letter, keywords signaling EO would appear 30.251 times. Model 1 in Table 2 is the base model that includes all the control variables, the firm-mean and firm-mean deviation scores of entry commitment, and the firm-mean and firm-mean deviation scores of CSR. Model 2 adds the firm-mean and firm-mean deviation scores of EO rhetoric. The regression coefficient of EO rhetoric's firm-mean score was positive and significant ($b = 0.016$, $p < .05$), thus demonstrating the presence of the between-firm relationship. On average, for health science firms with 1 standard deviation higher in the appearance of EO keywords in the CEO shareholder letters (i.e., 14.669 times) over the observation period, their valuations measured by Tobin's Q_{t+1} would be higher by about 23.470% (i.e., 1.6% × 14.669). Therefore, Hypothesis 1 is supported.

The regression coefficient of EO rhetoric's firm-mean deviation score was negative and significant ($b = -0.009$, $p < .05$), thus demonstrating the presence of the within-firm relationship. On average, for health science firms that had increased their EO keyword appearance on the CEO shareholder letter by 1 standard deviation (i.e., 11.014 times), their valuations measured by Tobin's *Q* would decrease by 9.913% (0.9% × 11.014). Therefore, Hypothesis 2 is supported. Following Schunck (2013, p. 69), we also tested the equality of the estimates of the between-and

TABLE 1 Descriptive statistics and bivariate correlations

	Mean	*SD*	Min	Max	1	2	3	4	5	6	7	8	9	10	11	12
1. Tobin's Q_{t+1}	2.172	1.544	0.259	11.500												
2. EOR (firm-mean)	30.251	14.669	4.000	71.200	0.100											
3. EOR (firm-mean deviation)	0.000	11.014	−41.889	44.800	−0.054	0.000										
4. EC	0.265	1.171	0.000	14.683	−0.100	0.059	−0.033									
5. CSR	0.632	1.021	0.000	5.383	−0.095	0.334	−0.036	0.165								
6. Regulatory stringency	6.308	5.287	0.000	11.209	0.209	0.285	−0.001	0.021	0.153							
7. Firm size	6.976	1.956	2.892	12.269	−0.262	0.308	−0.005	0.223	0.688	0.027						
8. Financial slack	3.899	3.025	0.487	21.952	0.130	−0.093	0.007	−0.102	−0.296	0.128	−0.431					
9. Return on assets	0.020	0.253	−3.187	1.647	−0.211	0.010	−0.011	0.088	0.235	−0.186	0.440	−0.243				
10. R&D ratio	0.271	0.343	0.000	1.000	0.288	0.162	0.019	−0.083	−0.214	0.424	−0.382	0.407	−0.708			
11. Debt ratio	0.170	0.210	0.000	1.705	−0.064	0.111	−0.022	0.027	0.005	0.174	0.114	−0.074	−0.159	0.214		
12. Letter length	67.605	37.392	9.000	205.000	−0.069	0.508	0.336	0.060	0.311	0.010	0.420	−0.258	0.248	−0.245	−0.042	
13. CSiR	0.944	0.854	0.000	6.000	−0.126	0.142	0.009	0.167	0.392	0.008	0.391	−0.182	0.129	−0.143	0.028	0.196

Abbreviations: CS(i)R, corporate social (ir)responsibility; EC, entry commitment; EOR, entrepreneurial orientation rhetoric; SD, standard deviation.
Note: Correlations with absolute value larger than 0.057, 0.070, and 0.088 were significant at $p < .10$, $p < .05$, and $p < .01$, respectively (two-tailed tests).

TABLE 2 Regressions on Tobin's Q_{t+1}

	Model 1	Model 2	Model 3	Model 4	Model 5
Constant	4.140 (0.442)***	3.847 (0.439)***	3.854 (0.446)***	3.802 (0.442)***	3.815 (0.447)***
Regulatory stringency	0.039 (0.019)*	0.029 (0.018)	0.029 (0.019)	0.029 (0.018)	0.028 (0.019)
Firm size	−0.297 (0.063)***	−0.327 (0.063)***	−0.328 (0.063)***	−0.330 (0.063)***	−0.333 (0.064)***
Financial slack	−0.058 (0.025)*	−0.056 (0.025)*	−0.055 (0.025)*	−0.055 (0.025)*	−0.055 (0.025)*
Return on assets	0.091 (0.488)	0.077 (0.478)	0.070 (0.473)	0.079 (0.471)	0.072 (0.465)
R&D ratio	0.719 (0.361)*	0.683 (0.372)†	0.685 (0.371)†	0.701 (0.372)†	0.702 (0.372)†
Debt ratio	−0.777 (0.290)**	−0.821 (0.286)**	−0.823 (0.286)**	−0.850 (0.286)**	−0.853 (0.287)**
Letter length	−0.001 (0.001)	0.001 (0.001)	0.000 (0.001)	0.000 (0.001)	0.000 (0.001)
CSiR	0.036 (0.065)	0.034 (0.064)	0.031 (0.064)	0.041 (0.063)	0.037 (0.063)
EC (firm-mean)	−0.123 (0.064)†	−0.119 (0.066)†	−0.106 (0.239)	−0.122 (0.064)†	−0.151 (0.242)
EC (firm-mean deviation)	0.034 (0.048)	0.023 (0.049)	−0.068 (0.033)*	0.041 (0.047)	−0.055 (0.028)*
CSR (firm-mean)	0.324 (0.113)**	0.259 (0.112)*	0.266 (0.112)*	0.418 (0.203)*	0.430 (0.212)*
CSR (firm-mean deviation)	−0.334 (0.101)***	−0.345 (0.105)**	−0.328 (0.108)**	−0.513 (0.128)***	−0.501 (0.131)***
EOR (firm-mean)		0.016 (0.007)*	0.016 (0.007)*	0.018 (0.008)*	0.018 (0.008)*
EOR (firm-mean deviation)		−0.009 (0.004)*	−0.009 (0.004)*	−0.014 (0.005)**	−0.014 (0.005)**
EOR ×EC (firm-mean)			−0.000 (0.007)		0.001 (0.007)
EOR×EC (firm-mean deviation)			0.006 (0.002)**		0.006 (0.002)**
EOR×CSR (firm-mean)				−0.004 (0.004)	−0.004 (0.004)
EOR×CSR (firm-mean deviation)				0.005 (0.002)*	0.005 (0.002)**
R2 within	0.141	0.152	0.156	0.161	0.165
Between	0.183	0.205	0.205	0.206	0.206
Overall	0.190	0.201	0.202	0.205	0.207

Abbreviations: CS(i)R, corporate social (ir)responsibility; EC, entry commitment; EOR, entrepreneurial orientation rhetoric.

Notes: (a) The firm-mean and firm-mean deviation scores of a variable captures its between-firm and within-firm effects, respectively; (b) Eight year dummies were included in all the models; (c) Unstandardized coefficients (numbers in brackets are standard errors), $^{\dagger}p < .10$, $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$ (two-tailed tests).

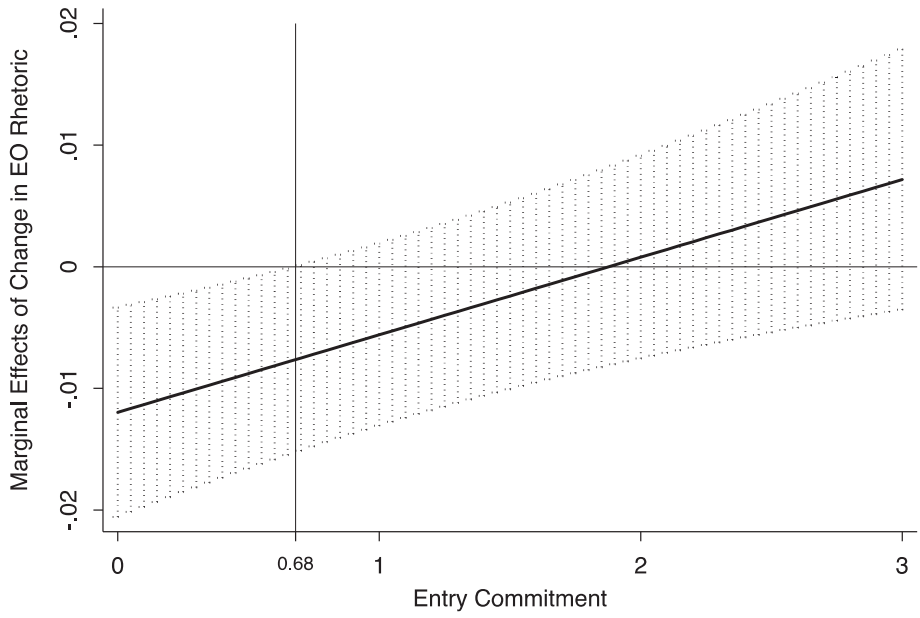

FIGURE 1 Marginal effects of change in EO rhetoric on Tobin's Q_{t+1} across entry commitment. *Notes:* (a) Plots are based on estimates from the fixed-effects model with both interaction terms; (b) Dashed bars represent 95% confidence intervals; (c) The negative effect of change in EO rhetoric on Tobin's Q_{t+1} was significant when the measure of entry commitment was lower than 0.68. EO, entrepreneurial orientation.

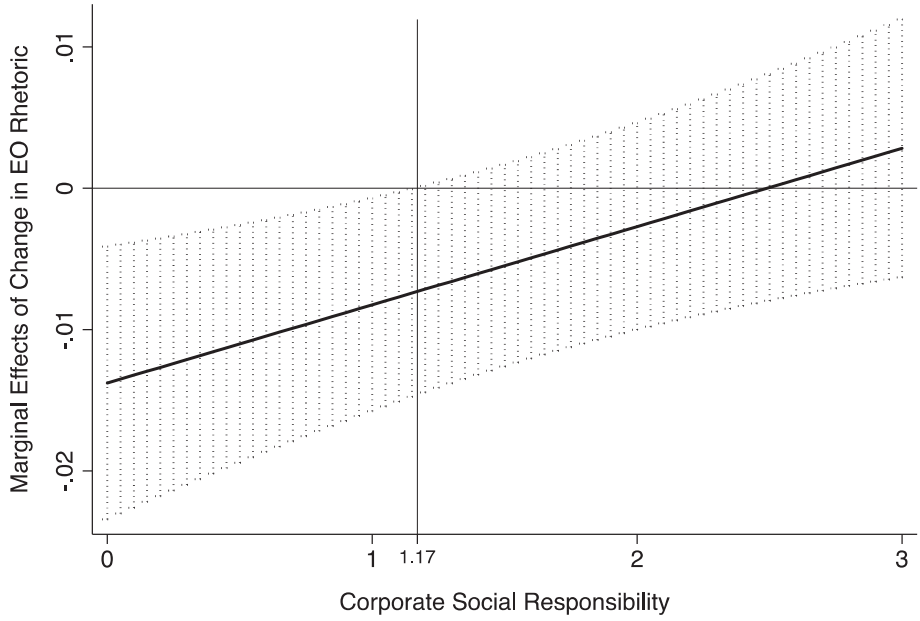

FIGURE 2 Marginal effects of change in EO rhetoric on Tobin's Q_{t+1} across corporate social responsibility. *Notes:* (a) Plots are based on estimates from the fixed-effects model with both interaction terms; (b) Dashed bars represent 95% confidence intervals; (c) The negative effect of change in EO rhetoric on Tobin's Q_{t+1} was significant when the measure of corporate social responsibility was lower than 1.17. EO, entrepreneurial orientation.

within-firm relationships. We found that the chi-squared test for equality is 12.51 ($p < .001$), providing further evidence that average EO rhetoric and change in EO rhetoric have different effects on health science firm valuation.

In Model 3, we added both the firm-mean and firm-mean deviation scores of the interaction term between EO rhetoric and entry commitment. After we accounted for the firm-mean of the interaction term, its firm-mean deviation score produced a positive and significant coefficient with Tobin's Q_{t+1} ($b = 0.006$, $p < .01$), supporting Hypothesis 3. In Model 4, we added both the firm-mean and firm-mean deviation scores of the interaction term between EO rhetoric and CSR. After we accounted for the firm-mean of the interaction term, its firm-mean deviation score produced a positive and significant coefficient with Tobin's Q_{t+1} ($b = 0.005$, $p < .05$), supporting Hypothesis 4. We also included the firm-mean and firm-mean deviation scores of both interaction terms in Model 5, and they produced results similar to those reported in Models 3 and 4.

We plotted the marginal effects of change in EO rhetoric on Tobin's Q_{t+1} across different levels of entry commitment and CSR, using estimates obtained from the fixed-effect model with both interaction terms.[2] As Figure 1 illustrates, the estimated marginal effects of change in EO rhetoric on Tobin's Q_{t+1} were significant when the measure of entry commitment was lower than 0.68. As Figure 2 illustrates, the estimated marginal effects of change in EO rhetoric on Tobin's Q_{t+1} were significant when CSR was lower than 1.17. Overall, these visual illustrations suggest that the negative effect of change in EO rhetoric on firm valuation is mitigated for health science firms with a concurrent change in entry commitment or CSR.

5 | DISCUSSION

These findings suggest that, over our observation window, investors bestow higher valuations on health science firms that maintain higher average EO rhetoric over time. An occasional increase in that rhetoric, however, prompts investor skepticism and lowers health science firms' valuations. We also find that a concurrent increase in entry commitment or CSR helps mitigate investors' skepticism. By joining scholarly conversations on health science firms that are increasingly important because of the rising health issues around the world, this study contributes to entrepreneurship and regulation research in several ways.

5.1 | Theoretical implications

First, we contribute to the EO literature by focusing on health science firms that face strict regulations by the U.S. FDA. As Miller (2011: 881) has recommended, researchers should "study EO within a carefully defined industry context" to better elucidate the particular challenges and opportunities associated with EO. We answer this call by incorporating the industry-specific characteristics of health science firms within EO research to reveal nuanced mechanisms that engender new insights into the context. Health science firms are characterized by long horizons of product development due to the discovery-driven nature of health science products and the strict regulations enacted by the FDA (Gittelman, 2016; Mohs & Greig, 2017). Therefore, health science firms are likely to benefit from an EO; without innovative, proactive, and risk-taking decisions and behaviors, they cannot develop novel products and enter promising markets.

However, strict FDA regulations place more emphasis on the safety of the public. Briggeman et al. (2016: 3) have even claimed that "In a sense, the FDA has restated its mission from *promoting* health to *protecting* health, from permitting new products that can advance health to demanding certainty that products will not cause any harm" (italics original). Increases in regulatory restrictions can lead to higher compliance costs for new entry (Chambers, McLaughlin, & Richards, 2018). Therefore, health science firms seem to face a dilemma. On the one hand, their EO is critical for them to pursue successful product innovation and market entry. On the other hand, strict regulations by the FDA make it difficult for them to realize economic returns from their EO, even if their innovative products are better, safer, and healthier than the existing ones (Lindblom, 2018). By considering this dilemma, our study suggests

that in certain industries, such as health science, EO's contributions to firm performance and valuation can be rather different from those identified in the extant research.

Second, we contribute to the emerging stream of research on the signaling function of EO rhetoric by offering a novel and nuanced distinction between average and change in EO rhetoric over time. Given the information asymmetry between firm insiders and outsiders, potential investors may not be confident in a health science firm without observing strong indicators that the firm can achieve successful product innovation and market entry. Researchers have started to consider EO rhetoric as a signal (Allison et al., 2013; Watson et al., 2019) that may reduce information asymmetry between the firm and potential investors. Drawing upon the theory of repeated signaling (Kaya, 2009; Manelli, 1996), we argue that average EO rhetoric and change in EO rhetoric over time play different roles in affecting information asymmetry between firm insiders and outsiders.

We find that sustained EO rhetoric over time is perceived well, while an occasional increase in EO rhetoric is met with investors' skepticism. Complex regulations are likely to make regulators dependent on industry expertise (Alvarez, Young, & Woolley, 2015), thus giving investors' confidence that firms with EO rhetoric sustained over time would be more influential in extracting economic rents than their industry rivals. However, investors may perceive an occasional increase in EO rhetoric as managerial overconfidence and impression management, since they know the many regulatory "hoops" that the firms have to jump through before launching their products in the markets.

Our findings that average EO rhetoric and change in EO rhetoric over time exhibit opposite effects on firm valuation support Certo et al. (2017), who point out that the between-firm and within-firm variances of an organizational factor can have profound and different theoretical implications that are largely neglected in the management literature. This may explain the inconsistent findings of past studies examining EO rhetoric. Some researchers have reported a positive relationship between EO rhetoric and firm valuation (Engelen et al., 2016; Liu, Tang, Yang, & Arthurs, 2019; Moss, Neubaum, & Meyskens, 2015), while others have shown a negative relationship (Mousa, Wales, & Harper, 2015; Short et al., 2010). In the industry we examine, strict FDA regulations and the consequent long product development horizons make it likely that false signals will be discovered and penalized over time. Therefore, firms with sustained EO rhetoric give confidence to investors that they will be able to extract higher economic rents, while those with occasional changes in EO rhetoric generate ambiguity and doubt among investors.

We also acknowledge that interpreting the difference of the between- and within-firm effects of a variable may not be straightforward (Certo et al., 2017; Schunck, 2013), given that average EO rhetoric over time may be correlated with firm- or CEO-specific unobserved variables (e.g., social capital) that enable the firm or CEO to benefit from an EO (Stam & Elfring, 2008). Another possible explanation for the difference is that the within-firm effect may depend on the between-firm effect (Certo et al., 2017; Schunck, 2013), so that the negative effect of change in EO rhetoric on firm valuation is weaker for health science firms with a higher level of average EO rhetoric over time. We tested this speculation and found that the interaction term of the firm-mean and firm-mean deviation scores of EO rhetoric produced a positive regression coefficient with firm valuation (b = 0.0004, p = .111). Although this coefficient is not strongly significant, its positive sign is consistent with this explanation.

Third, we contribute to signaling theory by illustrating how soft-information and hard-information signals can jointly affect the reactions of outsiders. More specifically, we illustrate that hard-information signals (entry commitment and CSR) can increase the credibility of soft-information signals (EO rhetoric within CEO shareholder letters). While widely assumed in the EO literature (Lumpkin & Dess, 1996), entry commitment has not been empirically studied. As Wales et al. (2020) posit, a firm's communicated EO is more closely aligned to its management style and positioning than its actual new entry, thereby creating an opportunity to examine the gap between EO rhetoric and firm valuation. Such a gap is likely to be mitigated for firms that have already made strong entry commitment, thus providing additional support for our finding that behavioral evidence in the form of increased entry commitment can enhance the relationship between change in EO rhetoric and health science firm valuation.

As other researchers have noted (Flammer, 2018; Su et al., 2016), the signaling function of CSR deserves further research. The more socially responsible practices a firm has engaged in, the more valuable its reputation and trustworthiness will be (Vanhamme & Grobben, 2009). Therefore, firms with a higher level of CSR are less likely to send

false signals, given that losses of reputation and trustworthiness due to false signaling can cause higher penalty costs for them. As a result, investors are more likely to be confident in firms with concurrent increases in EO rhetoric and CSR signaling. By introducing this nuanced mechanism, this study also offers novel evidence that firms can benefit from being entrepreneurial and responsible at the same time.

5.2 | Managerial implications

When considering EO rhetoric as a potential quality signal, investors should examine whether a health science firm has maintained a higher level of EO rhetoric than its peers over time and whether its EO rhetoric has changed recently. Average EO rhetoric over time constitutes a more credible signal; it helps identify health science firms with more substantive strategic and behavioral inclinations toward product innovation, entry opportunities, and business-related risks. Our findings imply that health science firms maintaining higher EO rhetoric over time deserve higher valuations, given the myriad of benefits that an EO can have for health science firms. A change in EO rhetoric, however, invites scrutiny because it may be serving a myriad of short-term purposes, such as impression management, hiding negative news, and misleading competitors.

For health science firm managers, how to communicate their firms' EO to investors is a significant challenge. The market will penalize false signaling, and investors are cautious regarding changes in EO rhetoric. Consistency is critical to overcoming skepticism that such rhetoric is merely "cheap talk." If a health science firm aims to communicate its entrepreneurial strategies and behaviors by ramping up its EO rhetoric, it should be aware that investors may misinterpret the increase and confront this misinterpretation head-on by concurrently increasing entry commitment or CSR.

5.3 | Limitations and future research

Researchers have argued and found evidence that strict regulations may help incumbent firms extract economic rents by erecting barriers to new entrants (Bessen, 2016; Gutiérrez & Philippon, 2017). We find that regulatory stringency produces a positive regression coefficient with Tobin's Q_{t+1} (Model 1), but this coefficient becomes insignificant when average EO rhetoric and changes in EO rhetoric are included in the regression models (Models 2–5). This positive coefficient seems to support the idea that increased barriers due to strict regulations can give incumbents a competitive advantage to earn economic rents. However, if these incumbents demonstrate a strong inclination to enter new product markets using EO rhetoric, investors may lower their valuations because of the potential risks (e.g., uncertainties in long product development horizons, difficulties in obtaining approvals from the FDA, and/or potential penalties due to product failures). It is important and promising to further disentangle the relationships among regulation, innovation, and firm value in future research.

We have conceptualized EO rhetoric as a unitary signal of strategies and behaviors to enable entrepreneurship, rather than comparing the signaling effects of individual EO dimensions or different configurations of EO dimensions. Researchers have paid increasing attention to various combinations of EO dimensions (Lomberg, Urbig, Stöckmann, Marino, & Dickson, 2017; McKenny et al., 2018). It may be fruitful to study the temporal characteristics of such configurations from a signaling perspective. Furthermore, investors differ in their investment horizons: some are long-term oriented, while others focus on a series of short-term gains (Bushee, 1998). Given the long-term product development horizons of health science firms, it is likely that the majority of their investors are long-term oriented. However, it is promising to examine how time orientation affects investors' interpretation of and reaction to health science firms' average EO rhetoric and change in EO rhetoric over time.

We have focused on health science firms in the United States, so our data lack variance at the industry level (Misangyi, Elms, Greckhamer, & Lepine, 2006; Peterson, Arregle, & Martin, 2012) and we cannot examine whether

and how industry-level regulation differences may shape the effect of EO rhetoric on firm valuation. But other industries (e.g., military products and national defense, air and aerospace travels, and the petroleum and nuclear energy sectors) also face industry-specific regulations that could expose further nuance in the relationship between entrepreneurship and firm valuation. Finally, we have relied on the KLD database to measure our sampled firms' CSR, and thus our results may not be generalizable to firms that had not been included in the KLD sample. It is important to further develop and test our hypotheses in other empirical contexts, such as firms from more industries that vary in regulatory stringency, with alternative CSR data sources and measures, and/or from other countries that differ in institutional and cultural environments that can affect EO (Semrau, Ambos, & Kraus, 2016).

6 | CONCLUSION

Being entrepreneurial and innovative is critical for health science firms, given that their success ultimately depends on product innovation and market entry despite the presence of strict regulations that may stifle their entrepreneurial strategies and behaviors. By drawing on signaling theory, we argue that EO rhetoric over time contains important information for investors to consider when valuating health science firms. We observe that investors favor health science firms with a higher level of average EO rhetoric over time but tend to be skeptical of firms exhibiting occasional increases in EO rhetoric in published communications. Moreover, we find that concurrent increases in entry commitment or CSR can mitigate investor skepticism.

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ENDNOTES

[1] In robustness checks, we used other time windows such as 5 years and obtained qualitatively identical results.

[2] Using Stata 15, it is impossible to use the "margins" command after the random-effects models as we needed to include the firm-mean and firm-mean deviation scores of the interaction terms between EO rhetoric and entry commitment and between EO rhetoric and CSR (for detailed explanations, see Schunck, 2013, p. 71–74). However, because Hypotheses 3 and 4 focus on within-firm relationships, the "margins" command after the fixed-effects models provide the correct postestimation.

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