

WHEN DOES CO-LEADERSHIP DRIVE INNOVATION? THE NON-LINEAR EFFECT OF CO-CEOS' POWER DIFFERENCES ON R&D SPENDING

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Abstract

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A co-leadership structure at the executive level is characterized by the presence of two co-CEOs exerting mutual influence on each other while working together towards common goals. This study relies on the unity of command and social comparison theories to investigate the relationship between power differences within co-CEO dyads and firm innovation. The results from a sample of US firms led by co-CEOs in the 2000-2016 period indicate an inverted U-shaped relationship, such that: 1) power differences between co-CEOs are positively related to firm innovation when power differences are below a high level; and 2) this positive relationship becomes negative as power differences become very large. This study improves upon Krause, Priem, and Love's (2015) analysis by arguing that social-psychological factors affect collaboration between co-CEOs and advances innovation literature by illustrating that the conditions under which a co-leadership structure promotes innovation are non-linear. These results suggest important implications for scholars and practitioners who are dealing with the strategic framing of the top executive team and aim at pursuing corporate results in terms of innovation.

Keywords: Co-CEOs, Co-Leadership, Unity of Command, Social Comparison Theory, R&D

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1. INTRODUCTION

In today's economy, firms are challenged to stay competitive and offer innovative products and services (Kor, 2006; Rim & Ghazi, 2010). Investments in research and development (R&D) have been the primary source of innovation and firm success (Chan, Lakonishok, & Sougiannis, 2001; Nishi, 2015). R&D investments indicate the strategic importance of innovation for a firm and build long-term benefits (Block, 2012; Ghazi & Rim, 2014). Nowadays, since it is challenging for a single leader to manage and promote innovation, there is a growing need for novel models of leadership. Modern corporations have simply become too great and too complex for one individual to handle. Moreover, knowledge work is increasingly dependent on the active engagement of multiple individuals with diverse backgrounds and experiences (Cox, Pearce, & Perry, 2003). As such, Bligh, Pearce, and Kohles (2006), Pearce and Manz (2005), and Pearce (2004) explicitly suggested the need to shift the focus from traditional models of leadership, largely based on upward and downward hierarchical influence processes, to shared leadership approaches, in which multiple leaders are engaged in reciprocal and peer influence. However, the implementation of shared leadership is not always associated with a positive outcome (Krause, Priem, & Love, 2015; O'Toole, Galbraith, & Lawler, 2002) as teams often fail to coordinate their members' actions and lack effective leadership to coordinate this process (Burke, Fiore, & Salas, 2003).

As a result, this paper studies how interpersonal influence between top management team members promotes innovation, that is a fundamental dilemma in strategic management research.

Specifically, the aim of this paper is to examine the conditions under which a co-leadership structure at the executive level fosters firm innovation. Such research question is relevant and significant for scholars and practitioners, as the decision to employ two co-chief executive officers (CEOs) divides the top-level powers and responsibilities often assigned to a solo CEO between two individuals and adds an expensive executive position to the organization's costs (Hambrick & Cannella, 2004).

Although the implementation of the co-CEO model, pursuant to which two co-CEOs are appointed to manage the principal executive officer responsibilities of the company, is not widespread, Motorola, Verizon Communications, Oracle, SAP, Research in Motion, Luxottica and Samsung represent examples of large global companies that have appointed multiple leaders. Previous literature has reported numerous advantages of co-leadership. Arena, Ferris, and Unlu (2011) found that firms with co-CEOs outperformed a control sample of non-co-CEO firms and Denis, Langley, and Sergi (2012) suggested that shared leadership is a panacea against corporate social irresponsibility, since co-CEOs, by sharing the same title, reduce leadership centralization by introducing a system of checks and balances atop organizations (Pearce & Manz, 2011; Choi, Hyeon, Jung, & Lee, 2018; Pearce, Manz, & Sims, 2008). Such a model could create further benefits, such as the division of tasks (Hunter, Cushenbery, & Jayne, 2017; Sally, 2002), the heterogeneity of perspectives on strategic decisions

(Alvarez, Svejenova, & Vives, 2007; O'Toole et al., 2002) and the decentralization of decision-making (Bligh et al., 2006; Pearce & Manz, 2011). The presence of two co-CEOs implies that functions must be coordinated to be successful (Dust & Ziegert, 2016). With regard to firm innovation, Hoch (2013) and Mihalache, Jansen, Van den Bosch, and Volberda (2014) empirically demonstrated a positive link between shared leadership and innovation and Hunter et al. (2017) advocated the addition of a second leader to reduce stress, pain, and anxiety and improve creativity.

However, dyad arrangements can vary widely (Krause et al., 2015). Accordingly, a co-CEO leadership structure does not imply that the two co-CEOs' powers, i.e., "the capacity of individual actors to exert their will" (Finkelstein, 1992, p. 506), will be distributed equally between them (Krause et al., 2015). An equal share of influence, representing the ideal type of shared leadership, is only one of a number of diverse configurations of power arrangements between co-CEOs (Seibert, Sparrowe, & Liden, 2003). A recent study conducted by Krause et al. (2015) found that firms with co-CEOs' powers distributed unequally overperform relative to those firms structured around an equal shared leadership model.

This study addresses the research question testing hypotheses that build upon two theories: the unity of command and social comparison theories. Unity of command theory supports the benefits of a leadership structure based on a single top manager exercising his formal authority over all other managers, while social comparison theory states that collaboration diminishes when large power differences exist between co-CEOs. Utilizing data collected from firms with co-CEO dyads between 2000 and 2016, thanks to Tobit regression analyses, we found that the relationship between co-CEOs' power differences and innovation is non-linear, suggesting that firms with co-CEOs whose powers are distributed unequally benefit from higher innovation when the power differences are below a large level (i.e., the threshold). However, above this threshold, in line with social comparison theory, power differences between co-CEOs become salient enough to activate perceptions of inequity and resentment (Fredrickson, Davis-Blake, & Sanders, 2010; Ensley, Pearson, & Sardeshmukh, 2007), thereby causing detrimental effects on innovation.

Our analysis contributes to the extant literature in several ways. Firstly, we add to Krause et al. (2015), who encourage new studies and call for a deeper understanding of co-CEO phenomena, testing to what extent co-CEOs' power distribution influences firm innovation, given that they have the greatest organizational power to influence R&D expenses (Barker & Mueller, 2002). Prior studies gave little guidance regarding how to structure co-CEO arrangements to boost innovation. We contribute to this literature (Hoch, 2013; Mihalache et al., 2014) by providing much-needed empirical evidence following our identification of the factors that increase co-CEO effectiveness. Accordingly, how to leverage the co-CEO powers that facilitate firm innovation is of great practical significance.

Secondly, we improve upon Krause et al.'s (2015) analysis by taking a social-psychological perspective, namely social comparison theory

(Festinger, 1954), to explain why an extremely high unequal distribution of powers between co-CEOs reduces collaboration and cohesion that in turn, impairs innovation.

Thirdly, previous studies (Siegel & Hambrick, 2005; Ridge, Hill, & Aime, 2017; Fredrickson et al., 2010) applied social comparison theory to explain the negative effects of horizontal pay dispersion between executives within the same hierarchical level, but it is crucial to evidence that they could have limited influence on the firm outcome, mainly under high CEO power. When co-CEOs lead an organization, however, they simultaneously occupy the pinnacle leadership position so that such a test is quite possible.

The rest of this paper follows the outline given below. The second section reviews the existing literature dealing with shared leadership and team outcomes and outlines the theories and the development of the hypotheses tested in this research. The third section describes the empirical research: the variables, the design of the research model and the sample adopted. The fourth section reports the results. Finally, the fifth section discusses the results and the last paragraph briefly concludes the paper.

2. LITERATURE REVIEW

2.1. Background

Research on leadership in teams differentiates between the traditional models of leadership that have long dominated the field, examining the role of a single individual that exerts influence over subordinates or followers and shared leadership models, involving a team-level process characterized by peer or lateral influence (Pearce & Conger, 2003). Pearce and Conger (2003) defined shared leadership as a “dynamic, interactive influence process among individuals in groups for which the objective is to lead one another to the achievement of group or organizational goals or both” (p. 1). Ensley, Hmieleski, and Pearce (2006) defined shared leadership as “a team process where leadership is carried out by the team as a whole, rather than solely by a single designated individual” (p. 220). Many works have conceptualized shared leadership as an emergent and dynamic team-level process characterized by lateral influence among peers with leadership roles and influence dispersed across team members (Zhu, Liao, Yam, & Johnson, 2018; D’Innocenzo, Mathieu, & Kukenberger, 2016).

Although research on shared leadership has flourished recently in a number of academic subjects, such as strategic management (Krause et al. 2015; Mihalache et al., 2014), entrepreneurship (Ensley et al., 2006; Hmieleski, Cole, & Baron, 2012), organizational behavior (Hunter et al., 2017; Pearce & Manz, 2005) and finance (Arena et al., 2011; Choi et al., 2018), the extant literature suffers from an abundance of definitions and corresponding measures across studies (Zhu et al., 2018). For this reason, the results of these studies are rarely comparable. A high proportion of papers investigated shared leadership in teams or groups. Empirical tests on the impacts of shared leadership have typically focused on various measures of firm

performance and demonstrated a positive relationship between shared leadership activity and team outcome (Carson, Tesluk, & Marrone, 2007; Ensley et al., 2006; Hmieleski et al., 2012; Hoegl & Muethel, 2016).

As shared leadership is suitable in a knowledge-intensive work environment (Pearce, 2004; Pearce & Manz, 2005), it could stimulate innovation (Arnone & Stumpf, 2010; Alvarez et al., 2007). Shared leadership theory suggests that it is rare to find a single leader possessing all of the skills required to manage innovation (O’Toole et al., 2002). Hoch (2013) and Gu, Chen, Huang, Liu, and Huang (2018) documented that shared leadership leads to a higher level of innovative behavior and in their review, Dust and Ziegert (2016) argued that the interaction of co-leaders with a high level of co-enactment, through diversity of thought, could produce a synergistic effect. Within R&D team members, Brooks (1994) documented that differences in power inhibit group reflection and process improvement and Yanadori and Cui (2013) evidenced that large pay dispersion disincentivizes innovation, as the generation of new ideas involves collaboration (Collins & Smith, 2006). Moreover, Hoffmann, Hoegl, Muethel, and Weiss (2016) highlighted the importance of the perceived equality and transparency of the technical ladder in determining R&D professionals’ organizational commitment and career satisfaction. Although the CEO wields the dominant power within an organization (Finkelstein, 1992), Mihalache et al.’s (2014) research on top management teams evidenced that shared leadership stimulates explorative and exploitative innovation. However, shared leadership leads to less accountability to shareholders, fosters confusion at the top and may promote internal competition among co-leaders (Marcel, 2009; Dalton, C. M. & Dalton, D. R., 2005; Denis et al., 2012). Shared leadership appears to be a structure that is suited to the development and growth of new ventures (Ensley et al., 2006), whereas traditional governance models could allow better organization and more effective decision-making (Dalton, C. M. & Dalton, D. R., 2005).

Previous literature has tried to test the unity of command principle by investigating CEO duality (Finkelstein & D’Aveni, 1994) and the separation of the CEO and president or chief operating officer (COO) (Marcel, 2009; Hambrick & Cannella, 2004). CEO duality clearly establishes a unity of command at the top of the firm, but it increases CEO entrenchment when informal CEO power or firm performance is high (Finkelstein & D’Aveni, 1994). Governance scholars and practitioners advocate the separation of CEO and board chair roles (Lorsch & Zelleke, 2005). With regard to CEO/COO duos, Hambrick and Cannella (2004) argued that COOs complement the knowledge of incoming CEOs or CEOs with limited experience and Marcel (2009) suggested that firms with COOs benefit from thorough information processing. Even though these studies have produced interesting results, the CEO/board chair and CEO/COO duos are still characterized by a hierarchical distinction in which the CEO is the most powerful, so they have not offered direct insights regarding the efficacy of shared leadership (Krause et al., 2015). Furthermore,

board chairs and COOs have different tasks compared to CEOs, i.e., while the former is generally considered to be involved in management oversight, the latter is responsible only for short-term goals and internal leadership functions (Hambrick & Cannella, 2004).

Leadership in the plural form may be categorized in numerous ways (Denis et al., 2012): one of the possible conceptualizations is pooling leadership, which focuses on situations in which multiple people act as the co-leaders of other outside groups (Denis et al., 2012). More specifically, in this paper, we examine co-leadership, defined by Pearce and Conger (2003) as a case of shared leadership in which two people share one leadership position. Although the concept of co-leadership has begun to emerge in the literature, there have only been a few empirical studies on this topic. The first stream of studies on co-leadership is illustrative and concern the reasons that lead to a co-head structure (Arnone & Stumpf, 2010; O'Toole et al., 2002), the conditions under which co-leadership is successful (Arnone & Stumpf, 2010; Pearce & Manz, 2005) and the advantages and the challenges associated with its implementation (Alvarez et al., 2007; Arnone & Stumpf, 2010; Pearce & Manz, 2005). Arena et al. (2011) first examined co-leadership empirically: they found that the presence of two co-CEOs increases firm performance and firm value. Furthermore, by receiving significantly less incentive compensation than solo CEOs and by employing a lower number of independent directors, co-CEOs are expected to provide mutual monitoring and advice to the firm's management. Choi et al. (2018), Lee, Park, and Hyeon (2019) and Hasija, Ellstrand, Worrell, and Dixon-Fowler (2017) complemented Arena et al.'s (2011) findings by documenting that co-CEO firms are charged lower audit fees, report more efficient resource allocations and higher corporate social performance as co-CEOs' mutual monitoring reduces earnings management activity, cost stickiness and potential for self-interest, respectively.

Lastly, Krause et al. (2015), compared with studies using a binary variable to measure whether co-CEOs are in charge (Arena et al., 2011; Choi et al., 2018), employed an indicator that explicitly takes into account both the temporal nature (the dynamic) of shared leadership and how leadership influence is distributed among members (the centralization) that are reflected in the most influential definitions on this topic (Sweeney, Clarke, & Higgs, 2019; Zhu et al., 2018; D'Innocenzo et al., 2016; Dust & Ziegert, 2016). For each co-CEO pair, across the years they operationalized a power gap construct that indicates the extent to which such influence is centralized within co-CEO dyads. While large power gaps imply that decision-making authority resides in the hands of one co-CEO, a minimal power gap highlights that co-CEOs truly share the power. Krause et al. (2015) analyzed power gaps between co-CEOs and firm performance, evidencing that co-CEOs with equal powers underperform. However, for an extremely high level of power gaps, they discovered an inflection point beyond which co-CEOs' power gaps start to become counterproductive as long as power gaps destroy communication and cohesion between co-leaders. Drawing on emergent research on share leadership in top management and work teams

(Mihalache et al., 2014; Hoch, 2013) and exploiting the varying co-CEOs arrangements (Krause et al., 2015), we combine two existing theories to determine how power gaps between co-CEOs affect innovation within organizations they lead.

2.2. Theory and hypotheses

Unity of command theory, traditionally supported by organization theory, maintains that every organization should have one clear individual with unambiguous leadership who decides the strategic direction and sends reassuring signals to stakeholders (Finkelstein & D'Aveni, 1994). Fayol (1949) stated that "A body with two heads is in the social as in the animal sphere a monster, and has difficulty in surviving" (p. 25). The unity of command principle establishes that organizational members should be responsible for one individual (Krause & Semadeni, 2013). In our context, even if co-CEOs share the same title, the unity of command principle is established when one co-CEO clearly holds the authority (Krause et al., 2015). Barker and Mueller (2002) suggested that CEO power, enabling faster decision-making, increases R&D spending. Research on power distribution between CEOs and top management teams have long supported the unity of command theory (Dalton, C. M. & Dalton, D. R., 2005; Lorsch & Zelleke, 2005). Shared leadership is not ideal for every team environment (Pearce & Manz, 2005; Bligh et al., 2006) as developing co-leaders' capacity for its effective implementation requires time (Arnone & Stumpf, 2010; Pearce & Conger, 2003). In this setting, co-leaders are asked to share power, which may cause a lack of confidence and communication, or they can engage in status contests (Arnone & Stumpf, 2010). Shared leadership could result in conflicts and coordination issues (Zhu et al., 2018; Arnone & Stumpf, 2010) regarding job role conflict and ambiguity (Wood & Fields, 2007) that can lead to power struggles (Lorsch & Zelleke, 2005). Moreover, co-CEOs function as mutual monitoring (Arena et al., 2011; Choi et al., 2018) and this effect could be stronger when co-CEOs' powers are distributed equally (Kandel & Lazear, 1992). The effects of the intensity of co-CEOs' monitoring could come at a significant cost of weaker advising. Given that co-CEOs' time is a finite resource, increasing the time spent on monitoring reduces the time dedicated to advising (Faleye, Hoitash, R., & Hoitash, U., 2011). Accordingly, in line with the unity of command theory, we hypothesize that:

Hypothesis 1 (H1): The power gap between co-CEOs is positively related to firm innovation.

Although organizations might benefit from an unequal distribution of powers between co-CEOs, it could potentially generate negative effects on collaboration (Krause et al., 2015). According to social comparison theory (Festinger, 1954), individuals tend to evaluate their abilities and outputs in comparison with others who are close to their own abilities. Consequently, comparisons with others who are too divergent are unlikely, people prefer comparing themselves with similar others. Furthermore, social comparison theory maintains that if the organization's goal is to maximize collaboration in top management teams, then pay

disparity should be minimized (Siegel & Hambrick, 2005; Fredrickson et al., 2010). Utilizing pay disparity within top management teams as a proxy for referent selection criteria, organizational and management scholars have extensively adopted social comparison theory (Siegel & Hambrick, 2005; Ridge et al., 2017; Ridge, Aime, & White, 2015; Fredrickson et al., 2010). In the context of co-CEOs, given that they share the title, it is highly probable that they will engage in a series of social comparisons, making them probable referents for each other (Fredrickson et al., 2010; Siegel & Hambrick, 2005). Previous literature reports that horizontal pay dispersion produces adverse effects, such as lower organizational and individual performance (Siegel & Hambrick, 2005; Bloom, 1999), lower work satisfaction (Pfeffer & Langton, 1993), higher turnover (Ridge et al., 2017), invidious comparisons (Siegel & Hambrick, 2005) and lower collaboration and cohesion (Fredrickson et al., 2010), as it reduces motivation and feelings of equity (Ridge et al., 2017). Particularly in our context, social comparison logic has a strong predictive ability, since a large power gap, similar to a large pay disparity, makes co-CEOs inherently different from each other (Finkelstein, 1992; Ridge et al., 2015) and organizational output strongly depends upon co-CEOs' cooperation due to high work interdependencies (Ensley et al., 2007; Siegel & Hambrick, 2005).

Consistent with this line of reasoning, we speculate that since the participation in innovation activity requires co-CEOs to put forth efforts and invest resources, they are stimulated to collaborate only when they perceive that their powers are approximately equal (Ensley et al., 2007). By comparison, an extremely unequal level of powers for the co-CEOs increases the perception of inequity and deprivation, which results in unhealthy competition and destructive behaviors (Ensley et al., 2007), impairing innovation activity. In line with Krause et al. (2015), the positive effect of power gaps might be stronger at lower power gap levels and then it might become negative as excessive power differences could have deleterious effects by reducing communication and cohesion between co-CEOs. Therefore, we hypothesize that:

Hypothesis 2 (H2): The power gap between co-CEOs exhibits an inverted-U-shaped relationship with firm innovation.

3. RESEARCH METHODOLOGY

3.1. Dependent and independent variables

In line with Kor (2006), Bozec and Di Vito (2018), and Block (2012), the dependent variable (R&D) is a proxy for firms' innovation. It is the ratio between

$$R\&D = \alpha_0 + \beta_1 POWER\ GAP + \gamma_1 SHARED + \gamma_2 AGE + \gamma_3 BOARD\ SIZE + \gamma_4 FIRM\ AGE + \gamma_5 WORKING\ CAPITAL + \gamma_6 ASSETS + \gamma_7 EMPLOY + \gamma_8 ROA + \gamma_9 LEV + \gamma_{10} CFO + \gamma_m Industry + \varepsilon \quad (1)$$

We tested H2 utilizing the following equation:

$$R\&D = \alpha_0 + \beta_1 POWER\ GAP + \beta_2 POWER\ GAP^2 + \gamma_1 SHARED + \gamma_2 AGE + \gamma_3 BOARD\ SIZE + \gamma_4 FIRM\ AGE + \gamma_5 WORKING\ CAPITAL + \gamma_6 ASSETS + \gamma_7 EMPLOY + \gamma_8 ROA + \gamma_9 LEV + \gamma_{10} CFO + \gamma_m Industry + \varepsilon \quad (2)$$

the total annual R&D expenditure and total assets at the end of the year. With regard to the test variable, to construct the index, *POWER GAP*, we used Krause et al.'s (2015) methodology, so our measure relies on four separate indicators: 1) co-CEOs' base salary; 2) co-CEOs' tenure; 3) co-CEOs' stock ownership; and 4) a binary variable reflecting whether each co-CEO also held the title of board chair (or co-chair). Apart from the latter indicator, the first three indicators were standardized. Consistent with Krause et al. (2015), we calculated the differences for the four indicators for each co-CEO dyad, then summed all four components, took the absolute value of the sum and standardized it. Consequently, while a large power gap, indicative of unity of command, suggests that one co-CEO clearly holds the authority, a minimal power gap suggests co-CEOs truly share the power at the top of the organization (Krause et al., 2015).

At the co-CEO level, in line with Krause et al. (2015), we added co-CEOs' shared tenure (*SHARED*) to control for interpersonal relationships and age differences between co-CEOs in a number of years (*AGE*). We also controlled for board size (*BOARD SIZE*), in line with innovation research (Dalziel, Gentry, & Bowerman, 2011).

At the firm level, we included firm age (*FIRM AGE*), measured as the natural log of the number of years since the firm was founded (Dalziel et al., 2011), because older firms have less incentive to innovate and working capital (*WORKING CAPITAL*), measured as working capital scaled by total assets because internally generated funds favor investments in innovation (Himmelberg & Petersen, 1994). To control for company size, since larger companies invest more in innovation, we used two common controls (Bozec & Di Vito, 2018; Krause et al., 2015): the natural log of the total assets in thousands (*ASSETS*) and the number of employees in thousands (*EMPLOY*). Moreover, we added firms' profitability (*ROA*), using the net income deflated by the total assets (Dalziel et al., 2011) to control for the level of profitability and economic activity of the firm, expecting a positive relation. We included leverage (*LEV*), measured as long-term debt scaled by total assets (Krause et al., 2015; Arena et al., 2011) and firm liquidity (*CFO*), measured as the cash flow from operations scaled by total assets, as firms with greater resources are more likely to invest in R&D (Kamien & Schwartz, 1978). Finally, we included industry indicators to control for industry fixed effects by utilizing binary variables based on the one-digit US SIC codes (Arena et al., 2011).

3.2. Econometric regression model

We tested H1 using the following equation:

We estimated Eq. (1) and (2) by fitting a classical Tobit model with left-censoring at zero because true innovation activity is not observed with zero scores (Faleye et al., 2011; Gomez-Mejia, Campbell, Martin, Hoskisson, Makri, & Sirmon., 2014; Naveen, 2006) and used clustered standard errors at the firm level due to the panel structure. Alternative methods adopted by scholars to conduct research on R&D represents both random- and fixed-effects ordinary least squares (Block, 2012; Barker & Mueller, 2002) and random effects generalized least squares regressions (Kor, 2006).

3.3. Sample and data collection

We identified our sample from two sources. We began our sample selection procedure by receiving the list of US firms led by co-CEOs between 2000 and 2011 utilized by Krause et al. (2015). Second, we performed our own search of co-CEO firms from 2000 to 2016 by utilizing as search terms “co-CEO”, “co-chief executive officer”, “co-president”, “joint CEO” and “joint chief executive officer” in the ExecuComp database, AuditAnalytics (in the Director and Officer Changes module), Thomson Reuters Eikon Officers and Directors database (limited to US firms) and LexisNexis (limited to the annual reports filed in EDGAR). To better understand the effects of co-CEO power gaps, we collected firm-level data for every year in which the firm had a co-CEO leadership structure, going back as far as 1996. Accordingly, we limited inclusion in our sample to firms led by co-CEOs during the period 2000 to 2016, but if the firm met that criterion, we collected data as far back as the co-CEO structure was in place. In this way, we avoided truncating the data. We next excluded firms with co-CEO leadership structures lasting less than one financial year (Krause et al., 2015), because

these structures were unlikely to have been in place long enough to affect innovation, and firms operating in the banking and finance industries (SIC codes 60-69). We excluded any cases in which executives listed as co-CEOs were the leaders of subsidiaries and not of whole organizations (Krause et al., 2015) and observations with missing values. We collected governance and executive data manually from the information contained in corporate proxy or annual reports. All accounting data were obtained from Compustat and Thomson Reuters Eikon. Our final sample comprises 106 firms (355 firm-year observations) led by co-CEOs at various points between 1996 and 2016.

4. RESULTS

Table 1 summarizes the descriptive statistics, including the means, medians, standard deviations and Pearson's correlations of the variables used in our multivariate analysis, limited to uncensored observations. As the table shows, the average shared tenure of co-CEO pairs is 12 years, suggesting that many co-CEOs had worked together for quite a long time. Co-CEOs do not tend to be the same age ($mean(AGE) = 8.85$). On average, the firms in our sample have low profitability ($mean(ROA) = -0.11$), scarce liquidity ($mean(CFO) = -0.02$) and they are moderately indebted ($mean(LEV) = 0.15$).

R&D is positively and significantly related to *POWER GAP* ($\rho = 0.27$), providing initial evidence for the unity of command theory. Moreover, R&D is negatively correlated with *ASSETS*, *ROA* and *CFO*, with higher R&D associated with lower firm size ($\rho = -0.18$), profitability ($\rho = -0.52$) and liquidity ($\rho = -0.78$), respectively. The (unreported) variance inflation factor test demonstrated the absence of issues of multicollinearity.

Table 1. Descriptive statistics and Pearson's correlations

	Mean	Median	S.D.	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]
[1] R&D	0.10	0.05	0.28											
[2] POWER GAP	0.17	0.11	0.96	0.27										
[3] SHARED	12	9	9.76	-0.06	-0.28									
[4] AGE	8.85	5	8.71	-0.03	0.30	-0.41								
[5] BOARD SIZE	7.68	7	2.27	-0.20	0.02	0.10	-0.07							
[6] FIRM AGE	3.20	3.22	0.71	-0.09	0.15	0.33	-0.14	0.38						
[7] WORKING CAPITAL	0.18	0.26	0.96	-0.09	-0.16	0.16	-0.13	0.02	0.21					
[8] ASSETS	12.15	11.61	2.53	-0.18	-0.24	0.27	-0.29	0.55	0.22	0.19				
[9] EMPLOY	6.01	0.47	18.86	-0.06	0.07	-0.09	-0.14	0.36	0.24	0.05	0.55			
[10] ROA	-0.11	0.04	0.57	-0.52	-0.20	0.15	-0.13	0.21	0.27	0.46	0.39	0.09		
[11] LEV	0.15	0.02	0.24	-0.12	0.03	-0.13	0.07	0.23	-0.01	-0.57	-0.05	0.14	-0.31	
[12] CFO	-0.02	0.06	0.34	-0.78	-0.27	0.18	-0.16	0.21	0.22	0.48	0.38	0.11	0.77	-0.26

Note: All correlations greater than |0.18| are significant at the $p < 0.05$ level.

Table 2 presents the results of the regression analysis. The results of Eq. (1) shown in Table 2, Column 1 evidence that the relationship between co-CEOs' power gap and R&D investment is slightly positive ($\beta_1 > 0$; $p < 0.10$), providing some support for *H1*. To test *H2*, we added the squared power gap term (*POWER GAP*²) as we speculated about an inverse-U-shaped relationship. As the results of Eq. (2) in Table 2, Column 3 shows, *H2* received empirical support with a positive and significant *POWER GAP* ($\beta_1 > 0$; $p < 0.05$) and a negative and significant *POWER GAP*² ($\beta_2 < 0$; $p < 0.05$), evidencing

that increasing power gaps between co-CEOs are positively related to firm innovation, but this support is subject to an important boundary condition: a substantially high level of power gaps between co-CEOs causes the undesired effect of damaging the ability of co-CEOs to collaborate. We also found a significant relationship between R&D and certain control variables included in the specification. We found that *WORKING CAPITAL* ($\gamma_5 > 0$; $p < 0.01$) and *ASSETS* ($\gamma_6 > 0$; $p < 0.05$) affect R&D positively, whereas *LEV* ($\gamma_9 < 0$; $p < 0.10$) and *CFO* ($\gamma_{10} < 0$; $p < 0.01$) have a negative impact on

R&D. Consequently, consistent with our expectations, we found that firms with a higher amount of internal finance and larger firms invest more in innovation, whereas high leverage impairs firms' investment in R&D.

To ensure the robustness of the empirical findings, we utilized both industry and year fixed

effects. The results for Eq. (1) and (2) shown in Table 2, Columns 2 and 4 respectively highlight that our models are robust to different specifications. *McFadden's Pseudo-R²* ranges were between 0.18 and 0.27, supporting an overall satisfying empirical explanatory power.

Table 2. Tobit regression models of R&D

Variables		R&D (1)	R&D (2)	R&D (3)	R&D (4)
POWER GAP	β_1	0.0373* (1.97)	0.0367* (1.83)	0.0668*** (2.66)	0.0645** (2.37)
POWER GAP ²	β_2	-	-	-0.0264** (-2.21)	-0.0267** (-1.99)
SHARED	γ_1	-0.0003 (-0.12)	0.0004 (0.18)	-0.0012 (-0.61)	-0.0006 (-0.29)
AGE	γ_2	-0.0041* (-1.76)	-0.0025 (-1.13)	-0.0053** (-2.06)	-0.0040 (-1.59)
BOARD SIZE	γ_3	-0.0055 (-0.54)	-0.0084 (-0.87)	-0.0091 (-0.91)	-0.0110 (-1.21)
FIRM AGE	γ_4	0.0148 (0.39)	0.0314 (0.81)	0.0133 (0.35)	0.0275 (0.72)
WORKING CAPITAL	γ_5	0.1229*** (3.07)	0.0935*** (2.70)	0.1336*** (3.15)	0.1061*** (2.82)
ASSETS	γ_6	0.0242** (2.05)	0.0286*** (2.66)	0.0274** (2.39)	0.0311*** (2.98)
EMPLOY	γ_7	-0.0011 (-1.30)	-0.0010 (-1.37)	-0.0014* (-1.70)	-0.0014* (-1.96)
ROA	γ_8	0.0203 (0.70)	0.01380 (0.55)	0.0279 (1.03)	0.0210 (0.84)
LEV	γ_9	-0.2248* (-1.93)	-0.2240** (-2.15)	-0.2217* (-1.90)	-0.2188** (-2.11)
CFO	γ_{10}	-0.8753*** (-4.69)	-0.8558*** (-5.24)	-0.8986*** (-4.87)	-0.8810*** (-5.43)
Industry Fixed Effects		Incl.	Incl.	Incl.	Incl.
Year Fixed Effects		Excl.	Incl.	Excl.	Incl.
McFadden's Pseudo R ²		0.27	0.20	0.25	0.18

Note: This table presents the estimates of Eq. (1) in Column 1 and Eq. (2) in Column 3. The results of Eq. (1) and (2) with industry and year fixed effects are tabulated in Columns 2 and 4, respectively. To correct for heteroscedasticity and serial correlation, we adjusted standard errors for firm clustering. Coefficients for intercept, industry and year dummies are omitted to conserve space.

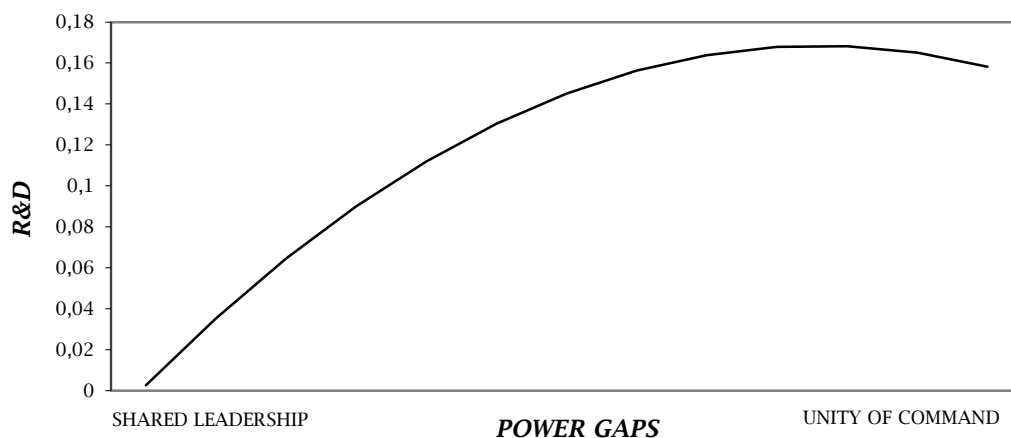
*, **, and *** denote statistical significance at the 0.10, 0.05 and 0.01 levels (two-sided, respectively).

5. DISCUSSION

The present study advances understanding in relation to the conditions under which a co-leadership structure at the CEO level fosters firm

innovation by uncovering an inverted-U-shaped relationship between power gaps and innovation. The shape of this curvilinear effect is depicted in Figure 1.

Figure 1. Predicted values of R&D



The graph plots a non-linear effect, illustrating that the relationship between the unity of command and innovation follows an inverted-U-shaped pattern and the curvature caused by the inflection point is located in the upper-right side of the figure. These results strongly support the unity of command theory, showing that unity of command generally favours innovation more than shared leadership.

These results were rather unexpected considering some previous research, like Hoch (2013) and Mihalache et al. (2014), who documented positive effects of shared leadership on firm innovation. Proponents of the unity of command principle have argued that shared command spreads confusion as to who is in charge and the organization suffers as a result (Dalton, C. M. & Dalton, D. R., 2005; Fayol, 1949; Finkelstein & D'Aveni, 1994). However, in line with social comparison theory (Festinger, 1954), we report that high power gaps diminish collaboration and impede innovation output.

Our study contributes to the literature in several ways. Firstly, this study expands the understudied management literature on the phenomenon of co-CEOs. Prior research focused only on firm performance (Krause et al., 2015) while we examined the unexplored impact on firm innovation that is highly dependent on co-CEOs' interactions (Hunter et al., 2017), given that they are the central strategic decision-makers.

Secondly, our work responds to O'Toole et al. (2002) and Dust and Ziegert (2016) by examining the configuration types of multi-leader teams so as to understand the conditions under which they are more effective. Since research highlights that shared leadership is challenging to implement (Arnone & Stumpf, 2010), we identified criteria for a co-head structure to capitalize on co-CEOs' knowledge in a way that promotes innovation.

Thirdly, researchers have so far mainly focused on examining a linear relationship between shared leadership and innovation (Hoch, 2013; Mihalache et al., 2014). However, our research identifies an inverted-U-shaped effect, evidencing that the positive effect of the unity of command in the co-CEO context can only be realized when co-CEOs' power gaps are moderately high. Above this threshold, we report that extremely high levels of power gaps elicit feelings of inequity and resentment that result in detrimental effects on innovation. This supports social comparison theory, introduced by Festinger (1954), suggesting that high power gaps between co-CEOs, who are highly likely to see each other as a social comparison target, impair collaboration and cohesion.

Siegel and Hambrick (2005), Ridge et al. (2017) and Fredrickson et al. (2010) applied social comparison theory to explain the effects of horizontal pay dispersion between executives (excluding CEOs) on firm performance. While these studies have produced insightful knowledge, due to the higher structural power of CEOs, executives may have limited decisional power (Finkelstein, 1992) in determining organizational outcomes, especially under a powerful CEO. By studying co-CEOs, however, we focus our attention on co-leaders at the very apex of their organizations.

Regarding the practical managerial implications, anecdotal evidence has reported

conflicting findings for the co-CEO leadership structure. As observed by Arnone and Stumpf (2010), while some pairs of co-CEOs perform well (e.g. California Pizza Kitchen and Motorola), others perform poorly (e.g. Martha Stewart Living OmniMedia and Kraft Foods). These mixed results have produced a multitude of best-practice recommendations for co-CEO firms often consisting of intangible and difficult to quantify solutions, such as communicating, setting boundaries and expectations, speaking with one voice and so on (Alvarez et al., 2007; Sally, 2002).

Our study provides theory- and evidence-based practical recommendations for employing co-CEOs. If a board of directors decides to appoint co-CEOs, it would do well to establish a clear power gap between them; however, an excessive concentration of powers would be counterproductive. Failure to do so could seriously impair the innovation capability of the organization. As such, if successful implementation requires clear power differences, why do firms should adopt the co-CEO structure? An answer possibly lies in the boundary condition identified in the theories. The advantages of having co-CEOs are potentially numerous and should be further explored by future research. Within family firms, this model could ease the transition between generations (Hasija et al., 2017). Moreover, the co-CEOs often divide their tasks performing separate roles, making decisions autonomously in predetermined areas, and collaborate on the main decisions. Lastly, many organizations adopt a dyadic approach when a single CEO is not a viable option due to the high skills required in certain complex work environments for the position or to retain talented individuals. The recommendation for co-CEOs only holds for moderately-high power gaps, so our study produced no evidence discouraging co-leadership structure at the executive level under those circumstances.

6. CONCLUSION

Even though leadership is one of the most important factors that determine organizational success, the study of the co-CEO structure has received poor attention from academics and practitioners so far. Given the interdependence nature of co-CEOs work, understanding how interpersonal influence shapes corporate behavior is of great interest to various stakeholders. Drawing upon the unity of command and social comparison theories, we found a curvilinear (i.e., inverted U-shaped) relationship between power gaps and innovation in co-CEOs firms. We believe that our study, along with Krause et al. (2015), provides the board with prescriptions for maximizing co-CEOs effectiveness.

The main limitation of this study is the adoption of a single national setting, the US. An interesting development of this work could be a comparison among different contexts. Testing the non-linearity by adopting a sample of co-CEO firms that operate in other institutional contexts could be useful to understand whether there are institutional contexts in which the salience of unity of command theory never becomes excessive and the co-CEOs' power gaps could have only a positive effect on innovation activity.

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