THE DETERMINANTS AND CONSEQUENCES OF HAVING A CHIEF OPERATING OFFICER

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This study examines the determinant and consequences of having a chief operating officer (COO). Specifically, we investigate chief executive officer (CEO) related factors that affect the choice to employ a COO and look into the impact of having a COO on firm operational efficiency using a data envelopment analysis (DEA)-based measure. Although prior literature has extensively investigated the role of CEOs and chief finance officers (CFOs) on firm outcomes, few studies focus on the impact of COOs. Thus, this study explores characteristics associated with the likelihood that a firm will have a COO. This research also sheds light on the effect of COOs on firm operational efficiency because the core duties of COOs include optimizing operational performance and improving cost efficiency. Our results imply that CEO busyness, CEO ability, CEO demographic characteristics, and CEO network size have a significant impact on the decision to employ a COO. We also find that firms that have a COO have a lower level of operational efficiency than firms that do not. This result implies that the cost of having a COO outweighs the benefit of having one. The effects last for three years on average. Further, we find that firms with a COO have lower receivables turnover and sales to cost of goods sold ratio, lower sales to PPE expense ratio than firms without a COO. Finally, we find evidence that COOs with industry expertise are associated with higher operational efficiency than those without such expertise and outside COOs perform better than inside COOs in terms of operational efficiency.

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CHAPTER 1

INTRODUCTION

This study investigates CEO-related characteristics associated with the likelihood of having a chief operating officer (COO) and whether the presence of a COO affects operational efficiency. The motivation comes from two sources. First, COO is considered a "second in command" position and one of the C-suite's toughest roles in a constantly changing business world (EY 2014). Prior literature has extensively investigated the role of the chief executive officer (CEO) and chief finance officer (CFO) on firm outcomes (e.g., Ali and Zhang 2015; Hoitash, Hoitash, and Kurt 2016; Li, Sun, and Ettredge 2010; Lin et al. 2014; Xuefeng Jiang, Petroni, and Yanyan Wang 2010). However, few studies focus on COO. To that end, we explore and expand factors influencing the decision to hire a COO. Second, as COOs are expected to ensure better operational efficiency, it is important to know whether COOs' performance matches with this expectation. Since operational efficiency is one of the important metrics in evaluating firm financial performance (Baik et al. 2013), this study contributes to the literature by shedding light on the role of COOs in the context of operational efficiency.

Hambrick and Cannella (2004) draw on the contingency theory to explore some conditions that affect the decision to have a COO. Three conditions are industry dynamism, extraordinary organizational task demands, and the CEO's limitations. Their results show that all CEO-related factors are significantly associated with the presence of a COO. In addition, anecdotal evidence suggests that the CEO is the one who decides to hire a COO. Thus, we expand and explore additional CEO-related factors that more fully address what types of firms that have a COO. Our four CEO-related factors are CEO Busyness, CEO Ability, CEO demographic characteristics and CEO network size. Our results indicate that CEOs with a heavy

workload tend to hire a COO to assist their work. Highly competent CEOs are more capable of working independently, thus less likely to hire a COO. Older CEOs are more likely to appoint a COO to reduce some of their responsibilities. Finally, CEOs with a larger network size have more professional contacts to employ a COO.

Approximately one-third of the S&P companies have a COO to handle internal operations separately while others include the duty for their CEO (Nelson 2015). To remain important in organizations, COOs can focus on some key areas (the role of COO varies by firms and industries). According to EY's 2014 COO survey, 65% of COOs and 53% of their C-suite peers believe that optimizing operations performance is the area where COO's work adds value to the company. Sixty percent of COOs also believe that delivering significant cost efficiencies is another area where COOs can contribute to the company. Accordingly, this study examines whether the presence of a COO has a differential effect on firm operational efficiency. Prior literature suggests that there are two types of COO. For some firms, heirs, destined to become future CEO, initially take the COO position to gain necessary skills and institutional knowledge. For others, COOs are purely COOs who maintain the position for the rest of their careers (Crainer and Dearlove 2003; Hambrick and Cannella 2004)[1]. As the motivations of the COO position vary across organizations, we also investigate the following question: Are heir-apparent COOs more likely to improve operational efficiency than non-heir-apparent COOs?

Prior research suggests that the presence of a COO affects firm operational efficiency. However, the empirical evidence is mixed concerning whether the presence of COO increases or decreases firm operational efficiency. Hambrick and Cannella (2004) find that firms with a COO

[1] In the previous years, there are some prominent COOs who are promoted to CEOs. Example includes John Brock (Cadbury Schweppes), Mike Zafirovski (Motorola), John Walter (AT&T), and Robert Willumstad (Citigroup).

have a significantly lower level of operational efficiency, while Marcel (2009) finds contradicting results. Despite their conflict, each of these findings makes inherent sense. On one hand, the presence of a COO may improve firm operational performance. Because COOs are primarily responsible for daily operations, the presence of a COO helps CEOs to have more time to shape a vision and develop long-term strategic goals (Hambrick and Cannella 2004; Zhang 2006a)[2]. As a result, firms with COOs have better operational efficiency than those without. Alternatively, having a COO may separate the formulation and implementation of strategy within a company. This weakens the CEO's capacity to lead the firm, as the CEO does not have full access to critical information such as internal function failures promptly (Marcel 2009; Zhang 2006b)[3]. Another reason that having a COO may negatively impact firm operational efficiency is an accountability problem. The division of leadership roles tends to make CEOs easier to escape accountability (Hambrick and Cannella 2004; Marcel 2009; Zhang 2006)[4]. Stated differently, CEOs may shift blame to the COOs for internal function failures and operational efficiency issues. This results in the CEOs' slacking on overseeing daily operations. Having a COO also adds another layer of bureaucracy, which is costly and hinders the

[2] An example includes Michael Dell and Mort Topfer. In an interview, Mort Topfer, said that "As it turned out, Michael focused on the technology of the company; he focused on the interfaces with the street he focused on the customer relationships because he did really well at that. He really had no interest in running the company on a day-to-day basis and getting very much involved in the operations and things like that. When I joined the company, it was a $2.8 million company and had never done a three-years plan and never did an annual plan, and it wasn't because they didn't want to do it. They just didn't have the structure and discipline to do it. In the first year at the company – 1994- we did our first three-years plan. (Bennet and Miles 2006)

[3] It is critical important for a COO to believe in the CEO's strategy and vision. The CEO and COO need to operate with an identical understanding of the details of the strategy plan for a successful implementation. For instance, the statements that the CEO is speaking to the media should be consistent to the statements that the COO speaking to plant employees (Bennet and Miles, 2006).

[4] A chief executive of CUC International, Walter A. Forbes talked to the press after CUC International was found to inflate revenues and hid expenses. He indicated that it is unnecessary to know what was happening inside the company. He worked on the strategy vision part, talking to key clients and being the outside voice of the company. He said: "I think I was much more valuable to shareholders doing that than in day-to-day operations". (Norris, 2005). Others example of these scapegoat problems include Richard Scrushy (HealthSouth); Bernard J. Ebber (World Com); and Ken Lay and Jeffrey Skilling (Enron).

information processing efficiency among the top management team (Marcel 2009). Taken together, we expect that having a COO affects firm operational efficiency, but we do not offer a directional hypothesis due to the conflicting evidence.

Next, we investigate whether heir-apparent COOs are more likely to improve operational efficiency than non-heir-apparent COOs. Prior literature documents that internal promotion improves long-term firm financial performance (Zhang and Rajagopalan 2004). Heir- apparent COOs are also more likely to be involved with strategy formulation to better prepare themselves for the next job. These pieces of evidence suggest that heir-apparent COOs are better at ensuring operational efficiency than non-heir apparent COOs. On the other hand, heir-apparent COOs are more likely to take sides with their CEOs than non-heir apparent COOs in most cases as CEOs play a key role in determining who is going to be the next CEO. This creates a problem in case that CEOs misuse companies' resources for their gains, deteriorating operational efficiency. On the whole, we propose a null hypothesis due to appealing arguments on both sides.

To conduct our analyses, we use a sample of 27,026 firm-year observations from 2004 to 2015. In all specifications, we follow Cheng, Goh, and Kim 2018 and Demerjian et al. 2013 and control for factors previously shown to influence operational efficiency. As prior research on COO agrees that firms with a COO tend to have different characteristics than firms without a COO, we employ a Heckman procedure to address the sample selection bias (Bucchheit et al. 2019; Hambrick and Cannella 2004). We also employ a lagged regression design to the second stage to address the reverse causality problem. One may argue that firms that have operational problems are more inclined to hire COOs to fix these issues. In the first stage, we regress different factors that influencing the decision to have a COO on the likelihood that a firm will have a COO. In the second stage, we specifically regress firms' operational efficiency at time t+1

on an indicator variable of whether firms have a COO (COO) at time t. The result shows that firms that have a COO have a lower level of operational efficiency than firms that do not. This naturally leads to the question of what parts of operational efficiency that firms with a COO perform worse than firms without a COO. To answer that question, we replace our dependent variable, firm's operational efficiency, with different variables: receivables turnover, inventory turnover, payables turnover, sales to SG&A expense ratio, sales to PPE expense ratio, sales to cost of goods sold ratio and sales to other expenses[5] ratio. The results suggest that firms with a COO have lower receivables turnover and sales to cost of goods sold ratio than firms without a COO. We employ a firm fixed-effect model to control for potential time-invariant omitted variables to test the robustness of our main result. We also employ a concurrent design[6] and include a lagged variable of operational efficiency to control for potential omitted variable bias. All inferences remain unchanged. [7]

We examine the association between heir-apparent COOs and operational efficiency in the sample of firms with a COO and the full sample[8]. We proxy for heir-apparent COOs by an indicator variable indicating whether the COO is promoted to CEO in the following years. Our results suggest that heir-apparent COOs are not significantly associated with lower operational efficiency than non-heir apparent COOs. Both firms with heir-apparent COOs and non-heir-apparent COOs perform worse than firms without a COO on optimizing operational performance. It seems that the benefits of the costs of having an heir-apparent COO are canceled out.

[5] Other expenses include goodwill and intangible assets.

[6] We regress firm's operational efficiency at time t on an indicator variable of whether firms have a COO at time t.

[7] This test is to mitigate the concern that small industries shave higher DEA efficiency scores. The potential bias of DEA efficiency scores toward small industry is discussed in Cheng, Goh, and Kim (2018) and Demerjian (2017).

[8] The full sample consists of both firms with a COO and firms without a COO.

In an additional analysis, we examine whether COO with industry expertise has an impact on firm operating efficiency. Prior research shows that top executive qualifications have an impact on firm outcomes (Bamber, Jiang, and Wang 2010; Li, Sun, and Ettredge 2010). For instance, Li, Sun, and Ettredge (2010) find that firms with better qualified CFOs, measured as more years of working experience as a CFO or with accounting qualifications, tend to have fewer internal control material weaknesses (ICMW) than firms without. Cohen et al. (2014) document that the audit committee with industry expertise improves audit committee effectiveness. In our context, having industry expertise is important as the operating system in each industry is unique. Prior industry experience helps COOs have a deeper understanding of a firm's operation, thus resulting in better operational efficiency. Following Cohen et al. (2014), we define a COO with industry expertise if he or she was employed by another firm that has the same two-digit SIC code as the firm in which he or she now serves as a COO. Our finding indicates that in firms that have COOs, COOs with industry expertise perform better than COOs without such expertise in terms of operational efficiency.

In another additional analysis, we examine whether outside COOs are more likely to improve operational efficiency than inside COOs. Outside COOs did not work for companies that they are hired as COOs. In contrast, inside COOs refer to COOs who are promoted to a COO position after more than one year of working in the company. While inside COOs may be more familiar with the internal operations of the company, outside COOs can bring a "fresh eye effect" to the company, potentially pointing out the existing problems of the internal operation. Our result suggests that firms with outside COOs have better operational efficiency than firms with inside COOs.

This paper adds to the literature by investigating the role of C-suite executives. Most published studies focus on the roles of CEO and CFO. While it is undeniable that CEO and CFO have a great influence on firm outcomes, other C-suite executives also contribute to the firm's success. This paper looks further into the role of a C-suite executive who affects firm success through his or her primary role. Specifically, we investigate the determinants influencing a firm's decision to employ a COO, the consequence of having a COO and qualifications affecting the performance of a COO.

This paper contributes to the literature by investigating the role of COO on firm outcomes. Prior research provides mixed evidence about the role of COO in financial performance. Hambrick and Cannella (2004) show that having COOs deteriorates firm performance while Marcel (2009) documents a positive association between the presence of COO and firm performance in five industries. As operational efficiency is one of the important indicators to predict firm future performance (Baik et al. 2013), we contribute to the literature by providing evidence that firms with a COO have lower operational efficiency than firms without a COO across industries. We also shed some light on how differences in COOs' expertise and experience shape the differences in operational efficiency results. Our results should be of interest to investors and analysts as they find operational efficiency to be value relevant. Given the validity and importance of a COO position in the top management team structure[9], our results should also be of interest to boards of directors regarding making decisions about top management team compositions and CEO succession.

[9] According to the senior executive search firm Crist Kolder Associates, about one-third of the Fortune 500 and S&P 500 firms hire COOs to be in charge of their internal operations (Nelson 2015).

The remainder of the paper is organized as follows. Chapter 2 discusses prior literature and develops our hypotheses. Chapter 3 presents our research design. Chapter 4 describes our sample selection and data. Chapter 5 discusses our results. Chapter 6 provides additional analyses and Chapter 7 concludes the paper.

CHAPTER 2

PRIOR RESEARCH AND THEORETICAL DEVELOPMENT

2.1 The Presence of a Chief Operating Officers (COO)

Chief operating officers (COO) are considered "the number two position" in the C-suite, overseeing internal operation (Bennet and Miles 2006; Nelson 2015). While there are variations among the role of COO, most researchers agree that COO is primarily responsible for daily operational issues ranging from monitoring employees' activities, implementing strategies, and allocating resources to handling disturbances. Hambrick and Cannella (2004) interview COOs and find that firms with a COO have most business units (e.g., information technology and procurement) directly reporting to the COO. Later, the COOs and other staff areas in finance, general counsel, public/investors affairs, and business development report to the chief executive officers (CEOs).

Hambrick and Cannella (2004) take the first step to explore why firms need a COO. They use a contingency theory to argue that three factors affecting a COO hiring decision are industry dynamism, organizational task demands, and the CEO's limitations. Industry dynamism refers to the industry condition that increases the demand for a COO: growth industry and technology intensity. Organizational task demands directly affect a CEO's workload and the need to hire a COO to lessen that burden. These demands arise in large firms that are highly diversified and engaged in mergers and acquisitions and in firms that CEO serves as board chairman. Finally, a CEO with a limiting experience needs a COO to support him with operational responsibilities. For instance, a CEO that is promoted from outside the company lacks institutional knowledge that helps him succeed in the early years of his career. The results show that most CEO-related variables are significant while industry factors are not significant. This indicates that the decision

to have a COO lies in the CEO's hand. Thus, we want to investigate various CEO characteristics associated with the decision to hire a COO.

We expand Hambrick and Cannella's (2004)'s model and include additional CEO characteristics to fully explain why firms decide to have COO while other firms do not. We also use a larger sample from a new period (2005-2014) to ensure the reliability of the test. Four CEO-related factors that likely impact the hiring decisions are CEO busyness, CEO ability, CEO demographic characteristics, and CEO network. Our set of factors is grounded in prior literature on COO and chief executive characteristics.

2.1.1 CEO Busyness

Busy CEOs are more likely to hire COOs to lessen their workload. Busyness hypothesis states that CEOs with heavy workload might dissipate their time and attention, reducing their ability to oversee all organizational tasks (Ferris, Jagannathan, and Pritchard 2003). There are some situations that CEOs have a busy schedule. CEOs who also serve as board chairs likely carry heavier workload than CEOs who do not (Hambrick and Cannella 2004). Similarly, CEOs who have multiple board assignments may also be overwhelmed with a heavier workload. Empirical evidence provides that holding multiple board assignments impair the CEO's ability to monitor management (Ferris, Jagannathan, and Pritchard 2003). The costs of having multiple board assignments are low board meeting attendance (Jiraporn et al. 2009), greater likelihood of financial statement fraud (Beasley 1996), weak corporate governance, lower market-to-book ratios, weaker profitability, and lower sensitivity of CEO turnover to firm performance (Fich and Shivdasani 2006). Based on the above discussion, we present the following hypothesis:

> *H1: The degree of CEO busyness is positively associated with the likelihood that a firm will have a COO.*

2.1.2 CEO Ability

CEO ability is another important factor that affects the hiring decision. A less capable CEO is more likely to hire a COO to support him with overseeing operational functions. In this case, CEO ability refers to relevant education and experience that helps a CEO to be effectively in charge of operational matters in the company. For instance, CEOs promoted from the outside company do not have relevant institutional knowledge before their appointments. Thus, they may need to have a COO to get acquainted with different organizational tasks. Besides, CEOs who used to be COOs are more comfortable with operational issues than those who have never been COOs. And CEOs who have a Master of Business Administration (MBA) degree are more likely to understand the general business matters that are relevant to succeed in the company. Prior research provides evidence that highly educated executives contribute to firm value. Jalbert, Furumo, and Jalbert (2010) documents that CEOs having a Top-10 graduate degree has a positive effect on Return on Assets (ROA). Bhagat, Bolton, and Subramanian (2010) provide document that CEOs with an MBA degree enhance their firms' short-term operating performance. These evidence suggest that highly educated CEOs are capable of delivering good firm performance, thus less likely to hire a COO to assist them.

> *H2: The degree of CEO ability is negatively associated with the likelihood that a firm will have a COO.*

2.1.3 CEO Demographic Attributes

Research on the influence of executives' demographic characteristics posits that management's perceptions, values, and behaviors influence firm outcomes. And those management's perceptions and behaviors are shaped by their demographic characteristics i.e., age and gender (Plöckinger et al. 2016; Qi et al. 2018). Following similar reasoning, we believe that CEO's demographic characteristics are associated with the likelihood that a CEO will hire a

COO. More specifically, CEOs whose ages are closer to retirement tend to hire a COO to reduce their workload and prepare for a smooth transition. Thus, older CEOs are more likely to have a COO to support their work. As for gender effect, anecdotal evidence suggests that employers are more likely to hire people who are similar to them. In other words, female CEOs tend to hire more women for qualified positions. Since there are more male COOs than female COOs, we predict that female CEOs are less likely to have a COO.

H3a: Older CEOs are more likely to hire a COO.

H3b: Female CEOs are less likely to hire a COO.

2.1.4 CEO Network

CEO network of personal and professional contacts is an important source of external information. Well-connected CEOs might have access to better information about qualified executives and reach them in the network more efficiently (El-Khatib, Fogel, and Jandik 2015). Prior literature shows some benefits of large network size. Hong et al. (2015) document the positive association between CEO network size and management forecast accuracy. They argue that well-connected CEOs can use their contacts to identify important industry and economy-wide trends, thus improving earnings forecast accuracy. El-Khatib, Fogel, and Jandik (2015) document that M&A deals initiated by well-connected CEOs carry greater value losses to both acquirer and the combined firm than deals not initiated by those. Intintoli, Kahle, and Zhao (2018) provide evidence that connectedness of independent, non co-opted audit committee members has a positive effect on financial reporting quality and accounting conservatism. Based on the above discussion, we posit that CEOs with large network sizes have better and easier access to the executive labor market to employ qualified COOs.

H4: The size of a CEO's network is positively associated with the likelihood that a firm will have a COO.

2.2 The Association between Having a COO and Operational Efficiency

2.2.1 Prior Research on COO and Firm Performance

Management literature provides mixed evidence about the role of COO in firm performance. Using a sample of about 400 companies over 10 years, Hambrick and Cannella (2004) document that firms with a COO have lower financial performance than those without a COO. They use return on assets (ROA) and market to book (MTB) ratio to proxy for financial performance. A follow-up study by Marcel (2009) shows the contradicting result that firms with COO have higher financial performance than those without. Using similar proxies for financial performance and procedures to identify firms with COO, the author employs a sample of 153 firms from five industries. Most recently, Krause et al. (2013) investigate the role of having an external COO on the board of directors on firm performance in the manufacturing industry. The findings show that an external COO, who can provide operational expertise to the board, improves firm performance when operational expertise is needed but reduces firm performance when operational expertise is less needed. Even though this study does not look at the role of having an internal COO, the finding suggests that the value of having a COO may vary across organizations. Overall, it remains unclear whether having a COO positively or negatively affects firm performance.

Another study in the management literature examines the role of COO on different firm outcomes. Zhang (2006) investigates whether the presence of COO affects strategic change and CEO dismissal. Strategic change refers to the extent to which a firm changes its resource allocations in key strategy dimensions including advertising intensity, research and development intensity, plant and equipment acquisition, non-production overhead, and inventory level. The results indicate that the presence of COO increases the magnitude of strategic change under low

firm performance while decreases the magnitude of strategic change under high firm performance. The presence of COO also increases the likelihood of CEO dismissal under low firm performance but does not have a significant impact on the likelihood of CEO dismissal under high firm performance. The author argues that internal conflicts among top management are more likely to arise under low firm performance conditions. As the external labor market constantly evaluates a COO based on firm success, the COO is more likely to challenge the CEO when the firm is performing poorly to protect his or her reputation. This results in a higher likelihood of strategic change and CEO dismissal under the low firm performance condition. In contrast, there is no reason for a COO to be concerned about the external labor market evaluation under the high firm performance condition, resulting in a lower likelihood of strategic change and CEO dismissal.

Scant evidence in the accounting literature examines the role of COO on firm outcomes. A recent study by Cassell et al. (2019) looks at the impact of having a COO on real earnings management. The study documents that firms which have a COO have a significantly higher level of real earnings management than those which do not. To the best of our knowledge, prior research has not explored the direct relationship between the presence of a COO and operational efficiency. Another study by Bucchheit et al. (2019) document that firms that COO-CFO combined position have relatively more volatile discretionary accruals, hence better financial reporting quality. To that end, we investigate whether having a COO improves operational efficiency.

2.2.2 Prior Research on Operational Efficiency

Prior accounting literature on operational efficiency uses simple accounting ratios to investigate the association between operational efficiency and firm performance (Baik et al.

2013). For example, studies use changes in assets turnover and changes in operating margin as a proxy to measure operational efficiency (e.g., Fairfield and Yohn 2001; Nissim and Penman 2001). On the other hand, management accounting literature has employed Data Envelopment Analysis (DEA) and Stochastic Frontier Analysis (SFA) to construct organization efficiency measures. For instance, several papers use DEA and SFA methods to measure relative efficiency for cost variance analysis and performance measurement for a non-profit organization (e.g., Mensah and Li 1993; Rouse, Putterill, and Ryan 2002). Recently, Demerjian, Lev, and McVay (2008) introduce a managerial ability measure, which is derived from a portion of the operational efficiency measure unexplained by firm-specific factors[10]. This study generates interest in using DEA to measure operational efficiency in financial accounting research by showing the advancement of using DEA to measure operational efficiency over simple financial ratios. A follow-up study by Baik et al. (2013) employs both DEA and SFA approaches to measure operational efficiency and investigates whether changes in operational efficiency are associated with firm future performance. The results show that changes in operational efficiency are positively associated with changes in current and future earnings. The authors also find changes in operational efficiency are positively related to future stock returns, implying that investors incorporate the information about efficiency changes into their valuations. This suggests the value relevance of operational efficiency and the need to further explore the role of operational efficiency in financial accounting research. Most recently, Cheng, Goh, and Kim (2018) examine the relationship between internal control and operational efficiency. They find that firms that report internal control material weaknesses have a significantly lower operational efficiency than firms that do not. The authors argue that ineffective internal control leads to

[10] Details of the operational efficiency measure will be discussed in the methodology section.

agency problems and the likelihood of misappropriation of corporate resources by managers and other employees. On the other hand, ineffective internal control can result in unintentional errors in internal management reports and in untimely financial reporting processes. Managers are likely to make suboptimal decisions given inaccurate internal reports. Our paper adds to this conversation by providing evidence that while internal control system is crucial to operational efficiency, managers who are in charge of setting policies also play an important role in influencing operational efficiency. For firms with a COO, COOs are likely to be the managers who make decisions regarding internal control system over operation. As for firms without a COO, CEOs are in charge of making such decisions (Bennett and Miles 2006). Thus, it is important to know whether COOs or CEOs are the ones who make better operational decisions for their firms.

2.2.3 The Effect of COOs on Operational Efficiency

The preceding discussion suggests that the presence of COO affects operational efficiency. There are some specific reasons to support the claim that having a COO can positively influence operational efficiency. First, CEOs are traditionally in charge of both internal operations and external affairs. For firms with a COO, the role of overseeing internal operations can be solely delegated to the COOs. Thus, CEOs have more capacity to formulate long-term strategies, develop visions, and communicate with analysts, investors, regulators, and the media effectively (Hambrick and Cannella 2004; Zhang 2006b). Second, COOs have incentives and reputation concerns to improve operational efficiency. The 2014 survey by EY indicates that the majority of COOs and their C-suite peers agree that optimizing operational performance, delivering significant cost efficiencies, and managing functional departments are key areas where COOs can build their reputation. Without adding value to these areas, COOs are

unlikely to maintain their positions in the companies.

Alternatively, prior literature points out several reasons that the presence of a COO may negatively impact firm operational efficiency. First, critics of COOs argue that having a COO structurally separates the strategy formulation and implementation roles in a company. This separation potentially creates a misalignment between the strategic planning and implementation processes. In addition, this hinders a CEO's ability to act on daily operation issues promptly (Hambrick and Cannella 2004; Marcel 2009; Zhang 2006b). Second, the setup of a COO position can create an accountability problem within an organization. A CEO can shift blame to a COO if the company experiences poor operational performance (Boeker 1992; Zhang 2006). Taken together, adding a COO can be a costly arrangement which potentially leads to a problematic implementation of strategies and CEOs avoiding responsibility for operational failures. Third, recent trends indicate that an organization structure becomes flatter and horizontal. The advancement of technology and digital communications extends a CEO's capacity to oversee internal operations while being away. Specifically, CEOs become more efficient in communicating with all parties, from employees to investors and analysts while being able to access timely and customized internal reports through the use of email, voice mail, and video-conferencing and social media (Nelson 2015). The ability of multitasking reduces the need to have a separate COO for internal affairs. Taken as a whole, we propose the following null hypothesis:

> *H5: Firms that have a COO do not have a different level of operational efficiency than firms that do not have a COO.*

2.2.4 Heir-Apparent COOs and Operational Efficiency

Prior literature documents that firms may set up a COO position to train candidates to become the next CEO (e.g., Crainer and Dearlove 2003; Hambrick and Cannella 2004; Zhang

2006). The 2014 EY survey also documents that 40% of the interviewed COOs see themselves in a CEO or a managing director role within the next five years while 53% of their C-suite peers think that their COOs will be the next CEO. As such, the incentives of an heir-apparent COO to improve operational efficiency may be different from that of a non-heir-apparent COO for the following reasons. First, prior literature on CEO successions suggests that inside CEOs[11] are more likely to improve long-term firm performance than outside CEOs. Based on a meta-analysis of 60 samples from 1972 to 2013, Schepker et al. (2017) find that promoting an inside CEO results in better firm performance. More specifically, Zhang and Rajagopalan (2004) document that promoting a COO results in better firm performance than hiring an outside CEO [12]. Second, a COO who later becomes a CEO, an heir-apparent COO, is more likely to be involved in the firm's strategic formulation than a non-heir-apparent COO. According to the 2014 EY survey, 40% of COOs cite the excellence in operations and 24% of the COOs cite the need for strategic thinking as key factors to becoming a successful future CEO. Early involvement in strategic formulation equips an heir-apparent COO with necessary skills to succeed in his or her next stage of career. This also reduces the potential misalignment between strategic formulation and implementation for firms with a COO. Still, there can be a situation whereby having an heir-apparent COO reduces operational efficiency. CEOs' empire building and inappropriate allocation of corporate resources for personal benefits reduce operational efficiency. It is possible that an heir-apparent COO might want to avoid a potential conflict with

[11] An inside CEO refers to a CEO that are promoted internally. An outside CEO is hired externally.

[12] It is important to note that their study investigates the impact of relay succession on firm performance. Relay succession refers to an incumbent CEO works with an heir apparent and passes the leadership to the heir. The authors then identify a relay CEO succession as one in which the new CEO was an executive of the given firm who had firm tenure of at least two years at the time of succession and was the heir apparent to the predecessor CEO. An heir apparent status is then identified as "any officer who has the only person in the firm holding the title of president or COO or both and who was at least five years than the incumbent CEO". Thus, a relay CEO succession essentially refers to an heir apparent COO.

the current CEO, as the current CEO plays a role in CEO succession. In such cases, heir-apparent COOs are less likely to resist CEOs' pressure when dealing with managerial slack. The preceding discussion leads to our prediction that having an heir-apparent COO can have a positive or negative effect on operational efficiency:

> *H6: Firms that have an heir apparent COO do not have a different level of operational efficiency than firms that have a non-heir apparent COO.*

CHAPTER 3

RESEARCH DESIGN

3.1 Measuring Operational Efficiency

We measure firm operational efficiency using Data Envelopment Analysis (DEA) method.[13] The DEA method is a nonparametric method of measuring the efficiency of a decision- making unit (DMU). The approach maximizes the level of output given a specific level of input to produce an efficient frontier. Specifically, the efficient frontier is derived from solving the following optimization problem:

$$max\ \theta_v = \frac{Sales}{v_1\ COGS + v_2 SG\&A + v_3 PPE + v_4 Operating\ leases + v_5 R\&D + v_6 Goodwill + v_7\ OtherIntangibles}$$

The operational efficiency scores derived from the method are an ordinal ranking of the relative efficiency of a firm to firms that are on the efficient frontier. Other papers using the DEA approach to measure firm operational efficiency include Baik et al. (2013); Cheng, Goh, and Kim (2018); Demerjian et al. (2013) and Demerjian, Lev, and McVay (2012). See Baik et al. (2013) and Demerjian, Lev, and McVay (2012) for a detailed discussion of the advantages of using the DEA method to measure operational efficiency over simple financial ratios such as return on assets and profit margins.

Following Cheng, Goh, and Kim (2018) and Demerjian, Lev, and McVay (2012), we use revenues as the output variable as prior research indicates that revenue is a primary source of earnings and cash flows generated from firms' operating activities. Inputs to generate revenue includes net property, plant, and equipment (PP&E), net operating leases, net research and development expenses (R&D), purchased goodwill, other intangible assets; cost of goods sold

[13] We obtain the DEA efficiency measure from Professor Demerjian's website: http://faculty.washington.edu/pdemerj.html. We thank Professor Demerjian for making this data available for academic use.

(COGS) and selling, general and administrative expenses (SG&A). These inputs capture managers' choices in the revenue-generating process (Cheng, Goh, and Kim 2018; Demerjian, Lev, and McVay 2012). Prior research generally agrees that operational efficiency is different across industries since the business models and cost structures are distinct in each industry. Therefore, we estimate the EFFICIENT score by industry using the Fama-French industry classification.

3.2 The Likelihood that a Firm will have a COO

We estimate the following probit regression model to investigate the CEO-related factors associated with the likelihood that a firm will have a COO:

$$\begin{aligned} COO_{i,t} = {} & \alpha_0 + \alpha_1 CEO\_MULTIBOARD_{it} + \alpha_2 CEOCHAIR_{it} + \alpha_3 CEO\_COO_{it} \\ & + \alpha_4 CEO\_MBA_{it} + \alpha_5 OUTSIDECEO_{it} + \alpha_6 CEO\_LNAGE_{it} \\ & + \alpha_7 CEOGENDER_{it} + \alpha_8 CEO\_NW_{it} + \alpha_9 PERCENTAGE\_COO_{it} \\ & + \alpha_{10} LAG\_ROA_{it} + \alpha_{11} LAG\_EFFICIENT_{it} + \alpha_{12} FOREIGN_{it} + \alpha_{13} SIZE_{it} \\ & + \alpha_{14} MKTSHARE_{it} + \alpha_{15} LNAGE_{it} + \alpha_{16} FCF_{it} + \alpha_{17} MA_{it} + YearFE \\ & + Industry\ FE + \varepsilon_{it} \end{aligned}$$

Our dependent variable, COO, is an indicator variable set equal to one if firm *i* employs a COO at year t, zero otherwise. We use two measures to proxy for CEO busyness: CEO_MULTIBOARD, CEOCHAIR. CEO_MULTIBOARD is an indicator variable set equal to one if the CEO of firm i serves three or more boards, zero otherwise. CEOCHAIR is an indicator variable set equal to one if the CEO of firm i is also the chairman of the board. Three measures to proxy for CEO ability are: an indicator variable set equal to one if the CEO of firm i worked as a COO before the appointment, zero otherwise (CEO_COO), an indicator variable set equal to one if the CEO of firm i has an MBA degree, zero otherwise (CEO_MBA), and an indicator

variable if a firm's CEO joined the firm within 2 years of becoming CEO (OUTSIDECEO). CEO demographic characteristics are included: the CEO's age (CEO_LNAGE) and CEO gender (CEOGENDER). CEO Network is measured as in Boardex: the number of overlaps through employment, other activities, and education of the CEO of firm i (CEO_NW). We also control for company and industry characteristics. These are as follows: percentage of firms with a COO within an industry (PERCENTAGE_COO), firm past performance (LAG_ROA), an indicator variable set equal o zero if firm i has a merger and acquisition at time t (MA), firm size (SIZE), market share (MKTSHARE), the Herfindahl index for business segmentation (CONCENTRATION), an indicator if firms have foreign operations (FOREIGN), firm age (LN_AGE), and firm i's free cash flow (FCF).

3.3 The impact of COOs on Operational Efficiency

First, firms with a COO may be systematically different from firms without a COO (Hambrick and Cannella 2004). To control for a sample selection bias, we conduct a Heckman selection model. We regress COO on several determinants in the first stage (model 1) and include the inverse Mill ratio estimated from the first stage in the second stage. The second stage is as follows:

$$LEAD\_EFFICIENT_{i,t+1} = \alpha_0 + \alpha_1 COO_{it} + \alpha_2 SIZE_{it} + \alpha_3 MKTSHARE_{it} + \alpha_4 FCF_{it} + \alpha_5 CONCENTRATION_{it} + \alpha_6 FOREIGN_{it} + \alpha_7 LNAGE_{it} + \alpha_8 ICMW_{it} + YearFE + \varepsilon_{it}$$

where LEAD_EFFICIENT $_{i, t+1}$ refers to our measure of operational efficiency for firm i in year t+1, COO $_{it}$ is an indicator variable set equal to one if firm *i* employs a COO at year t, zero otherwise. We employ a lagged design to examine H1 to mitigate reverse causality concerns. It is

possible that firms that have problems with operational efficiency may hire COOs to fix the problems. The time-lagged analysis strengthens the causality assumption as we examine the association between the presence of a COO and the level of operational efficiency in the following year. Other control variables include the natural logarithm of total asset (SIZE), the percentage of revenues earned by a firm within its Fama- French(1997) industry (MKTSHARE), an indicator variable for free cash flow (FCF), the Herfindahl index for business segment concentration (CONCENTRATION), an indicator variable for foreign operations (FOREIGN). These variables refer to the determinants of operational efficiency that have been included in Cheng, Goh, and Kim (2018) and Demerjian, Lev, and McVay's (2012) studies. Specifically, we control for SIZE and MKTSHARE because larger firms tend to be more effective in negotiating terms with suppliers and customers. We control for free cash flow because firms with available cash can pursue positive net present value projects more effectively. We control CONCENTRATION and FOREIGN to proxy for diversified operations. Firms with more diversified operations have more challenges to achieve operational efficiency. Finally, we control for LNAGE because it takes time for firms to optimize operational performance. We also include internal control material weakness (ICMW) because Cheng, Goh, and Kim (2018) document that firms with internal control material weakness have a significantly lower level of operational efficiency than firms without such weaknesses. Appendix A presents detailed variable descriptions. The coefficient of interest in Equation (2.) is α_1 (the coefficient on COO). Consistent with H1, we expect either a positive or negative significant coefficient on COO. If the presence of a COO has a negative impact on operational efficiency, the coefficient on COO is significantly negative. Otherwise, if having a COO is positively associated with operational efficiency, the coefficient on COO is significantly positive.

3.4 The Effect of Heir Apparent COOs

To test whether firms with an heir apparent COO are associated with a different level of operational efficiency, we estimate the following models using the sample of firm-year observations with a COO:

$$LEAD\_EFFICIENT_{i,t+1} = \beta_0 + \beta_1 HEIR_{it} + \beta_2 SIZE_{it} + \beta_3 MKTSHARE_{it} + \beta_4 FCF_{it} + \beta_5 CONCENTRATION_{it} + \beta_6 FOREIGN_{it} + \beta_7 LNAGE_{it} + \beta_8 ICMW_{it} + YearFE + \varepsilon_{it}$$

where HEIR is an indicator variable set equal to one if the current COO becomes CEO within three years and zero otherwise. The coefficient of interest is β_1 (the coefficient on HEIR) A positive coefficient suggests that firms with an heir apparent COO have a higher level of operational efficiency than firms without an heir apparent COO. A negative coefficient implies a lower level of operational efficiency among firms with an heir apparent COO relative to firms without. All other variables are previously defined.

CHAPTER 4

SAMPLE SELECTION AND DATA

Starting with all public firms from Compustat from 2004 to 2015, we exclude financial institutions (SIC 6000-6999) and firms in regulated industries (SIC 4400-4999). Demerjian et al. (2012) argue that financial services firms have a unique asset structure, which requires a different calculation of firm operational efficiency. In addition, firms in utility industries are also excluded because of their regulated output prices. We merge all firms from Compustat to Boardex database to identify firm-years with COO. We exclude firms-years that have fewer than five officers with non-missing titles to reduce the likelihood of type II error in our COO identification. [14] We code officers as COOs if they hold the title of Chief Operating Officer, President of Operations, and Executive Vice President of Operations or Senior Vice President of Operations (Cassell et al. 2019). We exclude officers with additional unrelated titles to operating functions (e.g., President of Marketing) and officers that are in charge of sub-operating units and geographical regions. We also exclude firm-year observations that the COOs previously served as CEO[15]. We do not include CEO turnover years and observations without a COO for at least 360 days in the fiscal year to remove the partial year. We also exclude missing data to calculate control variables, CEO-related variables, and variable EFFICIENT. The resulting sample consists of 27,026 observations. There are 13,603 observations with COO and 13,423 observations without a COO.

[14] See Cassell et al. (2019) for the detailed discussion.

[15] For COOs previously served as CEOs, the incentives and motivations of such COOs are different from other COOs. In addition, their compensation is likely to be different due to their previous position.

Table 1. Sample distribution

Panel A: Percent of firms with a COO by year

Year	Total	COO=1	COO=0	% of Obs.
2004	2561	1183	1378	46%
2005	2545	1191	1354	47%
2006	2452	1221	1231	50%
2007	2370	1215	1155	51%
2008	2331	1180	1151	51%
2009	2210	1065	1145	48%
2010	2138	1049	1089	49%
2011	2073	1064	1009	51%
2012	2068	1122	946	54%
2013	2094	1113	981	53%
2014	2088	1105	983	53%
2015	2096	1095	1001	52%
Total	27026	13603	13423	50%
N	27026	13603	13423	50%

Panel B: Sample selection

Sample selection (2004-2015)	
Firm-years from Compustat and Boardex	99,342
Exclude financial services industries (SIC 6000- 6999)	26,554
Exclude regulated industries (SIC 4000- 4999)	7,194
Missing control variables	10,508
Missing variable EFFICIENT	15,214
Missing CEO-related variables	12,846
Final sample (firm-years)	27,026

Table 1, Panel A shows the percentage of firms with a COO and without a COO by year. We find that around 50% of sample firm-years have a COO[16]. Panel B shows the details of the sample selection procedure for all firm-years. Table 2 presents the descriptive statistics for firm-

[16] Prior to removing CEO-related variables, our sample includes approximately 39,000 observations. About 37% of the observations are firm-years with a COO. Untabulated analysis indicates that all results remain unchanged.

years with a COO and firm-years without a COO. On average, firms with a COO are larger and have a higher market share. Firms with a COO tend to be older and have more foreign operations. Finally, we find univariate evidence that firms with a COO have higher levels of operational efficiency than firms without a COO (LEAD_EFFICIENT). However, as firms with a COO has distinct characteristics (larger in size, more internal material weakness, more foreign operations, etc.) from firms without a COO, it is necessary to look at the multivariate results to draw further conclusions. As noted earlier, we also use the Heckman procedure to address the sample selection bias.

Table 2. Descriptive statistics

	COO =0	COO=1		
	Mean	Mean	Difference	t-statistics
EFFICIENT	0.562542	0.61805	-0.0555***	-17.14
SIZE	5.734273	6.64042	-0.906***	-37.5
MKTSHARE	0.004736	0.00889	-0.00416***	-18.2
FCF	0.130746	0.12115	0.00960*	2.38
CONCENTRATION	0.810366	0.79761	0.0128***	4.13
FOREIGN	0.32422	0.34213	-0.0179**	-3.12
LNAGE	2.809389	2.82155	-0.0122	-1.36
ICMW	0.050659	0.05212	-0.00146	-0.54
CEO_MULTIBOARD	0.185279	0.2384033	-0.0531***	-10.71
CEO_CHAIR	0.384638	0.5091524	-0.125***	-20.76
CEO_COO	0.258586	0.2622216	-0.00364	-0.68
CEO_MBA	0.2141846	0.2042932	0.00989*	2.00
OUTSIDE CEO	0.5269314	0.5808278	-0.0539***	-8.93
CEO_LNAGE	4.176945	4.18349	-0.00654***	-4.15
CEOGENDER	0.034195	0.0239653	0.0102***	5.01
CEO_NW	6.02851	6.294048	-0.266***	-15.53
No. of Obs.	13423	13603		

CHAPTER 5

EMPIRICAL RESULTS

Table 3 shows the determinant model that identifies related factors influencing the decision to hire a COO. The coefficients on CEO_MUTIBOARD and CEOCHAIR are both positive and significant (0.0374, t-statistics = 1.85 and 0.247, t-statistics = 14.60, respectively), suggesting that CEO busyness is positively associated with the likelihood of having a COO (H1). The coefficients on CEO_COO and CEO_MBA are both negative and significant (-0.0356, t-statistics = -1.87 and -0.0942, t-statistics = -4.85, respectively). These results imply that firms that have CEOs with previous COO work experience are less likely to hire a COO. In addition, CEOs with an MBA degree tend not to hire a COO, on average. The coefficients on OUTSIDECEO is positive and significant (0.0629, t-statistics = 3.56), suggesting that CEOs that lack specific institutional knowledge are more likely to hire a COO to support them. These results support H2, which predicts that CEO ability is negatively associated with the likelihood of having a COO. CEO demographic characteristics include CEO age and gender. The coefficient on CEO_LNAGE is positive and significant (0.398, t-statistics = 5.58), indicating that older CEO tends to hire a COO to support their work. The coefficient on CEOGENDER is negative and significant (-0.211, t-statistics = -4.36). Female CEOs are less likely to hire a COO, on average. Finally, the coefficient on CEO_NW is positive and significant (0.032, t-statistics = 4.57). The result shows that the size of a CEO's network is positively associated with the likelihood that a firm will have a COO (H4).

Table 3. Related factors influencing the decision to hire a COO

	(1) COO
CEO_MULTIBOARD	0.0374*
	(1.85)
CEOCHAIR	0.247***
	(14.60)
CEO_COO	-0.0356*
	(-1.87)
CEO_MBA	-0.0942***
	(-4.58)
OUTSIDECEO	0.0629***
	(3.56)
CEO_LNAGE	0.398***
	(5.58)
CEOGENDER	-0.211***
	(-4.36)
CEO_NW	0.0320***
	(4.57)
PERCENTAGE_COO	3.105
	(0.76)
LAG_ROA	-0.000138**
	(-2.20)
LAG_EFFICIENT	-0.124***
	(-3.36)
MA	0.0953***
	(4.66)
FOREIGN	0.0300*
	(1.66)
SIZE	0.133***
	(22.40)
MKTSHARE	4.034***
	(6.44)
LNAGE	-0.0790***
	(-6.18)

	(1)
	COO
FCF	-0.161***
	(-6.48)
Year FE	Yes
Industry FE	Yes
N	26637
pseudo R^2	0.072

*Notes: This table reports the results from probit regression of COO on CEO-related factors and control variables. The dependent variable is a dummy variable set equal to one if firm i has a COO in year t and zero otherwise. See Appendix 1 for variable definitions. All continuous variables are winsorized at the 1 percent and 99 percent levels. All t-statistics are computed using the standard errors adjusted for firm- and year-level clustering and are based on two-tailed tests (in parenthesis). *, ** and *** indicate significance at the 0.10, 0.05 and 0.01 levels, respectively.*

Table 4 presents the pooled tobit regression result in the association between the presence of COO and firm operational efficiency (H5). We find that the coefficient on COO is negative and significant at 1% level (-0.00818, t-statistics = -2.99) in column (2.). The result indicates that firms with a COO have a significantly lower level of operational efficiency than firms without a COO. In terms of economic significance, the operational efficiency of a firm with a COO is on average approximately one percentile rank lower than that of a firm without a COO.[17] The coefficients on control variables indicate that larger firms have a higher level of operational efficiency. Operational efficiency is also higher for firms with more cash flow and higher concentration. Consistent with Cheng, Goh, and Kim (2018), we also find that firms that have internal material weakness have a significantly lower level of operational efficiency. Taken together, our result rejects H1 and suggests that firms with a COO tend to have a lower level of operational efficiency.

[17] The dependent variable (LEAD_EFFICIENT) is the standardized percentile rank of operational efficiency score within industries. Given the coefficient on COO is -0.0087, firms with a COO have 0.87 percentile rank lower than firms without a COO on average.

Table 4. COOs and Operational Efficiency

	(1) EFFICIENT	(2) LEAD_EFFICIENT
COO	-0.00577**	-0.00818***
	(-2.09)	(-2.99)
SIZE	0.0832***	0.0832***
	(77.70)	(78.26)
MKTSHARE	0.515***	0.473***
	(6.67)	(6.17)
FCF	0.0923***	0.0838***
	(24.40)	(22.07)
CONCENTRATION	0.105***	0.0995***
	(19.77)	(18.99)
FOREIGN	0.0225***	0.0245***
	(8.02)	(8.78)
LNAGE	-0.00430**	-0.000562
	(-2.15)	(-0.28)
ICMW	-0.0238***	-0.0203***
	(-3.75)	(-3.24)
Mills	0.0866***	0.0738***
	(10.11)	(8.75)
_cons	-0.0691***	-0.0543***
	(-4.73)	(-3.79)
N	26637	26637
pseudo R^2	2.378	2.431

*Notes: This table reports the results from pooled tobit regression of firm operational efficiency on COO and control variables. The dependent variable is the standardized percentile rank of firm operational efficiency within industries. See Appendix 1 for variable definitions. All continuous variables are winsorized at the 1 percent and 99 percent levels. All t-statistics are computed using the standard errors adjusted for firm- and year-level clustering and are based on two-tailed tests (in parenthesis). *, ** and *** indicate significance at the 0.10, 0.05 and 0.01 levels, respectively.*

Table 5 reports the results from the estimating equation (3.), which we regress LEAD_EFFICIENT on HEIR using the COO-only sample. In column 1, the coefficient on HEIR is insignificant (-0.00626, t-statistics = -1.26). The results suggest that firms with an heir apparent COO do not have a significantly higher level of operational efficiency. Perhaps the

positive and negative effects of having an heir-apparent COO are both canceled. To understand more fully the effect of having an heir-apparent COO on operational efficiency, we also present the regression result using the full sample. In column (2), we include two additional variables NONHEIRCOO, which equals one if a COO is a non-heir-apparent COO and zero otherwise, and HEIRCOO, which equals one if a COO is an heir-apparent COO and zero otherwise. The result suggests that both firms with an heir apparent COO and with a non-heir apparent COO perform worse than firms without a COO with regards to operational efficiency on average. All signs of coefficients on the control variables are similar to those indicated in table 4.

Table 5. Heir Apparent COOs and Operational Efficiency

	(1) LEAD_EFFICIENT	(2) LEAD_EFFICIENT
HEIRCOO	-0.00626 (-1.26)	-0.0170*** (-3.37)
NONHEIRCOO		-0.0102*** (-3.63)
SIZE	0.0776*** (74.37)	0.0750*** (101.70)
MKTSHARE	0.383*** (4.25)	0.460*** (6.13)
FCF	0.0888*** (17.76)	0.106*** (28.81)
CONCENTRATION	0.0900*** (12.66)	0.0994*** (18.75)
FOREIGN	0.0300*** (7.84)	0.0247*** (8.84)
LNAGE	0.00970*** (3.66)	0.00159 (0.83)
ICMW	-0.0269*** (-3.13)	-0.0243*** (-3.83)
_cons	0.0122	0.0423***
Year FE	Yes	Yes

	(1) LEAD_EFFICIENT	(2) LEAD_EFFICIENT
N	13603	27026
pseudo R^2	2.499	2.219

*Notes: This table reports the results from pooled tobit regression of firm operational efficiency on HEIR and control variables. The dependent variable is the standardized percentile rank of firm operational efficiency within industries. See Appendix 1 for variable definitions. All continuous variables are winsorized at the 1 percent and 99 percent levels. All t-statistics are computed using the standard errors adjusted for firm- and year-level clustering and are based on two-tailed tests. *, ** and *** indicate significance at the 0.10, 0.05 and 0.01 levels, respectively.*

To ensure the robustness of the result indicated in table 4, we employ several sensitivity tests. Table 6 reports result from several sensitivity tests. In column (1.), we employ an alternative test to mitigate endogeneity concern. In particular, we include firm fixed effect to control for potentially omitted time-invariant variables. The coefficient on COO is still negative and significant. In column (2.), we include an EFFICIENT variable in our regression to control for potential omitted variables. An in column (3.), we regress EFFICIENT on COO at the same time t. We also include LAG_EFFICIENT (lagged variable of EFFICIENT). All inferences remain the same. Overall, we find that the presence of a COO is negatively associated with firm operational efficiency.

Table 6. Robustness Tests

	(1) LEAD_EFFICIENT	(2) LEAD_EFFICIENT	(3) EFFICIENT
COO	-0.00851**	-0.00680***	-0.00442*
	(-2.25)	(-3.17)	(-1.90)
EFFICIENT		0.588***	
		(101.51)	
LAG_EFFICIENT			0.572***
			(91.95)
SIZE	0.0435***	0.0323***	0.0340***
	(16.90)	(41.06)	(41.35)
MKTSHARE	0.722**	0.160**	0.174**
	(2.12)	(2.51)	(2.57)

	(1) LEAD_EFFICIENT	(2) LEAD_EFFICIENT	(3) EFFICIENT
FCF	0.0345***	0.0307***	0.0517***
	(8.73)	(10.59)	(16.48)
CONCENTRATION	0.0712***	0.0389***	0.0441***
	(5.14)	(8.99)	(9.44)
FOREIGN	0.000451	0.0125***	0.0112***
	(0.08)	(5.60)	(4.67)
LNAGE	-0.0193	0.00307**	-0.000891
	(-1.56)	(2.02)	(-0.50)
ICMW	-0.0191***	-0.00733	-0.0161***
	(-3.22)	(-1.52)	(-2.90)
_cons	0.328***	0.0160**	0.0149*
	(8.78)	(2.13)	(1.80)
Year FE	Yes	Yes	Yes
N	27026	27026	22647
pseudo R^2		4.488	4.832

*Notes: This table reports the results from several regressions of firm operational efficiency on COO and control variables. The dependent variable is the standardized percentile rank of firm operational efficiency within industries. See Appendix 1 for variable definitions. All continuous variables are winsorized at the 1 percent and 99 percent levels. All t-statistics are computed using the standard errors adjusted for firm- and year-level clustering and are based on two-tailed tests. *, ** and *** indicate significance at the 0.10, 0.05 and 0.01 levels, respectively.*

CHAPTER 6

ADDITIONAL ANALYSIS

6.1 The Effect of COOs with Industry Expertise on Operational Efficiency

Upper echelons theory predicts that differences in managers' backgrounds are associated with differences in management styles, resulting in differences in organizational outcomes (Bamber, Jiang, and Wang 2010; Call et al. 2017). Prior research on the role of executives documents that having better qualifications results in positive firm outcomes. For instance, Bamber, Jiang, and Wang (2010) find that CEOs and CFOs with an MBA background provide more accurate forecasts than CEOs and CFOs without an MBA. Li, Sun, and Ettredge (2010) document that firms that have CFOs who have previous working experience in finance have significantly less internal control material weakness. As the main responsibility of a CFO is to oversee internal control over financial reporting, this result implies that CFOs with the relevant background is likely to perform better on their primary responsibility. Following the same logic, we expect that not all COOs add value to operational efficiency to the same degree. We expect that COOs that have industry expertise, such as years of working experience in the industry, will add more value to the firm, especially on their primary responsibility. Prior accounting research has examined the impact of industry expertise on firm outcomes. For instance, Cohen et al. (2014) find that audit committee members who are both accounting, and industry experts perform better than those with only accounting expertise. Their main argument is that industry expertise is likely to help the audit committee members understand and evaluate industry-specific estimates under different industry-specific accounting standards and practices. In our setting, industry expertise equips COOs with knowledge of industry-specific operations. This is valuable given operation systems are unique and distinct in each industry. To examine the

impact of having a COO with industry expertise on operational efficiency, we estimate the following model using the sample of firm-year observations with a COO:

$$LEAD\_EFFICIENT_{i,t+1} = \delta_0 + \delta_1 INDUSTRYEXPERTISE_{it} + \delta_2 SIZE_{it} + \delta_3 MKTSHARE_{it} + \delta_4 FCF_{it} + \delta_5 CONCENTRATION_{it} + \delta_6 FOREIGN_{it} + \delta_7 LNAGE_{it} + \delta_8 ICMW_{it} + YearFE + \varepsilon_{it} \quad (5.)$$

where INDUSTRYEXPERTISE refers to a COO who is/was employed by another firm that has the same two-digit SIC code as the firm in which he or she now serves as a COO. The coefficient of interest is δ_1 (the coefficient on INDUSTRYEXPERTISE). This suggests that having a COO with better qualifications is positively associated with operational efficiency. All other variables are previously defined. Our result indicates that firms that have COOs with industry expertise have a significantly higher level of operational efficiency than firms that have COOs without industry expertise. Specifically, the coefficient on INDUSTRYEXPERTISE is positive and significant (0.0147, t-statistics = 2.58). In terms of economic significance, firms that have a COO with industry expertise have approximately 1.5 percentile rank higher than firms that have a COO without industry expertise. In column (2), we include two additional variables NONINDEXP, which equals to one if a COO has no industry experience and zero otherwise, and INDEXP, which equals to one if a COO has industry expertise and zero otherwise. This inclusion of the NONINDEXP and INDEXP variables allows us to compare the performance of three different groups: firms with an industry-expertise COO, firms with a non-industry-expertise COO and firms without a COO. The results show that firms with a non-industry-expertise COO have a significantly lower level of operational efficiency than firms without a COO. And there is no significant difference between firms having a non-industry-expertise COO and firms without

a COO. Overall, we provide evidence that industry expertise adds value to improve firm operational efficiency among firms that have a COO.

Table 7. The effect of industry expertise on firm operational efficiency

	(1) EFFICIENT	(2) LEAD_EFFICIENT
INDUSTRYEXPERTISE	0.0147***	
	(2.58)	
INDEXP		-0.000240
		(-0.04)
NONINDEXP		-0.0150***
		(-5.45)
SIZE	0.0772***	0.0762***
	(72.98)	(102.68)
MKTSHARE	0.386***	0.430***
	(4.25)	(5.72)
FCF	0.0891***	0.0930***
	(17.76)	(25.22)
CONCENTRATION	0.0885***	0.0965***
	(12.40)	(18.36)
FOREIGN	0.0302***	0.0271***
	(7.88)	(9.73)
LNAGE	0.0101***	0.00420**
	(3.80)	(2.21)
ICMW	-0.0291***	-0.0227***
	(-3.38)	(-3.63)
_cons	0.0126	0.0424***
	(0.96)	(4.48)
Year FE	Yes	Yes
N	13506	26929
pseudo R^2	2.525	2.320

Notes: This table reports the results from pooled tobit regression of firm operational efficiency on INDUSTRYEXPERTISE and control variables using the COO-only sample. The dependent variable is the standardized percentile rank of firm operational efficiency within industries. INDUSTRYEXPETISE is a dummy variable which equals one if a COO that was/is employed by another company in the same 2-digit SIC code for the fiscal year t, zero otherwise. NONINDEXP is a dummy variable which equals one if a COO that wasn't/isn't employed by another company in the same 2-digit SIC code for the fiscal year t, zero otherwise. See Appendix 1 for variable definitions. All continuous variables are winsorized at the 1 percent and 99 percent levels. All t-statistics

*are computed using the standard errors adjusted for firm- and year-level clustering and are based on two-tailed tests. *, ** and *** indicate significance at the 0.10, 0.05 and 0.01 levels, respectively.*

6.2 Outside COOs vs. Inside COOs

We also examine whether outside COOs perform better than inside COOs. Outside COOs may bring in a different perspective to the companies, thus identifying errors and mistakes previously overlooked by existing managers. On the other hand, inside COOs tend to have a better knowledge of the company's operations. Their previous working experience in the company gives them insights into internal operations, thus giving them advantages to ensure smooth operation. We proxy for outside COOs by an indicator variable OUTSIDE, equaling one if the COO has not worked at the company before their appointment and zero otherwise. Specifically, we get information about a number of years a COO has work in the company and in the position. We estimate the following model to investigate the impact of outside COOs on operational efficiency:

$$LEAD\_EFFICIENT_{i,t+1} = \delta_0 + \delta_1 OUTSIDECOO_{it} + \delta_2 SIZE_{it} + \delta_3 MKTSHARE_{it} + \delta_4 FCF_{it} + \delta_5 CONCENTRATION_{it} + \delta_6 FOREIGN_{it} + \delta_7 LNAGE_{it} + \delta_8 ICMW_{it} + YearFE + \varepsilon_{it} \quad (6.)$$

We code OUTSIDE as one if the difference between the number of years a COO has work in the company and in the COO position is less than one. Our finding indicates that firms that have outside COOs have a higher level of operational efficiency than firms that have inside COOs. The coefficient on OUTSIDE is positive and significant (0.0196, t-statistic = 2.29). It appears that outside COOs add value to the company by bringing in new perspectives. Specifically, firms that have an outside COO have approximately 1.96 percentile rank higher than firms that have an inside COO.

Table 8. Inside COO vs. Outside COO

	(1) EFFICIENT
OUTSIDECOO	0.0196**
	(2.29)
SIZE	0.0780***
	(42.79)
MKTSHARE	0.251
	(1.42)
FCF	0.0881***
	(9.81)
CONCENTRATION	0.0795***
	(5.97)
FOREIGN	0.0276***
	(3.56)
LNAGE	-0.00327
	(-0.59)
ICMW	-0.0244
	(-1.42)
_cons	0.0358
	(1.51)
N	3536
pseudo R^2	3.198

*Notes: This table reports the results from pooled tobit regression of firm operational efficiency on OUTSIDECOO and control variables using the COO-only sample. The dependent variable is the standardized percentile rank of firm operational efficiency within industries. OUTSIDECOO is a dummy variable which equals one if a COO did not work for his/her company more than one year prior to becoming COO, zero otherwise. See Appendix 1 for variable definitions. All continuous variables are winsorized at the 1 percent and 99 percent levels. All t-statistics are computed using the standard errors adjusted for firm- and year-level clustering and are based on two-tailed tests. *, ** and *** indicate significance at the 0.10, 0.05 and 0.01 levels, respectively.*

6.3 Subsample Analysis: Using COO Turnover Years

As an alternative test of Hypothesis 5, we conduct a subsample analysis to provide further evidence on the relationship between COO and firm operational efficiency. By using a subsample analysis of only firms that did not have COO in year *t-1* and year *t-2*, but hired a new

COO in year *t* and year *t+1*, we want to narrow down the impact of COOs on firm operational efficiency. Table 9 presents the result. We find that the coefficient on COO is significant and negative (-0.0107, t-statistics = -2.27), indicating that firms that started to hire a new COO have a significantly lower level of operational efficiency than previously. The results on control variables are largely consistent with those reported in table 4.

Table 9. Regression using subsample of COO turnover

	(1) LEAD EFFICIENT
COO	-0.0107**
	(-2.27)
SIZE	0.0776***
	(55.58)
MKTSHARE	0.317**
	(2.29)
FCF	0.0962***
	(14.03)
CONCENTRATION	0.0896***
	(9.34)
FOREIGN	0.0272***
	(5.46)
LNAGE	-0.00539
	(-1.54)
ICMW	-0.0221**
	(-2.08)
_cons	0.0476***
	(2.58)
N	8155
pseudo R^2	2.758

*Notes: This table reports the results from pooled tobit regression of firm operational efficiency on COO and control variables during the COO turnover years. COO turnover years refer to two years before firms have COO and two years after firms have COO. The dependent variable is the standardized percentile rank of firm operational efficiency within industries. See Appendix 1 for variable definitions. All continuous variables are winsorized at the 1 percent and 99 percent levels. All t-statistics are computed using the standard errors adjusted for firm- and year-level clustering and are based on two-tailed tests. *, ** and *** indicate significance at the 0.10, 0.05 and 0.01 levels, respectively.*

6.4 Additional Efficiency Analysis

As the main result in table 4 indicates that firms with a COO have a significantly lower level of operational efficiency than firms without a COO, we want to dig deeper into what channels that make firms with a COO have a lower level of operational efficiency. Specifically, we regression six different dependent variables on COO and other control variables. The dependent variables include REC_TRN (Receivables Turnover), INV_TRN (Inventory Turnover), PAY_TRN (Payable Turnover), PPE (Sales to Property, Plant and Equipment Expense ratio), SGA (Sales to Sales, General & Administration Expense, COGS (Sales to Cost of Goods Sold ratio) and OTHER (Sales to Other expenses including Goodwill and Intangible Expense ratio). The results indicate that firms with a COO have significant lower account receivables turnover and lower sales to COGS ratio and lower sales to other expenses ratio (Table 10, column (2.) and (5.)).

Table 10. Additional efficiency analysis

	(1) REC_TRN_	(2) INV_TRN	(3) PAY_TRN	(4) COGS	(5) PPE	(6) SGA	(7) OTHER
COO	-5.853***	-3.037	8.709	-0.634**	-3.981**	0.370	-43.93*
	(-2.66)	(-0.56)	(1.29)	(-2.00)	(-2.24)	(1.57)	(-1.85)
SIZE	0.476	-1.788	-0.164	0.238	-5.960***	0.973***	-12.04**
	(0.51)	(-0.66)	(-0.57)	(1.17)	(-4.05)	(9.38)	(-2.20)
MKTSHARE	-63.84*	220.3***	138.2	-7.300**	187.1***	90.15***	706.8**
	(-1.83)	(2.59)	(0.95)	(-2.13)	(5.09)	(6.26)	(2.52)
FCF	5.315	-1.667	-2.864	0.177	5.451***	0.0208	35.68
	(1.42)	(-0.37)	(-0.96)	(0.51)	(4.45)	(0.06)	(1.28)
CONCENTRATION	12.86***	10.95*	7.742	1.312***	9.680***	-0.849*	130.7***
	(3.61)	(1.89)	(1.21)	(6.56)	(3.89)	(-1.71)	(3.60)
FOREIGN	-2.117	-2.025	8.196	-0.126	2.709	-0.729***	-37.26**
	(-1.35)	(-0.40)	(0.87)	(-0.55)	(1.32)	(-2.74)	(-2.25)
LNAGE	-0.555	-12.05***	-6.119	0.0637	1.015	-0.702***	-10.55
	(-0.28)	(-2.73)	(-1.26)	(0.58)	(0.65)	(-3.19)	(-0.63)
ICMW	-2.801*	7.124	-5.810	0.0498	-4.183*	-0.967***	-8.455
	(-1.74)	(0.92)	(-1.24)	(0.26)	(-1.82)	(-2.66)	(-0.83)
mills	-5.053	6.968	28.97	0.363	-9.957	4.517***	-33.71
	(-0.53)	(0.22)	(1.24)	(0.16)	(-1.10)	(4.80)	(-0.65)
_cons	23.93	30.84	-6.938	-0.807	41.74**	-4.149**	191.2
	(1.46)	(0.70)	(-0.31)	(-0.24)	(2.31)	(-2.23)	(1.18)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	10573	8549	10692	12864	10704	12148	8925

*Notes: This table reports the results from pooled OLS of different efficiency channels on COO and control variables. REC_TRN refers to receivable turnover, calculated by net sales divided by average account receivables over two years. INV_TRN refers to inventory turnover, calculated by cost of goods sold divided by average inventory. PAY_TRN refers to account payable turnover, calculated by cost of goods sold divided by average account payables over two years. PPE refers to Property, Plant and Equipment expense ratio, calculated by net sales divided by PPE. SGA refers to net sales divided by Sales, General, and Administrative Expense to Sales ratio, calculated by net sales divided by SG&A expense. OTHER refers to sales to Other expense ratio, calculated by net sales divided by the sum of goodwill and intangibles. See Appendix 1 for variable definitions. All continuous variables are winsorized at the 1 percent and 99 percent levels. All t-statistics are computed using the standard errors adjusted for firm- and year-level clustering and are based on two-tailed tests. *, ** and *** indicate significance at the 0.10, 0.05 and 0.01 levels, respectively.*

CHAPTER 7

CONCLUSION

In this paper, we investigate factors that determine the decision to hire a COO and whether the presence of a COO is associated with firm operational efficiency. Using a sample of 27,026 observations from 2004-2015, we document that CEO Busyness, CEO Ability, CEO demographic characteristics, and CEO network size are significant factors affecting the likelihood that a firm will have a COO. The finding contributes to the literature by suggesting that CEO related characteristics are important driving factors of having a COO.

This paper is the first empirical study, showing that firms with a COO tend to have a lower level of operational efficiency than firms without a COO. We use several regression specifications to ensure the robustness of this result. The robustness tests both imply that firms with a COO may have trouble with maintaining a high level of operational efficiency. The organizational structure of separating strategy formulation and implementation roles may not be effective. As we look further into what parts of firm operational efficiency are troublesome, we find that firms with a COO have lower inventory turnover ratio and SG&A expenses to sales ratio. In a subsequent test using a sample of firms with a COO, we provide evidence that firms with an heir apparent COO do not have a higher level of operational efficiency than firms with a non-heir apparent COO. These findings should be of interest to investors, analysts, and boards of directors who make decisions regarding hiring a COO and planning for CEO succession.

APPENDIX

VARIABLE DEFINITIONS

LEAD_EFFICIENT	=	Continuous measure of firm efficiency, ranging from 0 to 1, for fiscal year t+1 based on the Data Envelopment Analysis (DEA). We obtain the data on firm efficiency from Professor Peter Demerjian's website (http://faculty.washingtonn.edu/pdemerj/data). Firm efficiency is estimated by one output of revenue (SALE) and seven inputs: net PP&E, cost of goods sold, selling, general and administrative expense, capitalized operating leases, capitalized R&D, purchased goodwill and other intangibles. For our regression analysis, we use the standardized percentile rank of firm operational efficiency within the industry to control for the variation across industry.
COO	=	A dummy variable that equals 1 if firm i in year t has a COO, 0 otherwise [Boardex].
HEIR	=	A Dummy variable that equals 1 if firm i in year t has an heir- apparent COO, 0 if firm i in year t has a non-heir-apparent COO. A heir- apparent COO is a COO who becomes a COO in the later years. [Boardex].
CEO_MUTTIBOARD	=	A Dummy variable that equals 1 if firm i in year t has a CEO who serves in three or more boards of directors, 0 otherwise. [Boardex].
CEOCHAIR	=	A Dummy variable that equals 1 if firm i in year t has a CEO who also serves as chairman of the board, 0 otherwise. [Boardex.]
CEO_COO	=	A Dummy variable that equals 1 if firm i in year t has a CEO who used to work as a COO prior to the CEO appointment, 0 otherwise. [Boardex.]
CEO_MBA	=	A Dummy variable that equals 1 if firm i in year t has a CEO who obtained an MBA degree prior to the CEO appointment, 0 otherwise. [Boardex.]
OUTSIDECEO	=	A Dummy variable that equals 1 if firm i in year t has a CEO who is promoted from outside of the company, 0 otherwise. [Boardex.]
CEO_LNAGE	=	Natural logarithm of the age of the CEO at firm i in year t. [Boardex.]
CEOGENDER	=	A Dummy variable that equals 1 if firm i in year t has a female CEO, 0 if firm i in year t has a male CEO. [Boardex.]
CEO_NW	=	The network size of the CEO at firm i in year t. According to Boardex definition, network size of selected individuals is the number of overlaps through employment, other activities and education. [Boardex.]
MA	=	A dummy variable that equals 1 if firm i in year t has a merger and acquisition, 0 otherwise. [Compustat.]
ICMW	=	A dummy variable that equals 1 if a firm reports a material weakness in ICFR for fiscal year t, 0 otherwise. [Audit Analytics].
MKTSHARE	=	Percentage of revenue earned b a firm within its Fama and French (1997) industry for fiscal year t. [Compustat.]
FCF	=	A dummy variable that equals 1 if a firm's free cash flow if not negative, 0 otherwise. [Compustat.]
LNAGE	=	Natural logarithm of the number of years a firm has appeared in the Compustat database at the end of fiscal year t [Compustat].
CONCENTRATION	=	Herfindahl index for business segment concentration, measured as the square of the ratio of individual business segments sales to total sales, summed across all business segment for fiscal year t [Compustat].
FOREIGN	=	A dummy variable that equals 1 if a firm reports a nonzero value for foreign currency adjustment for fiscal year t, 0 otherwise [Compustat].
SIZE	=	Natural logarithm of market value of equity [Compustat].

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