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Interlocking Directorates among the S&P 500: Social Networks, Gender Diversity, and Corporate Governance

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Interlocking Directorates among the S&P 500: Social Networks, Gender Diversity, and Corporate Governance

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DEDICATIONS AND AKNOWLEDGEMENTS

I dedicate this dissertation to my beautiful and loving wife, Pamela whose combined patience and encouragement enabled me to complete this project at the expense of many other projects. A special feeling of gratitude is offered to my caring parents, Peter and Diane Magistad, for whom this project's completion probably seems long overdue. I would also be remiss not to acknowledge the very hard work of my dissertation advisor, Dr. Stacie Bosley. Without Dr. Bosley's consistent and high-quality feedback along with many focused readings, this report would have been submitted in far shabbier condition.

The inspiration for this project was the simple confluence of laboring in the risk management profession with an associated interest in a particular analytical method. Combined with the accident of stumbling upon this research subject during a military deployment to an area near the shores of the Persian Gulf, this project is proof of how someone can become intellectually infatuated with a wide range of topics if they spend enough time studying them. The net result of these hours is the hope the research inspires other corporate governance researchers to challenge the output and conclusions featured here in order to make them more conclusive.

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Introduction to

Interlocking Directorates among the S&P 500:

Social Networks, Gender Diversity,

and Corporate Governance

Introduction

This multi-article investigation examines corporate board composition and the implications for regulatory penalties. Director diversity on key board committees and board interlocks influence board behaviors as they relate to regulatory risk. Directors bring experience and inter-industry ties to a board position and subsequently transfer and receive specific knowledge, practices, and contacts with other directors (Hillman & Haynes, 2010). Despite this exchange, firms may suffer regulatory oversight penalties because different directors perceive and respond to risk differently (Douglas & Wildavsky, 1983; Flynn et al., 1994). Leveraging the tenets of the cultural theory of risk perception (Douglas & Wildavsky, 1983) and of resource dependence theory (Pfeffer & Salancik, 1978), I formulate hypotheses and test those hypotheses, empirically. This dissertation research combines existing theory along with board compositional data to explore the relationship between board characteristics and firm performance vis-à-vis a regulatory penalties database (Good Jobs First, n.d.). Examining financial penalties between 2016 – 2020 among firms in the S&P 500 and the firms' respective boards, I advance a model that describes and predicts the type of firms at greatest risk for agency-imposed financial penalties. Combining board gender diversity data, board and director attributes, and social network derived variables, this research explores whether gender diversity and highly influential directors bring greater monitoring effectiveness to the board.

This research is carried out in a three-article format and the rationale for the multi-article approach is described in the following summary:

Article 1 Purpose
Theme: Explore relationship between board gender diversity and regulatory penalties.
1. Introduce new outcome variable (regulatory penalties) and discuss as a potential deterrent to firm misconduct (Good Jobs First, n.d.).
2. Establish board functions and directors as resources.
3. Establish importance of gender to risk perception (Douglas and Wildavsky, 1983).
4. Some industries are more regulated than others. Controlling for industry regulatory index (low to high regulation), I test the relationship between board audit committee diversity relative to outcome variable.

Design / Methodology:
Statistical techniques including OLS and Hurdle regression are used to analyze S&P 500 data and Violations Tracker penalty database across ten years of enforcement actions.

Article 2 Purpose
Theme: Identify ways in which social network data analysis can be leveraged to quantify board interlocks.
1. Introduce social networks and graph theory as an established way to understand board interlocks (Hurd, 2019; Jackson, 2020).
2. Compare quantifiable network results with industry embeddedness as alternative measurements of board capital (Hillman and Haynes, 2010).

Design / Methodology:
Using the linkcomm package in R and analyzing edgelists from WRDS director data, I develop betweenness centrality and degree centrality quantities for each of the 500 firms based upon director interlocks (Hillman and Haynes, 2010).

Article 3 Purpose
Theme: Combine network results from article 2 with article 1 audit committee diversity data as independent variables to analyze relationships between these variables and the response variable, average regulatory penalties.
1. Determine if findings in article 1 are robust after incorporating social network measures.
2. Test for the impact of the social network data on regulatory penalties, holding all other variables equal.

Design / Methodology:
The statistical technique is OLS and Hurdle regression to analyze the combined S&P 500 data and Violations Tracker penalty database and report the results.

Originality / value (three articles).
This is the first research to combine the disparate topics of social networks and audit committee gender diversity to test the combined relationship with regulatory penalties.

The roles of regulatory agencies as "monitors" arises from an agency's authority to regularly collect nonpublic information from firms to ensure compliance with agency-issued rules (Van Loo, 2018, p. 3). Boards of directors play a role in firm oversight as well. In the United States, when firms fail to follow the rules, costs to the firm can be extensive. Firm misconduct can comprise all manner of wrongdoing: banking and lending discrimination, water quality and environmental pollution, worker safety issues, price-fixing, and an array of other cases resolved by federal and state regulatory agencies through monetary enforcement actions.

In Article 1 of this three-article dissertation, I posit that board gender diversity acts as an additional control on management since a wider range of views from people who perceive risk differently increases the incentive to monitor the firm and its potential missteps. Article 1, entitled "Who Pays the Penalty? Board Gender Diversity and Regulatory Fines among the S&P 500," links director gender diversity on a key risk management committee with regulatory penalties. Specifically, I test the relationship between a firm's average regulatory penalties and the firm's gender diversity on the board audit committee controlling for other board characteristics including director age, tenure, previous penalties, and the firm's industry. While firm performance is referenced extensively in the literature, it seems also to have been measured in a variety of ways. In some ways, the measurement I employ is the inverse of actual performance: lower average values equal better performance. Average annual regulatory penalties per firm – the monetary fine or penalty imposed by a federal, state, local, or foreign governmental agency for a firm's violation of an agency rule (e.g., an EPA fine to a chemical manufacturer for illegal pollution) – represents a tangible way to evaluate whether differences in board characteristics help to explain variation in risk perception across firms.

An underlying theory guiding Article 1 is that, on average, females directors are better at anticipating regulatory risk based upon the cultural theory of risk perception (Douglas & Wildavsky, 1983). Moreover, when risk anticipation (or perception) is lowest, then penalties are highest. An extension of this idea is that gender diversity deficits on key committees provide the fuel for regulatory consequences. Describing concepts like risk perception can become complex where professional groups,

such as boards, tend to engage in "groupthink" behavior and directors often "conform to the social norms of 'group think' and limit frank discussion or dissent" (Barclift, 2011, p. 13). This first article proceeds from the notion that risk perception may be intertwined with gender diversity in corporate governance and that risk perceptions may be altered by increasing or decreasing board homogeneity through member gender diversity.

In Article 2, entitled "Social Networks and Corporate Boards in the S&P 500: An Alternative Approach to Measuring Board Capital," I investigate the features of director social networks that potentially reflect measures of board capital breadth and depth (Hillman & Haynes, 2010). In one analysis, board functional expertise has been broken down to categorize directors into one of three board functional roles—business experts (e.g., executives from the same or similar industry), support specialists (e.g., lawyers or financiers), and community influentials (e.g., politicians or university leaders) to characterize board capital breadth (Hillman et al., 2000). Board capital breadth is assessed as the overall diversity of each of the three categories (experts, support specialists, and influentials) populating the board. Conversely, board capital depth concerns itself with the number of industry experts staffing a board (numerator) relative to all other members (denominator). In the literature, this idea of board capital depth is used interchangeably with the term "industry embeddedness" that describes the percentage of directors employed by the same industry as the firm where they serve as director (Hillman & Haynes, 2010).

Can networking replace board capital breadth and depth? In my analysis, I incorporate the notion of "board interlocks" using social network analysis to describe board capital from an alternative perspective. Here, I harvest social network data in support of the underlying theory put forth by Hillman and Haynes (2010): that board capital – the sum of the human and social capital of the board of directors – helps shape the underlying decision framework of boards. The network represents a series of board interlocks where the linkages between directors are defined by 1) the firm the director serves and 2) the firm the director lists as their primary employer. These linkages represent a means by which corporate directors interact with other firms – both those within and outside their own industry. Ultimately, I use

social network models to replicate these two dimensions using two discrete network measures: betweenness centrality and degree centrality (Jackson, 2020). Having generated these two values from the social network, I apply them to the regression models in the third article.

Where the main contribution of Article 1 was to consider gender diversity as an independent variable and to introduce a novel outcome variable (regulatory penalties) that is important from a public administration perspective, the contribution of Article 2 is to assemble directors in an interlocking network to derive data that reflects the twin concepts of betweenness centrality and degree centrality. Thus, Article 3 allows the integration of these items from the first two articles. In this final article, I specify a model with the Article 1 and Article 2 variables and test them as predictors of regulatory penalties. Here, I integrate board attributes like board gender diversity from Article 1 with social network data from Article 2 using firm as the unit of analysis to understand the drivers of regulatory penalties. Defined by betweenness centrality and degree centrality, this article explores whether influential directors drive greater or fewer average penalties. Within this last article, I also control for firm characteristics in the model by including the following attributes: board size, CEO independence, and board committee member independence. This final model yields policy recommendations along with practical observations about corporate governance strategies to mitigate risk through key committee composition.

Article 1

Who Pays the Penalty?

Board Gender Diversity and Regulatory Fines among the S&P 500

Abstract: Penalties are routinely imposed on firms that violate federal or state regulations and corporate governance plays a role in mitigating these enforcement actions. Directors themselves can add value in this regard. Resource dependence theory has bearing on the process by which corporate boards fulfill organizational requirements to add valued board members. Reflecting these dependencies, gender diversity is a subject of increasing importance in corporate boardrooms. However, research is mixed regarding diversity's relationship to corporate governance and the collective impact on performance. Breaking from previous research, this paper explores firm performance as measured by regulatory penalties, where penalties may be a consequence of insufficient board oversight. Using director-level variables – primarily board gender diversity and the share of females on the audit committee – I test a model to explore the relationship between these variables and firm risk performance (i.e., avoiding regulatory penalties). Using the model and examining financial penalties between 2016 – 2020 for firms in the S&P 500, I find that the model helps describe and predict the types of firms at greatest risk for agency-imposed financial penalties.

1. Introduction

As evidenced by the NASDAQ's recently announced efforts to promote gender and racial diversity in boardrooms and C-suites (Rogers, 2020), there is growing interest in corporate board director diversity in the U.S (Creary et al., 2019). Expanding gender and racial diversity is a matter of equity, but it may also be a matter of self-preservation since boards must ensure that firms' risk management policies receive proper attention from management.

Boards fulfill many responsibilities but, in this research, I explore risk management as an area of concern. One primary consequence of a relaxed risk management program is the imposition of regulatory violations and associated financial penalties. According to the Good Jobs First, Violation Tracker database (VT), these regulatory penalties cover a broad range of misconduct: everything from financial reporting to chemical spills whereby penalties vary over time and by industry (Good Jobs First, n.d.). The VT database combines federal and state agency fines but also captures the cost of supplementary expenses companies are often compelled to undertake as part of settlements. Among Fortune 100 companies in the VT database, firms paid a total of $1.1 billion in penalties during 2017 to federal regulatory agencies and the Justice Department, and penalties in the U.S. averaged $17 billion per year during the preceding eight years (Good Jobs First, n.d.). While enforcement activity and penalty levels vary by Presidential administration, corporations must consider their regulatory risk over the life of the firm amidst changes in the regulatory environment.

Because risks emerge from both the external and internal environment, resource dependence theory (RDT) suggests that a firm should guard against environmental risk through the acquisition of resources (Pfeffer & Salancik, 1978). Government, and more specifically regulatory agencies, are part of the environmental mosaic that compels firms to implement controls and risk management processes and can operate very passively or be very engaged in the business and management risk-taking (Nadler, 2004). To this end, boards can add strategic depth to the way firms perceive the regulatory environment. In other words, boards help navigate and scan the environment for risk, and the composition of a board can influence how well the environment is examined.

From this perspective, group dynamics factor into how environmental risk is managed, and while there is ample foundational evidence to show that diversity moderates group decision-making (Moscovici & Zavalloni, 1969; Sah & Stiglitz, 1991), specific studies on board dynamics suggest that firms with greater board diversity generally adopt less risky financial policies and less erratic corporate policies (Bernile et al., 2017). In other words, this recent evidence indicates that greater board diversity improves corporate outcomes primarily related to risk. In line with that approach, this analysis supposes that gender diversity is a benefit to firms and their boards and – in line with RDT – represents a kind of critical resource to reducing regulatory penalties. Using a quantitative approach to study the relationship between board diversity and firm performance, this paper explores the extent to which boards offer oversight and strategically enhance risk management processes. This paper posits that penalties are connected to a boards' effectiveness as a strategic monitor. I theorize that a board's ability to provide regulatory and risk guidance is, in part, determined by the characteristics of the board and committee membership and that board composition (specifically share of females) affects the firm's ability to avoid regulatory penalties.

If share of females (referred henceforth as 'gender diversity' or 'gender parity') is an important predictor of average regulatory penalties, key antecedents suggest the following. First, there seems to be a "critical mass" component to gender diversity's impact on firm performance. Joecks et al. (2013) argue that a board proportion of at least thirty percent gender diversity should be attained before an impact on performance is observed. Second, in the scheme of board committees, I would expect the audit committee to have primacy over risk management processes. As such, Adams and Ferreira (2009) find that:

> Holding other director characteristics constant, female directors are also more likely to sit on monitoring-related committees than male directors. In particular, women are more likely to be assigned to audit, nominating, and corporate governance committees although they are less likely to sit on compensation committees than men. (p. 2)

For this reason, gender diversity can be thought to potentially improve board oversight (and by extension, reduce average regulatory penalties) given the evidence that females are more often

represented on audit committees and that this type of diversity is thought to positively impact ethical outcomes based upon the tenets of the cultural theory of risk perception (Douglas & Wildavsky, 1983).

But not all boards and audit committees will function the same: diversity and its implications may vary by industry and board size. Similarly, industries experience different levels of scrutiny, and board characteristics may reflect this fact. In the UK for example, Brammer et al. (2007) find gender diversity is highest in financial services, hotels and restaurants, wholesale and retail and other business services and suggest other factors like firm size and board size influence gender diversity on corporate boards. In this research, they suggest that a firm's proximity to consumers (e.g., retail businesses) will affect board diversity and the board's relationship to the external environment. Finally, another simple but consistent finding is that board size matters to diversity; the larger the board, the greater the number of female directors (Brammer et al., 2007; Hyland & Marcellino, 2002; Sealy et al., 2007).

While board size and other industry factors likely influence board gender diversity, high versus low industry regulation may serve as another important line of demarcation. Examining stakeholder (i.e., non-shareholder) board representation, Luoma and Goodstein (1999) investigate the effects of industry on stakeholder board representation and assert there are differences among industries that are highly regulated (e.g., utilities, banks, railroads, and pharmaceutical, etc.) compared to their lightly regulated peers. One conclusion from this is that highly regulated firms are thought to be highly accountable to public concerns where these highly regulated firms may be signaling to their constituents that they are more aware of their external environment (Luoma & Goodstein, 1999; Scott, 2001). Luoma and Goodstein's results indicate that variations in industry regulation levels are associated with stakeholder representation on boards but they are not associated with key board committee (like audit committees) membership. To extend this line of thinking, board gender diversity levels may vary between these two industry classifications (i.e., high and low), while the classification may have little or no impact on audit committee representation.

On some fundamental level I assume board diversity matters – but *how* diversity matters to board effectiveness is what frames the hypotheses and data exploration. I use Corporate Governance data from

Institutional Shareholder Services (ISS) among the 500 firms that make up the 2019 Standard and Poor index companies. These data are joined with information on the over 5,000 directors who serve on the boards of these 500 firms, where public information is available, and with 2016-2020 penalty data from the Violation Tracker database (VT). The high-level contribution of this research is to investigate whether board gender diversity predicts firm penalties, all else equal. Using OLS regression, I analyze the relationship between board gender diversity and regulatory penalties controlling for the number of historic penalties, industry, high/low regulation classification, type of offense(s), board size, and director tenure, age, and racial and ethnic diversity. Central to this analysis is the notion that the share of females on the board audit committee (a subset of the broader board) is particularly important when the share of females on the broader board reaches a "critical mass" threshold (Joecks et al., 2013). To the extent audit committee gender diversity affects regulatory penalties, performance benefits are realized by the firm once this critical mass threshold is attained.

Building on the theoretical foundation of resource dependence theory, this research makes four primary contributions. First, I use a response variable (regulatory penalties) that receives less attention in the literature as a performance metric despite the fact this variable is directly connected to the board functions explored in this paper. Second, I combine two elements in the form of an interaction variable: audit committee share of female members with the critical mass feature related to overall board gender diversity. In this manner, I test whether firms with both higher proportions of female directors as well as audit committee female members are better at scanning the environment and avoiding regulatory penalties. Third, I test an interaction between industry and diversity using a high-low regulation segmentation scheme using the McLaughlin-Sherouse Index regulatory database (McLaughlin & Sherouse, 2016). The high-level findings indicate there is evidence to support the inclusion of these variables as a way to explain the incidence and U.S. dollar value of regulatory penalties. In short, there is evidence that as both the share of females on the broader board *as well as* the audit committee increases, average regulatory penalties trend lower.

2. Theoretical Framework

2.1 Regulatory penalties

The roles of regulatory agencies as "monitors" arises from its authority to regularly collect nonpublic information from firms to ensure compliance with rules issued by agencies (Van Loo, 2018, p. 3). In the United States, for example, the Food and Drug Administration (FDA) is empowered and required to keep unsafe food off of grocery store shelves. Although regulations are distinct from statutory law because regulators do not make rules through legislatures, their effect is binding (Buthe, 2011, p. 55). When firms fail to follow the rules, the costs can be extensive. Firm misconduct can comprise all manner of wrongdoing: banking and lending discrimination, water quality, environmental pollution, safety issues, price-fixing, and an array of other cases resolved by federal and state regulatory agencies.

During 2020, U.S. corporations were fined by federal, state, and local agencies 1,385 times for a grand total of nearly $25 billion (Good Jobs First, n.d.). Ninety-three percent of these penalties were levied by federal agencies, with $16.5 billion of the violations imposed by either the Justice Department Civil or Criminal Division (Good Jobs First, n.d.). Among publicly traded firms, the federal total was about $14 billion and, among this total, nearly $11 billion was charged to financial services firms with firms like Wells Fargo and Goldman Sachs ranking highest (Good Jobs First, n.d.). If the boards of these firms were actively engaged in monitoring Goldman's violation of the Foreign Corrupt Practices Act – which involved bribing high-ranking government officials in Malaysia and the Emirate of Abu Dhabi (U. S. SEC, 2020) – or Wells Fargo's illegal sales practices between 2002 and 2016 (U.S. DOJ, 2020), then certainly some directors were asleep at the switch or simply not asking enough tough questions.

From the perspective of a firm, some violations may seem like a simple cost of doing business. But when firms routinely enter the multimillion-dollar penalty territory, it is often an indication that a broken compliance process has gone unfixed for a sustained period of time and has attracted the attention of regulators. Thus, firms that experience financial penalties – due to some form of misconduct or an

absence of control measures – see the cost reflected on their financial statements. Ultimately these fines and penalties enter the firm's income statement as "Non-Operating Expenses and Losses."[1]

Despite the cost to firms, there is some controversy as to the effectiveness of these penalties when the penalties imposed on firms through the legal system may be smaller than penalties imposed by market mechanisms. Research in a number of disciplines including business ethics (Frooman, 1997), finance (Karpoff et al., 2008), law (Alexander, 1999), and management (Janney & Gove, 2011), have detailed empirical evidence for investor reaction to corporate misconduct. Some suggest that the stock market is an efficient mechanism for punishing misconduct although some violations expose companies to greater reputational losses than others, particularly when fraud is involved (Karpoff, 2012). Still, even with reputation loss, regulatory penalties imposed upon firms engaged in corporate fraud cause stakeholder hostility where the damage to a firm's reputation is subsequently associated with a negative stock price reaction (Gu et al., 2016). As a result, legal penalties may turn out to be only part of the firm's total losses when reputational losses inflict a secondary cost.

Related research suggests that once reputational damage occurs, firm profitability declines significantly in the long run (Graham et al., 2007; Johnson et al, 2014). In a more recent, quantifiable expression of these ideas, Karpoff et al. (2008) find that "scandals involving Enron, WorldCom, and other corporations have helped create a widespread presumption that firms face very small penalties for financial misrepresentation… [from 1978-2002] only 47 firms have been fined directly by regulators with a median fine of $890,000" (pp. 605-606). Yet, despite the penalty, these researchers demonstrate that the declaration of an enforcement action is associated with a 9.6 percent average decline in the firm's market value. Thus, while initial monetary penalties may be modest or the reputational damage simply unknown, over time the damage may extend beyond the baseline legal penalties.

[1] One firm's annual report characterizes it as follows: "The Company classifies interest and penalties related to unrecognized tax positions as a component of income tax expense." Please note that this is generic language common to nearly any public corporation's annual report.

There is some evidence that the benefits of misconduct can even outweigh the financial and reputational penalties. Vijay and coauthors (2018) find that firms facing bribery investigations incurred total market penalties of $60.61 billion and acknowledge that paying a bribe can confer a clear benefit to the firm and its stakeholders if it is awarded new business and the firm is only harmed if it is caught. The agency theory view of this benefit provides one explanation for why corporate decision-making can lead to misconduct across institutional environments (Zhang et al., 2008). Sometimes, pressure to increase quarterly revenues can cause bad decisions that eventually lead to misconduct. According to (Mishina et al., 2010):

> Managers in successful firms are likely to view the potential benefits of illegality as outweighing the costs when (1) they face great pressure to sustain performance, (2) they are not concerned with the potential costs of illegality because firms' coffers would pay any fines, and (3) they believe that they can outsmart regulators and thereby decrease the chances of any indirect negative consequences resulting from illegality. (p. 745)

Despite the somewhat limited evidence that misconduct is an acceptable cost of doing business, there is broad consensus in the legal and criminal justice literature that enforcement activities improve compliance even when they are confrontational and coercive (Short & Toffel, 2008). Prior to 1975, firms did not pay fines but were only given warnings, and numerous studies have shown that regulatory inspections now improve compliance at targeted firms (Braithwaite & Makkai, 1991; Gray & Shadbegian, 2005; Thornton et al., 2005; Kuperan & Sutinen, 1998; Magat & Viscusi 1990; Shimshack & Ward, 2005). Becker's (1968) foundational work on compliance suggests the probability of a regulatory inspection and the severity of penalty affect the decision to commit a crime and for this reason, compliance decisions from the firm should be treated as internally driven – meaning that the firm has direct control over it actions to establish proper controls. Further, there is growing empirical evidence suggesting more severe deterrence measures such as penalties and enforcement actions improve facilities' regulatory compliance (Aoki & Coiffi, 2000; Gray & Scholz, 1991; Gray & Shadbegian, 2005; Thornton et al. 2005; Mendelhoff & Gray, 2005; Shimshack & Ward, 2005).

When regulatory violations have been studied as a response variable, a distinction can often be made as to whether they are measured as the number of enforcement actions (i.e., the penalty count) versus whether they are operationalized as the actual size or severity of the financial penalty (i.e., the dollar value). Starting with a look at the number of violations, Feinstein (1989) researched commercial operating nuclear reactors in the United States based on data from more than 1,000 agency inspections at 17 power plants over 3 years. Using this data, he specified models in which the dependent variable was represented by the number of regulatory violations cited during an inspection. To predict this variable, Feinstein modeled plant characteristics, plant financial health, technology, and other plant-specific variables, ultimately finding that past penalties against either a particular plant or the industry at large had little impact on noncompliance. Analyzing water pollution, Shimshack and Ward (2005) also used the number of violations as a response variable where they endeavored to describe variance using explanatory features such as standard industrial classifications (SIC), county population demographics, and the number of previous fines and inspections and found the impact of a fine produced nearly a two-thirds reduction in the statewide violation rate in the year following the fine. Also researching water quality, Vasquez (2014) employed the number of violations subject to mandatory minimum penalties as the response variable and found that mandatory penalties are effective in promoting compliance but that the effects are due to both facility-specific factors as well as enhancement of the regulatory agency's enforcement reputation. Finally, researching labor violations, Marinescu et al. (2020) incorporated violation rate (prevalence) per thousand employees as a response metric and used industry (NAICS) to explain variance with the incidence of labor-related penalties. Their findings indicate that violations are positively correlated with worker survey reports of adverse working conditions and that increased unionization is also associated with a reduction in labor violations.

In addition to the incidence of the violation itself, the severity of the penalty (i.e., the dollar value) can also factor into a model. Looking at violation severity in environmental regulatory enforcement, Kleit et al. (1998) found penalties are more likely to occur and be higher based on the severity of the violation or if the firm had a previous record of environmental violations. Studying water

pollution, Adrison (2008) found that both the frequency and severity of past penalties against municipal and non-municipal facilities from four different polluting industries were positively associated with subsequent plant compliance. Here Adrison noted that energy plant facilities respond to penalties and while violation history mattered, he reported that "the larger the amount of penalty, the greater the likelihood that the facility will comply in the next period" (p. 27).

Thus, the study of regulatory violations is usually carried out by researchers interested in a specific policy area (e.g., water quality, pollution, nuclear energy) rather than a broad spectrum of public firms and a range of penalty types. Therefore, the explanatory variables often seem custom-tailored to the type of policy being studied. Also, these antecedents often look at the number of violations as a dependent variable rather than the financial size (severity) of the penalty itself. The research I undertake focuses on average penalties in dollars per month as a response variable, as this definition incorporates penalty frequency and size. As discussed in the 'Board Functions' section, corporate governance plays a clear role in monitoring and steering the management of an organization. For this reason, this article focuses on corporate governance's relationship to firm performance where performance is understood as the dollar value of regulatory penalties. Furthermore, this study is not limited to a specific industry or context. In line with past research, I do assume that penalties may vary by industry and may be related to the firm's violation history.

Historically, academic research has explored relationships between corporate governance and firm performance, but corporate governance is less often studied in conjunction with regulatory penalties. Adrison (2008) noted that only a handful studies included penalty as a dependent variable between the period of 1989 and 2006. Thus, when we discuss corporate governance relative to performance, other measures of firm performance generally come to the fore. A brief review of traditional approaches to assessing corporate governance's impact upon economic performance reveals numerous theories and methods of analysis, but one of the fundamental observations from prior corporate governance research is that performance metrics relative to corporate governance are varied (Ueng, 2016). Moreover, reported results detailing the relationship between corporate governance and firm financial performance from prior

studies are mixed and/or multi-directional. By way of example, performance has been measured as credit quality (Ashbaugh-Skaife, et al., 2006), as CEO compensation (e.g., whether CEOs earn greater compensation when governance structures are less effective as in Core et al., 1999), market valuation, shareholder equity, and other financial statement metrics (Gompers, 2003). As an example of some of these traditional performance indicators and related findings, Baysinger and Butler (1985) and Hermalin and Weisbach (1991) found no significant association between the percentage of outsiders on the board (i.e. , board independence) and same-year measures of corporate performance (ROE). Larcker et al. (2007) investigated the association between seven general corporate governance measures (including audit and compensation committee composition and meeting frequency) and various financial reporting metrics such as operating income and return on assets. The study represented exploratory research that leveraged principal components analysis to generate fourteen corporate governance dimensions and produced some ability to explain future operating performance and future excess stock returns as performance variables.

In order to study corporate governance's relationship to regulatory penalties, it seems productive to triangulate antecedents and connect past research on what we know from each domain. For example, in a policy and environmental economics context, we have seen how the frequency of past violations or penalty history matters. In addition, industrial classification also seems relevant to the study of enforcement actions. It is with this in mind that I transition away from more traditional corporate governance performance metrics and analyze regulatory penalties as a performance indicator, directly tied to the monitoring and oversight functions of corporate boards. In addition to potential losses from reputational damage, penalties alone still undercut a firm's profits and may serve as a deterrent. To the extent administrative regulation agencies possess power to enforce rules where enforcement actions can indirectly place a burden on shareholders (Funk & Seamon, 2009), it seems reasonable that most firms prefer to avoid running afoul of regulators or becoming mired in expensive and highly publicized enforcement actions. A board, in its capacity to scan the external environment and monitor top management, can be a force to ensure compliance with rules and laws. In the absence of processes,

programs, controls and disclosure protocols, firm self-regulation – the extent to which the legal environment and regulator enforcement activities force commitments rather than symbolic firm adoption – may be insufficient (Toffel & Short, 2011). Short and Toffel find that organizations are more likely to self-regulate when they are subject to heavy regulatory surveillance. For this research, I assume that regulatory penalties provide a reflection of the firm's ability and willingness to self-regulate and that board effectiveness is measured – in part – by their ability to instill a culture of self-regulation.

2.2 Board Functions

In terms of functional expertise, Hillman, Cannella, and Paetzold (2000) categorize directors into one of three board functional roles—business experts (for example, executives from the same or similar industry), support specialists (e.g., lawyers or financiers), and community influentials (e.g., politicians or university leaders). As business experts, directors can certainly provide oversight and environmental scanning unique to their role as outsiders among the firm's upper echelons, but in actuality, they carry out a number of additional duties: monitoring the CEO (Boyd, 1995; Daily, 1996); monitoring strategy implementation (Rindova, 1999); planning CEO succession (Pitcher et al., 2000) and evaluating and rewarding the CEO/top managers of the firm (Conyon & Peck, 1998).

Thus, firms' ability to manage risk extends to the board where research on board effectiveness has sought to focus on the monitoring the CEO or management oversight role of the board (van Ees & van der Laan, 2012, p. 183). Other research has sought to emphasize the importance of board processes (e.g., encouraging constructive dissent among the directors and committees, setting agendas, providing structure to meetings, etc.) to understand the ways that boards can mitigate risk (Finkelstein, 2003; Huse, 2005). By analyzing monitoring with an appreciation for board processes, we can infer that to be effective CEO monitors, boards have to genuinely understand what the company is doing and, to achieve this understanding, boards need well-designed processes. Thus, oversight and risk management are dependent on board processes and structures.

Unlike the board as a whole, board committees specialize in narrowly defined tasks. For example, one of the primary functions of an audit committee is to provide oversight in support of the firm's risk management and compliance objectives. In publicly traded firms, an audit committee is an operating committee of the board of directors charged with oversight of financial reporting and disclosure along with regulatory compliance and risk management activities. De Kluyver defined the role as such: "Traditionally, the role of the audit committee has been to oversee, monitor, and advise company management and outside auditors in conducting audits and preparing financial statements, subject to the ultimate authority of the board of directors" (2013, p. 115). Moreover, the audit committee recommends the appointment of independent auditors and periodically consults with them on matters relating to internal financial controls and procedures. Thus, audit committees are central to the monitoring function of a board and compared to the compensation, human resources, or nominating committees, operate as a safeguard against management and regulators.

To the extent they fulfill a monitoring and oversight role, boards as a whole have often been the target of criticism. In his influential article discussing the "journey" to building a high-performance board, Nadler (2004) suggests the history of boards has not necessarily been progressive:

> Everyone knows what most boards have been: gentleman's-club-era relics characterized by ceremony and conformity. And everyone knows what boards should be: seats of challenge and inquiry that add value without meddling and make CEOs more effective but not all-powerful. A board can reach that destination only if it functions as a team, as we have come to understand teams over the past few decades. (p. 102)

Moreover, Nadler (2004) suggests that boards have always been challenged by a major deficit in their oversight function: information. In Nadler's view, directors are outsiders with limited time to learn about the company. In order to be effective, directors must be positioned to exert influence over meeting agendas and have access to the right information. Without this kind of influence, boards will always govern under management's thumb and be less effective. Can idea heterogeneity and board diversity, especially on the audit committee, serve as a way to make boards "seats of challenge" and bring more

provocateurs into the mix? Perhaps management's willingness or reluctance to taking some of these board empowerment steps – measures to effect internal challenge – is driven by decisions and structures at the top tiers of an organization.

2.3 Diversity and the Corporate Elite: Upper Echelon Theory

The makeup of an organization's upper levels is thought to be a determinant of its organizational outcomes. Upper echelons theory (Hambrick & Mason, 1984) embraces the idea that decisions and performance are tied to the background of upper management. Hambrick and Mason argued that managers' characteristics like demographics or industry experience influence their decisions and therefore the actions of top management team (TMT) reflect these characteristics and subsequently affect organizational outcomes. Furthermore, research suggests these characteristics are associated with the many cognitive biases, values, and perceptions TMT leaders bring to an organization (Carpenter et al., 2016). Similarly, empirical evidence supports the idea that "demographic diversity of senior management is also associated with the adoption of diversity practices" (Nishii et al., 2007). Conceivably, this sort of theory may be used in human resource channels as a roadmap to recruit and hire directors to the board so that recruiting activities are nested within the culture of TMT. Thus, from a research perspective, we can see how organizational culture and demographics might determine how TMT prioritizes the diversification of its board.

As noted, diversity can take several forms including less obvious characteristics such as occupational experience and education. More obviously, we can characterize diversity as having demographic facets such as gender, race, and age. Thus, it could stand to reason that if TMT lacks gender diversity, the board might reflect the same gender homogeneity as well. While there has been a decisive trend leading to women holding board positions, in many countries, research suggests that women who serve as board members are still tokens (Daily & Dalton, 1993; Torchia et al., 2011).

Yet, the cultural biases of TMT could also stem from reluctance to diversify because of perceptions that that upper echelon homogeneity (rather than diversity) promotes shared values, terminology, and fast decision-making, as some research has noted that team diversity could lead to both

conflict and confusion. Miller and del Carmen Triana (2014) suggest that gender diversity is a double-edged sword because it can either propel or impede performance. Moreover, there is a tradition of literature that concludes that demographic differences lower social unity among group members and ultimately marginalize minority viewpoints from being reflected in the larger group decision (Caldwell & Barnett, 1989; Nemeth, 1986; Belliveau et al., 1996). While some studies find a negative relationship between team diversity and performance due to conflict, poor team integration, or a lack of cohesion (Amason, 1996; Miller, et al., 1998), other studies find positive effects of diversity. For example, diversity may be associated with greater innovation and environmental risk scanning (Glick et al., 1998).

And while there is some evidence that American corporate elites have become more diverse over the last thirty years, the U.S. firm is more likely to be characterized by limited types of diversity among senior executives with respect to traits such as education, socioeconomic status, and age (Hambrick et al., 2005). On these dimensions, prior research finds that diversity is a positive disruptor for innovation. For example, in an investigation of the U.S. airline industry, airlines that changed their TMT composition the most (e.g., shorter industry tenures, more marketing/sales backgrounds) subsequently changed their strategies the most (Hambrick, 2007). In sum, while TMT cultural biases may shape board diversity, the impact of diversity on organizational outcomes from an upper echelon perspective seems mixed.

2.4 Institutional Theory

Like upper echelons theory, institutional theory emphasizes conformity across firms where organizations conform to rules and norms prevailing in the environment (DiMaggio & Powell, 1983; Meyer & Rowan, 1977; Scott, 2001). The theory suggests firms encounter institutional isomorphic pressures from their peers and respond to institutional influence from two distinct sources: The industry in which they operate and the local geography they occupy (Marquis & Tilcsik, 2016). With industry, organizational similarities often result in mimetic behavior that has been referred to as “coercive isomorphism” (DiMaggio & Powell, 1983). Applying institutional coercive isomorphism to my

dependent variable (regulatory penalties), imitative behavior and cues from other firms in the same industry could influence how boards monitor and potentially affect regulatory penalty patterns.

Institutional theory accounts for regulative and normative conformity based upon shared belief systems (Scott, 2001). By extension, societal-cultural practices can be tied to geographical influence and how firm location may drive imitative behavior based on shared socio-cultural practices and perceptions (DiMaggio & Powell, 1991). Crossvergence theory was introduced by Ralston et al., (2007) and combined convergence and divergence to recognize that various socio-cultural influences and specific business ideologies associated with geography leads to the formation of new values. Along with other economic forces, imitative behavior based upon these geographic pressures to conform may explain why some firms in this analysis are likely to be subject to higher average penalties based upon their headquarters location.

Referencing Figure 1 below, there is evidence in the Violation Tracker database that institutional pressures may exist. Reviewing average regulatory penalties by region and major industry sector, we see higher averages in one key industry (Finance, Insurance, and Real Estate) as well as higher penalty averages in two regions (East and West). While other factors influence these penalties and enforcement actions may naturally tend to be of different magnitude or frequency in some industries, average penalties are much lower in the Midwest and South suggesting the possibility of a kind of regional conformity. In sum, when we compare the tenets of upper echelons theory with institutional theory, one theory seems to suggest a vertical conformity (i.e., up and down echelons within a firm) and the other a horizontal conformity (i.e., across firms in the same industry or geography).

Figure 1: Regulatory Penalties Average by Industry and Region

Industry Sector	East	Midwest	South	West	Industry Average
Agriculture, Forestry and Fishing				$1,821	$1,821
Construction		$80,065	$67,997		$70,411
Finance, Insurance and Real Estate	$7,491,761	$687,702	$1,274,050	$10,071,390	$4,827,501
Manufacturing	$1,264,768	$988,846	$352,863	$84,679	$690,490
Mining	$650	$5,244	$406,306	$680,885	$400,844
Retail Trade	$1,030,961	$783,818	$1,203,560	$196,831	$850,183
Services	$1,737,425	$893,658	$1,153,342	$3,061,822	$2,033,106
Transportation, Communications, Electric, Gas and Sanitary service	$1,126,297	$415,994	$391,599	$952,980	$646,115
Wholesale Trade	$29,263	$2,407	$53,763		$33,221
Region Average	$2,939,273	$774,149	$653,627	$2,495,329	$1,673,162

2.5 Board Diversity and 'Resource Dependence Theory'

As noted above, Glick et al. (1998) observed that increasing TMT and board diversity supports improved environmental awareness, and improved awareness supports the board's ability to scan and manage external risk. Similarly, resource dependence theory (RDT) proposes that corporate boards are a mechanism for managing external dependencies (Pfeffer & Salancik, 1978) and reducing environmental uncertainty (Pfeffer, 1972). Singh (2007) suggests that "those responsible for recruiting directors seek particular characteristics in new appointees to complement the existing board and to provide connections to new resources to secure the future of the firm" and "each new director brings a unique mix of personal attributes, skills, knowledge and experience" (p. 2129). Given the fact that directors bring resources vis-à-vis their background and experience, RDT represents a potential way to study the linkages between gender diversity and a board's ability to scan the external environment and provide CEO and firm oversight.

In their central work formalizing RDT, Pfeffer and Salancik (1978) propose that directors bring four main benefits to organizations, which Reddy and Jadhav summarize as follows: "(a) information in the form of advice and counsel, (b) access to channels of information between the firm and environmental contingencies, (c) preferential access to resources, and (d) legitimacy" (2019, p. 2). While agency theory (Mitnick, 1973; Ross, 1973) may be the preeminent way to explain the relations between directors and management, RDT is used to describe the necessity of external organizational resources where

organizations leverage resources to increase their own power and decrease risk (Pfeffer, 1987, pp. 26-27). Research has illustrated the need to align the resources provided by the board with the needs of the firm (Hillman et al., 2009) where one clear type of resource directors provide is social capital. Hillman suggests that RDT represents the optimal framework for dissecting boards – particularly to the extent boards are dependent on attributes like resource-rich directors and the idea diversity they bring.

Other literature supports the notion that RDT is linked to diversity and is employed to study boards and their effectiveness (e.g., Hillman et al., 2009; Johnson et al., 1996; Zahra & Pearce, 1989). To the extent the theory characterizes the firm as a type of a system, dependent on resources based upon unforeseen events in the external business and social environment (Reddy & Jadhav, 2019), Hillman et al. (2000) "extend(s) the RDT framework to suggest that a more diverse board represents a valuable set of resources and may help achieve better economic outcomes" (Hillman et al., 2000, as cited in Reddy & Jadhav, 2019, p. 2). Since RDT can be characterized as an effort to increase internal board power, RDT can be thought of as a basis for managing such power. Pfeffer and Salancik (1978) suggest "boards of directors may manage the environment by appointing (to the board) representatives of organizations on which the focal firm depends" (Pfeffer and Salancik, 1978, as cited in van Ees and van der Laan, 2012, p. 183). Expanding board gender diversity may help advance a similar type of goal through the acquisition of different perspectives (Dutton & Duncan, 1987; Watson et al., 1993).

The literature reveals that RDT can inform approaches to recruiting board members. Provan (1980) finds that firms that are able to attract and recruit powerful members onto their boards are able to acquire very specific critical resources. For example, among regulated industries, Pfeffer and Salancik (1978) note that firms may require more outsiders or directors with very specific experience. In terms of CEO monitoring, other research demonstrates that boards can ensure compliance with regulations through "interlocks" or linkages with other compliant corporations since boards may look upon other corporations when determining best practices to adopt (van Ees & van der Laan, 2012). Boyd (1990) suggests board interlocks are a benefit, suggesting that "resource-rich" directors should be the focus of board composition. Through these interlocking directorates, research has also given attention to specific board

member expertise. Studies of boards have analyzed the effects of specific industries and occupational representation: bankers (Byrd & Mizruchi, 2005), venture capitalists (Baker & Gompers, 2003) and (former) politicians (Hillman, 2005; Lester et al., 2008) to name a few.

In summary, RDT research has shown that diverse groups of people offer a wider array of opinion along with a greater range of experiences and perspectives, generating more alternative solutions to (regulatory) problems (Dutton & Duncan, 1987; Watson et al., 1993). Similarly, Hillman and Dalziel (2003) assert that a more heterogeneous board of directors acts as a better control on management because a wider range of views increases board independence. Clearly, a management team can ensure a board and regulators are given access and visibility to the firm's operations but may only do so when they feel compelled. Management may emplace robust controls, or they may simply cherry-pick information for the board, omitting important details or mistakes. Likewise, the board themselves may fail to ask tough operational questions.

Diverse directors act as a bridge to important constituencies in the external environment, resulting in greater access to talent. This talent base expansion may embolden directors to probe managers for information. Diverse directors also hold unique information that can potentially improve board advice to managers and help craft better decisions and non-traditional approaches to problem solving (Reddy & Jadhav, 2019). Boards are dependent on resources, and opinion diversity is a critical element whereby diverse boards may facilitate greater transparency into the corporate governance process.

2.6 Gender Diversity, Resources, and Firm Outcomes

Audit Committees

How different are female directors from their male counterparts? Kirsch (2017) identified four basic research streams on director gender diversity. First, scholars have sought to establish whether women directors really are different from men on boards. Second, they have sought to understand what factors shape board gender composition. Third, researchers have analyzed how board gender composition

affects organizational outcomes, and last, research has investigated the extent to which regulation impacts board gender composition.

Addressing the first and third research stream, Chen et al. (2016) asserts that if "female directors are capable of being a better monitor and advisor as many people believe, we should observe favorable economic consequences as a result of increasing female board representation in addition to enhanced monitoring of financial reporting quality" (p. 600). Because the measures of economic outcomes in the literature are varied, it seems appropriate for this paper to link this perceived monitoring strength to a suitable performance variable. To the extent we view females as better monitors, it seems reasonable to think gender diversity could affect regulatory or enforcement outcomes. After all, Adams and Ferreira (2009) and Reddy and Jadhav (2019) have reported female directors are more likely to be assigned to audit, nominating, and corporate governance committees. Moreover, audit committees are charged with oversight of financial reporting and disclosure along with regulatory compliance and risk management activities. This prior empirical analysis identified that woman directors regularly have functionally different board roles than male directors.[2] While Kirsch (2017) notes that the linkages between board composition and firm outcomes often rely on assumptions about women directors' behavior (e.g., that women are more ethical or risk averse), she indicates that gender diversity can improve social and ethical aspects of the firm. Still other research indicates women adopt more ethical, risk-averse and long-term oriented points of view (Rosener, 1990), that women are believed to be capable of playing a better monitoring and advisory role in the board (Adams & Ferreira, 2009; Daily et al., 1999), and that increased gender diversity relates to opinion diversity in the boardroom, in general (Francoeur et al., 2008). Finally, despite or because of the fact the literature states women directors adopt more cautious or risk-averse points of view, Reguera-Alvarado et al. (2017) find in Spain "the results show that having more women in governance positions increase the business performance" (p. 347).

[2] Using S&P 500 data from 1996-2003, [include in text citation here so there is no confusion about who "these researchers" are] find that women are 7.5% more likely to sit on audit committees than their male counterparts.

To summarize, research suggests gender-diverse boards allocate more effort and investment to monitoring. Therefore, it may be fair to suggest there is preliminary evidence that board gender diversity has benefits since better oversight can potentially increase firm value – to the extent financial penalties impact a firm's bottom line. Therefore, for this article, I reference RDT as the key theoretical perspective to study corporate governance where firms are uniquely *dependent* on populating the ranks of their audit committee with a higher percentage of females in order to enrich firm oversight. In conjunction with Kirsch's (2017) observation that gender diversity can positively affect ethical behavior, it stands to reason that an extension of the ethics argument is that regulatory violations will be lower as the result of enhanced gender diversity given 1) disproportionate female representation on the audit committee and 2) a tendency toward risk aversion and purported higher standards of ethical behavior.

Gender Critical Mass

As described above, research on diversity and firm performance has produced mixed findings, and firm performance has been measured in a variety of ways. Furthermore, the literature generally argues that stronger monitoring increases shareholder value (Hermalin & Weisbach, 2003), although some research posits excessive board monitoring can decrease value (Almazan & Suarez, 2003). Additionally, if enhanced participation by directors leads to perceived meddling or interference, gender diversity could also negatively affect performance on a number of performance measures (Adam & Ferreira, 2007).

A key component of this research focuses on Kanter's (1977) foundational work concerning gender diversity and critical mass theory. In support of Kanter, Joecks et al. (2013) empirically find "evidence for gender diversity to at first negatively affect firm performance and-only after a 'critical mass' of about 30 percent women has been reached-to be associated with higher firm performance (i.e., ROE) than completely male boards" (p. 1). Joecks et al. (2013) highlight the interaction of diversity "critical mass" and performance whereby boards that comprise 30 percent or greater women on the board are associated with higher levels of performance. Surprisingly, at very low levels of gender diversity (below 10% female representation), an increase in diversity might actually be associated with reduced firm

performance. Therefore, this "U-shaped" evidence for gender diversity at critical mass points (Joecks et al., 2013) is one of the testable propositions of this article and relates directly to the first hypothesis.

2.7 Cultural theory of risk perception

As referenced in earlier sections, the cultural theory of risk perception informs the understanding of gender diversity, board oversight, and firm performance. This theory provides a conceptual framework of risk perception where perceptions vary across cultural, socio-political, or demographic groups. The theory was first described by anthropologist Mary Douglas and political scientist Aaron Wildavsky (1983). In the authors' analysis, individual cultural traits are major determinant of how people perceive and assume risk. Since this foundational work, an update on cultural risk perception includes the study by Flynn et al. (1994) that compared risk perception ratings among 25 well known hazards (e.g., alcohol consumptions, pesticides, radon in homes, etc.) among different gender and racial groups. The most striking finding here was that among white males, white women, nonwhite males, and nonwhite females, the mean risk ratings for white males' risk perception for all 25 hazards were consistently lower than the means of the other three groups. In other words, white men perceived the least amount of risk. A similar result was found by Finucane et al. (2000) where whites continued to rate risks lower than nonwhites, with nonwhite females often giving the highest risk ratings. The authors dub this reinforced finding the "white male effect."

Tying this cultural theory of risk perception to corporate governance and regulatory penalties, we might conclude that boards staffed by a majority of white males might represent the biggest risk takers (i.e., perceiving the least risk). Moreover, as it is the audit committees' job to manage risk, we could extend the argument to assert that audit committees staffed by a majority of white males might be willing to assume the greatest level of risk. As such, we could infer that consistent risk-taking behavior (due to lower rates of risk perception) will invariably lead to greater financial penalties.

As a board committee, the audit committee represents a key monitoring capability. Considering the tenets of the cultural theory of risk perception, it is also reasonable to posit that broader board gender

diversity acts as a control on management since a wider range of views from people who perceive risk differently increases the incentive to monitor the firm and its potential missteps. Furthermore, if we accept the notion that gender diversity[3] at critical mass levels enhances the monitoring capability of the board (combined with the possible interactive effect of greater audit committee representation), then it is a reasonable extension of that argument to assume critical mass play a role in this enhancement as well. Based on what we seem to know about gender diversity's relationship to critical mass and audit committee membership, the two variables may predict something about the board's monitoring function. Linking these facets of corporate governance to regulatory penalties, I offer the following hypothesis:

> ***Hypothesis 1****: As female representation in the audit committee increases, average regulatory penalties will decrease once critical mass is realized (>30 percent female board membership), all else equal.*

2.8 Other Board Facets and Interactions

National legal frameworks and social structures could interact with the relationship between board diversity and firm performance. Post and Byron (2015) found that

> female board representation is positively related to accounting returns and that this relationship is more positive in countries with stronger shareholder protections—perhaps because shareholder protections motivate boards to use the different knowledge, experience, and values that each member brings (p. 428).

Beyond national-level factors, other variables seem to play a role in the effect diversity has upon performance. For example, research shows that racial minority and female directors have more influence if they have network ties to majority directors through common membership on other boards, known as

[3] In the WRDS data, the variable "Female" is coded Yes/No to indicate the director's sex, allowing for two possible choices. Given that the literature tends to refer to gender rather than sex when discussing diversity and parity, I utilize this variable to measure gender diversity. Specifically, I measure the share of directors identified as female. A firm with a larger share of females is described as having higher gender diversity and greater gender parity.

interlocks (Westphal & Milton, 2000). Similarly, organizations linked in such a network structure provide "best practices" diffusion to similar firms (Aldrich & Zimmer, 1986; Hillman et al., 2007).[4]

Industry type can interact with performance outcomes as well. As researchers observe, the industry impact may be particularly profound for companies in industries with high accountability to the state (Luoma & Goodstein, 1999; Scott, 1995). In other words, industries that operate under a high level of regulatory scrutiny are more accountable to both government agencies and public concerns, and because they are more accountable, they are likely subject to a larger number of enforcement actions (Luoma & Goodstein, 1999; Miles, 1987; Oliver, 1991; Pfeffer & Salancik, 1978; Scott, 1987; Scott, 1995).

Despite this convergence of opinion, until recently precise identification of these industries was difficult (McLaughlin & Sherouse, 2016). To ascertain high and low regulated industries for this analysis, I apply the McLaughlin-Sherouse Restrictions Index from their regulatory database where industries such as 'Petroleum and coal products manufacturing' and 'Electric power generation, transmission, and distribution' are among the top regulated industries (see Table 3). According to Emery and Faccio (2020), "restrictions" is an estimate of the number of phrases indicating legally binding obligations and prohibitions present in the Code of Federal Regulations (CFR) whereby the database is formed using textual analysis to identify regulatory phrases for each part of the CFR (p. 13). Following the variable list in Table 1, the most regulated industries are highlighted in Table 3.

In their analysis of the propensity for public firms to employ a former government regulator, Emery and Faccio (2020) demonstrate that the percentage of firms that employ former regulators is highest among firms operating in the "utilities" and "finance and insurance" industries, and lowest among firms typically thought of as having more detached ties to government. In other words, firms that are

[4] During article two where I develop a method to position firms in a broad network, these research observations and interactions will be tested in concert with gender diversity and network position. In this paper I explore two primary dimension of director capital: breadth and depth where board capital breadth is defined as the portfolio of director experience and extra-industry ties, board capital depth refers to the embeddedness of a director in the firm's primary industry vis-a-vis interlocking directorships. This paper compares social network modeling results to levels of industry of embeddedness among S&P 500 firms.

highly regulated are responsive to regulatory guidance and consultation insofar as former regulators "tend to be hired in response to or concomitant with increased regulation, or concomitant with firms receiving fines" (p. 1).

Additional evidence shows that highly regulated industries attract regulatory expertise. For example, the "quid pro quo" hypothesis asserts former regulators are often hired by firms in exchange for favors received upon leaving government employment (Emery & Faccio, 2020). Despite this reciprocal exchange, Shive and Forster (2017) find no blatant evidence of more lenient monitoring or enforcement as the result of a federal regulator hiring by the target firm. The authors also find that regulated firms engage in lower-risk behavior after hiring a former financial regulator. Conversely, there is some limited evidence within specific industries where regulators are hired by the target firm because of their perceived leniency (Tabakovic & Wollmann, 2018; Tenekedjieva, 2020).

While the research is slightly mixed, the literature suggests hiring former regulators could lead to improvements or lower the risk of firm behavior along with the attendant reduction in regulatory penalties. I deduce that the industry type (and whether that industry is thought to be highly regulated) matters to a potential penalty outcome. Thus, based on Emery and Faccio (2020) and the notion that highly regulated firms are most savvy and accustomed to regulation and working with regulators, the expectation would be that these firms will have a better strategy to moderate the severity and frequency of penalties. Further, to the extent we borrow from the first hypothesis and accept that female representation on audit committees has a negative relationship to penalties, I advance the following second hypothesis.

> ***Hypothesis 2****: As female representation in the audit committee increases, there will be a stronger negative association with average regulatory penalties among firms that are more highly regulated, all else equal.*

In sum, while a number of variables could prove important to describing the impact of gender diversity (e.g., industry, interlocks), it is important to note more conventional types of covariates as well. Reviewing the corporate governance literature, some analyses control for the effects of firm size and audit committee independence. Interestingly, while audit committee independence seems to matter, it may be

offset by factors like industry or firm size. Naseem et al. (2017) find that in Pakistan that both board size and audit committee independence are positively linked with firms' financial performance, whereas board independence and gender diversity are negatively associated with the same performance metrics. Other research suggests smaller boards are associated with higher market valuation but make no accounting for board diversity and independence (Yermack, 1996).

In terms of control variables, some orthodox features come to mind as important or foundational. Region is included since there is some evidence regional spillover matters to regulatory penalties (Distelhorst et al., 2020). Moreover, there is also evidence that public corruption incidents per capita vary by state (Boylan & Long, 2003; Simpson et al., 2012) which could inform regional differences regarding regulatory penalties and enforcement actions.

Additional control variables include director age and director tenure because of their known utility in previous corporate governance research (Hillman & Haynes, 2010). For example, I posit director tenure has potential importance to the imposition of regulatory penalties insofar as firm behavior is filtered through shared knowledge or 'industry wisdom' (Burrell & Morgan, 1979) although the more seasoned a director is, the more difficult it may be for that person to consider alternative approaches (Huff, 1982). In sum, while it is unclear whether director tenure helps or hurts the regulatory relationship to stave off enforcement actions, it is clearly a factor in boardroom decisions.

Throughout this literature review, I have discussed a number of explanatory and control variables and suggest possible interactions. As the research cited here is global in scope, it is not surprising that there would be mixed review over whether, for example, audit committee independence is an important factor in a particular nation. Moreover, many different measurements of performance have been cited, yielding different results. In the end, I will test the control variables that seem to resonate the loudest in the corporate governance literature in an effort to understand how a key feature like board gender diversity may be offset by another highly cited variable.

2.9 Summary of Theoretical Framework

The focus of this article is to examine the relationship between board gender diversity and regulatory penalties among firms in the S&P 500. While theory drives the reasoning behind analytical decisions (e.g., adopting a critical mass component), the overall theoretical framework aligns with RDT as gender diversity represents a critical dependency to firms in their execution of corporate governance and oversight. In line with Pfeffer and Salancik's (1978) four main resource benefits, I offer that gender diversity functions as a resource – one that elevates advice and information to the realm of insight and decision-making. Like occupation or organizational experience matter as board functional resources (Hillman et al., 2000), I theorize that board gender diversity and its extension into committee diversity contribute to stronger management oversight – particularly among firms that are routinely scrutinized by regulatory agencies.

Theory and prior research suggest that regulatory penalties are a function of a board's share of females, board member tenure, committee composition, board size, age, industry, region, historical penalties, and the regulatory context (high/low). In the next section, I introduce the empirical framework where I discuss operationalizing and integrating the following parameters into this paper's model:

Average Penalties ($) per Month = $ß_0$
+ $ß_1$ (Percent Female)
+ $ß_2$ (Percent of Females on Audit Committee)
+ $ß_3$ (Dummy (> 30 Percent of Females on Board))
+ $ß_4$ (Historic Penalties (Average Penalties per Month: 2011-2015))
+ $ß_5$ (Restrictions Index (High/Low))
+ $ß_6$ (Average Tenure)
+ $ß_7$ (Average Director Age)
+ $ß_8$ (Total Overall Directors)
+ $ß_9$ (Percent of Females on Audit Committee * > 30 Percent of Females on Board indicator)
+ $ß_{10}$ (Percent of Females on Audit Committee * Highly Regulated Indicator (High/Low))

Other controls
+ $ß_{11\text{-}15}$ (Industry)
+ $ß_{16\text{-}18}$ (Region) + e_i

3. Empirical Framework

3.1 Overview of Data

To test the hypotheses described above, I use data from the 2019 Standard & Poor's 500 list of firms and link it to the 2016-2020 enforcement actions as tabulated by the VT penalties database. Five hundred observations from the S&P 500 (firms) are represented in the database. All firms in the dataset are large market capitalization firms, representing nine industries at the major classification Standard Industrial Classification (SIC) code level. The boards comprise 5,357 individual directors. Table 1 provides descriptions of variables while Table 2 includes descriptive statistics for the variables used in the statistical analysis. Since director data for S&P 500 firms was extracted using Wharton Research Data Services (WRDS) ISS data to collect information at both the firm and director level across the S&P 500, research assistants or data coders were not employed; therefore, inter-rater reliability is not a factor in the analysis. WRDS and ISS is a subscription-based trusted source for historical governance and director data. Since all 500 firms from the index are represented in the dataset, sampling methods were not necessary.

Dependent variable

Average regulatory penalties per firm are measured using the violations tracker (VT) data among 2016-2020 federal or state enforcement actions. According to the site:

> The basic violation data was obtained from the websites of the federal agencies, the Justice Department and the state attorneys general. In some cases, the data for a particular agency could be downloaded all at once. In other cases, we had to "scrape" the information from website tables or extract the information from official press releases posted on those sites. In all cases we initially gathered data going back to the beginning of 2010, and in September 2017 we extended the coverage back to the beginning of 2000. Much of the data for that ten-year expansion came from online sources but for some agencies we needed to supplement that with Freedom of Information Act requests. The litigation data comes mainly from federal and state court dockets.[5]

As a variable, there is considerable variation in both penalty amount and occurrence frequency. Over the 2016-2020 period, some firms are not penalized at all while other incur frequent and substantial penalties. In order to capture important violation patterns and reduce noise, the variable was smoothed vis-à-vis an average penalty amount. By using a simple mean average, the goal was to render the data more interpretable compared to other types of transformations (Hastie & Tibshirani, 1990). As such, I calculated the penalty per month as the sum of penalties for each firm over five years (numerator) divided by the number of months (denominator) to derive an average monthly value. Conceptually, a firm with many small penalties may look similar to a firm with a few large penalties. For this research, the measure indirectly represents the extent to which a firm has the capacity to self-regulate (Short & Toffel, 2010).

Independent and interaction variables

Data for independent variables were drawn from WRDS and VT data of the S&P 500 firms. Among the core set of variables are the raw diversity measurements. For example, this set of variables includes the percent of females serving on audit committees during 2019. The percentage of various diversity metrics is calculated based on the WRDS / ISS code for director diversity. The calculations are

[5] Violation Tracker | User Guide (goodjobsfirst.org)

then aggregated at the firm level. The main independent variable is 'Audit Committee Diversity' which represents the percentage of females serving on a board of directors' audit committee. This metric is simply the number of females divided by the total committee size so one female director on a committee of four people is 25 percent female and 75 percent male (i.e., 25 percent short of gender parity). Table 1 provides these precise descriptions.

Among the derived core variables, I create flags based on the calculations from the WRDS raw data. For example, I code whether a gender critical mass threshold has been met consistent with the literature (Joecks et al., 2013). Here I also account for historic penalties – both severity and frequency – as a driver of current penalties (Adrison, 2008). Also included in this group are the restrictions index values from the regulatory database to denote the level by which an industry is regulated relative to all industries (McLaughlin & Sherouse, 2016). Because most industries contain a zero value for number of restrictions and in order to avoid zero inflation in the model, the restrictions index is dummy coded into the variable 'Highly Regulated Industry' as a binary variable whereby values that equal zero remain zero (n=253) in the model and values greater than zero are coded as one (n=247). From this index and subsequent binary predictor, I derive whether the industry is lightly regulated or highly regulated (where the underlying continuous value is based on the McLaughlin-Sherouse Index). Because industry is categorical data, industry type is also dummy coded at the division or major classification level.

Table 1: Variable Descriptions[6]

Variable	Description	Source
Penalty per Month (DV)	The sum of penalties (2016-2020) divided by 60 months	Good Jobs First Violation Tracker database
Percent Female	The number of females serving on the board divided by the total board size.	Wharton Research Data Services ISS Governance data
Percent Female Audit	The number of females serving on the audit committee divided by the total committee size	Wharton Research Data Services ISS Governance data
Females exceed 30 percent?	Binary variable indicating whether the 'Percent Female' variable is equal or greater than .30	Wharton Research Data Services ISS Governance data
Average Penalties per Month: 2011-2015	The sum of penalties (2011-2015) divided by 60 months	Good Jobs First Violation Tracker database
Highly Regulated Industry (via Restrictions Index)	Derived from the RegData datasets[7] which capture the restrictiveness of an industry by counting words and phrases indicating a specific prohibited or required activity, called regulatory restrictions. Coded as follows: 1= highly regulated, 0 = not highly regulated.	RegData 2.2
Average Tenure (years)	The mean director tenure (years)	Wharton Research Data Services ISS Governance data
Average Director Age	The mean director age	Wharton Research Data Services ISS Governance data
Total Overall Directors	The number of total directors serving on the board	Wharton Research Data Services ISS Governance data
Major Industry	Major classification level among the Standard Industrial Classifications; Industry divisions are dummy coded in the dataset and 'manufacturing' constitutes the largest set of observations and, therefore, the reference category	Wharton Research Data Services ISS Governance data
Region	Census Bureau-designated region (South, Midwest, West, Northeast) plus U.S. firms that have incorporated off-shore Regions are dummy coded in the dataset and Northeast is the largest set of observations and therefore, the reference category.	Wharton Research Data Services ISS Governance data

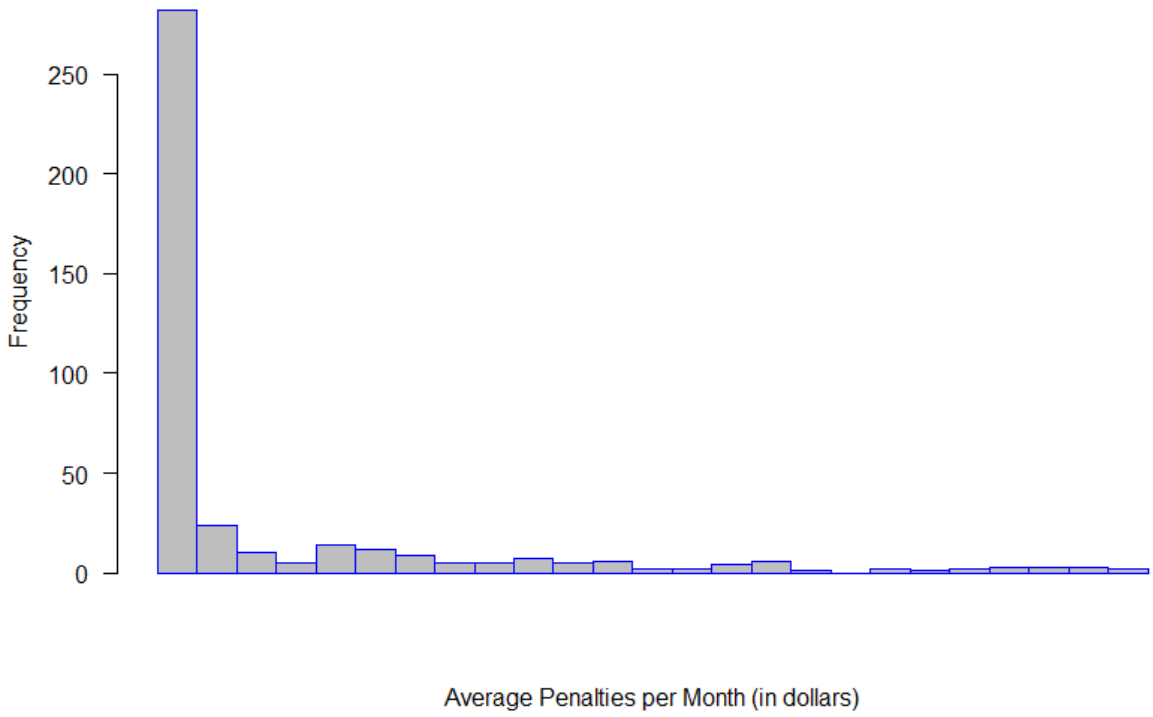
[6] McLaughlin, Patrick A. & Oliver Sherouse (2019). "RegData 2.2: a panel dataset on US federal regulations," Public Choice, Springer, vol. 180(1), pages 43-55, July.

3.2 Descriptive Statistics

Descriptive statistics are reported in Table 2 and the histogram of the base and transformed dependent variable, a five-year average of penalties per month, are presented in Figures 2 and 3. There is data for all 500 firms with a notable exception. The share of females of the audit committee could only be derived for 471 of the 500 firms' directors. Also noteworthy is the relationship of current average penalties (2016-2020) to historical penalties (2011-2015). The historical values (which were used in the models) were higher during the earlier period, suggesting that political factors may influence these dollar values over time. Finally, some variables' lack of level uniqueness presented a problem for model stability. An absence of data cardinality can present problems for specific models.[8] For example, the dummy variables that were used for the agriculture, construction and wholesale trade industries had so few positive values that they generated errors for Model 2 (described below). For this reason, these three dummy variables – as well as the off-shore variable for region – were omitted from the second count model that omitted observations with penalties that equaled zero.

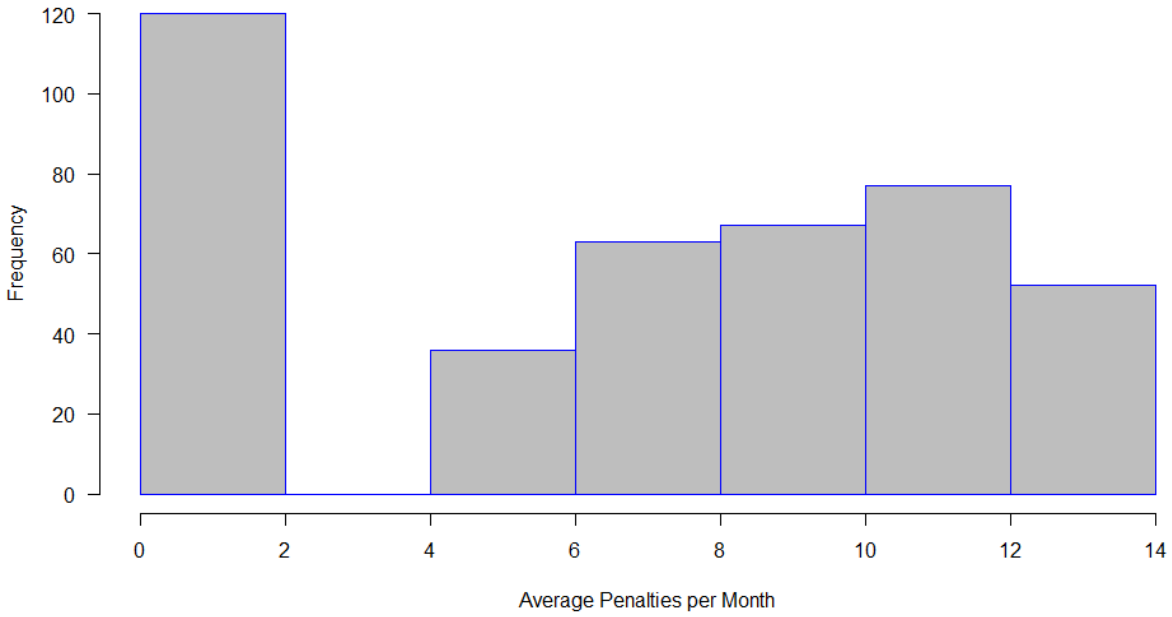
[8] A phenomenon known as "indicator saturation" when there are more variables (K) than observations (N) or so many predictor variables with so few levels that it is unlikely that it is unlikely the indicator will add much predictive power. For more, see: Santos, Carlos, et al. "Automatic Selection of Indicators in a Fully Saturated Regression." *Computational Statistics*, vol. 23, no. 2, Springer-Verlag, 2008, pp. 317–35, doi:10.1007/s00180-007-0054-z.

Figure 2: Histogram of average penalties per month for S&P 500 firms, 2016-2020 (excludes average monthly penalties > $500,000, 85 firms omitted)[9]



[9] Note: Extreme values were omitted from Figure 2 to better display the variation among the remaining firms. The 85 omitted firms have a mean of $9.58 million, a median of $2.06 million, a minimum value of $500,000 and a maximum value of $150.2 million, all in average penalties per month.

Figure 3: Histogram of logged average penalties per month for S&P 500 firms, 2016-2020 (excludes average monthly penalties > $500,000, 85 firms omitted)[10]



[10] Note: Extreme values were also omitted from Figure 3 to better display the variation among the remaining firms.

Table 2: Descriptive Statistics

Variable	n	min	max	mean	sd	median	skewness	kurtosis
Penalty per Month - 2016-2020 ($ 000)	500	0	150,176	1,673	9,824	7	10.60	131.28
Female Participation								
Percent Female	500	0.08	0.56	0.26	0.09	0.25	0.53	0.40
Percent of females - audit committee	471	0.00	1.00	0.30	0.19	0.25	0.34	-0.15
Female > 30 percent (binary)	500	0.00	1.00	0.35	0.48	0.00	0.63	-1.61
Historic Penalties								
Average Penalty per Month: 2011-2015 ($ 000)	500	0	1,044,216	5,534	54,446	12	15.94	280.11
Regulated Industry								
Highly Regulated (where value = 'yes')	500			0.49				
Director Characteristics								
Average Tenure	500	0.0	29.1	8.3	3.5	7.6	1.24	3.60
Average Director Age	500	51.3	76.9	62.6	3.3	62.7	-0.03	1.00
Total Overall Directors	500	5.0	27.0	10.7	2.1	11	1.14	7.50
Major Industry								
Agriculture, Forestry & Fishing	500			0.00				
Construction	500			0.01				
Finance, Insurance & Real Estate	500			0.19				
Manufacturing	500			0.36				
Mining	500			0.04				
Retail Trade	500			0.07				
Services	500			0.16				
Transportation, Communications Electric, Gas & Sanitary service	500			0.14				
Wholesale Trade	500			0.03				
Region								
Northeast	500			0.27				
Off-Shore	500			0.05				
West	500			0.22				
Midwest	500			0.21				
South	500			0.25				

Table 3: Most Regulated Industries (McLaughlin & Sherouse, 2016)

NAICS code	Industry name	Restrictions Index
3241	Petroleum and coal products manufacturing	25.48
2211	Electric power generation, transmission, and distribution	20.96
3361	Motor vehicle manufacturing	16.76
5222	Nondepository credit intermediation	16.58
5221	Depository credit intermediation	16.03
4811	Scheduled air transportation	13.31
1141	Fishing	13.22
5239	Other financial investment activities	12.26
2111	Oil and gas extraction	11.95
3254	Pharmaceutical and medicine manufacturing	11.51

3.3 Empirical Strategy

As seen from the histograms, most companies do not incur high average regulatory penalties. In fact, during the 2016-2020 period covered by this paper, 120 of 500 firms incurred no penalty at all. This absence of penalties results in a dataset with an excess of zeros distributed across the dependent variable. In such instances where we have non-negative continuous outcomes that are skewed and contain excessive zero observations, standard statistical techniques like regression and generalized linear models (GLM) should be used with great caution. Another approach to deal with this issue is known as zero-inflated modeling (Boulton & Wilford, 2018). Given the distribution of penalty data, I use both a traditional OLS regression approach and a zero-inflated modified count technique known as the Hurdle model. My intent is to review the two modeling approaches to see if a similar story emerges between the two models and report the intersection of those results.

It is worth noting the analytical tension in this paper between designing the most efficient model compared with evaluating the full list of variables that have strong theoretical purpose. Challenging the regression model's efficiency is the problem of multicollinearity. Multicollinearity is often encountered in applied regression models and occurs when two or more predictor variables are correlated, whereby the magnitude of correlation has an influence on the variance inflation factor (Belsley, et al., 1980). Furthermore, Lavery, et al. (2019) suggest that when predictors are correlated, parsimony is a proper

econometric goal for model implementation. In order to balance theory and practice, a tradeoff takes place in this paper between parsimony and theory. Moreover, research suggests that when collinear variables are applied mainly as control variables, a model can proceed using the highly correlated predictors (Allison, 2012). Thus, during each model iteration for this paper, I retain the full complement of predictor variables in order to see where theory is sustained by the addition of these predictors and where theory is potentially undermined.

Apart from ordinary least squares regression and a Hurdle model, other models and approaches were tested and considered. For example, significant outliers were identified so that the dataset could be potentially partitioned to assess the influence of outlier data.[11] Similarly, because the distribution of the dependent variable is such that 120 firms had penalty values equal to zero (i.e., firms that paid no penalty over the past five years), the data distribution is right-skewed. As a violation of multiple regression, one technique to correct this skewness is through a variable transformation on one or both sides of the equation. For the OLS portion of this analysis, a log transformation of the dependent variable was the only transformation technique that was ultimately adopted.

4. Results and Findings

4.1 Results

Tables 4 and 5 present results for two distinct models:

- Model 1 = OLS, using all core variables with logged dependent variable (DV)
- Model 2 = Two-part Hurdle model

A test of the first hypothesis asks whether greater diversity among the audit committee changes regulatory penalties among firms with greater than thirty percent female director membership. As indicated by both Model 1 and Model 2, the relevant interaction term is statistically significant, indicating that the audit committee share of females (i.e., gender diversity) is negatively related to

[11] Outliers were defined as exceeding +/- 3 standard deviations from the mean value.

regulatory penalties when gender critical mass is observed. Figure 4 shows the relationship between "critical mass" and "female share of audit committee" membership. Average penalties trend lower as share of audit committee membership rises among the critical mass segment and are even lower than the non-critical mass segment once audit committee female membership reaches a "very high" threshold (greater than or equal to 50 percent of the audit committee). The interaction and visual explanation in Figure 4 offers support for Hypothesis 1 where the results seem to indicate that audit committee female representation is negatively related to penalties, and that this is especially true for boards with female critical mass on the board. However, critical mass itself seems positively associated with penalties. However, if there is high female representation on the board but little or no female representation on the audit committee, the firm seems to actually experience higher average penalties, all else equal.

The evidence for Hypothesis 2 is less apparent. Neither Model 1 nor Model 2 shows support for the second hypothesis. That is, nothing indicates that as audit committee gender diversity increases among highly regulated firms there is a negative relationship with average regulatory penalties. While the final model uses restrictions index as a binary variable (zero versus non-zero values) for both the base metric and interaction, the pattern holds true whether it is measured as a continuous or categorical variable.[12]

Comparing control variables between the two models yields some mixed results. Two regions – South and Midwest – are statistically significant but point toward different directions depending on the model. In the OLS model, these two regions are associated with higher average penalties, yet within the Hurdle model (that filters out zeros from the response variable) these two regions are associated with lower average penalties. In other words, among firms that experience penalties, they are lower on average in the Midwest and South, all else equal. This finding supports the literature's claim that

[12] Over 50 percent of the restriction's values are equal to zero. 253 firms have no restrictive phrases identified in the Code of Federal Regulations.

corruption incidents per capita vary by state (Boylan & Long, 2003; Simpson et al., 2012) and those incidents potentially link enforcement actions to regional differences.

Director age may have some importance to the model, while director tenure is not statistically significant in either model. Despite this dissonance, tenure may reflect 'industry wisdom' (Burrell & Morgan, 1979), but director age is still a reflection of industry experience. In both Model 1 and Model 2, there is a statistically significant negative relationship between director age and average regulatory penalties. This indicates that the amount of time spent on the board (tenure) does not necessarily contribute to average penalties, but the age of the director does potentially contribute to enforcement actions avoidance. Finally, board size (total directors) seems to be significant in the OLS model but not in the Hurdle model, indicating no clear pattern.

Table 4: OLS Regression with log transformed dependent variable

		Estimate	Std. Error	t value	Pr(>|t|)	
1	(Intercept)	-3.04002	5.215983	-0.583	0.5603	
2	Percent Female	-0.63676	4.268787	-0.149	0.8815	
3	Percent Female Audit	-1.56221	1.694619	-0.922	0.3571	
4	Total Board: Females exceed 30 percent?	2.457755	1.078847	2.278	0.0232	**
5	Total Overall Directors	0.465876	0.113843	4.092	0.0001	***
6	Average Penalties per Month: 2011-2015	0.009337	0.004223	2.211	0.0275	**
7	Restrictions Index	-0.33178	0.562581	-0.59	0.5556	
8	Average Director Tenure	-0.1331	0.078558	-1.694	0.0909	*
9	Average Director Age	0.100162	0.085034	1.178	0.2394	
10	Major Industry: finance / insurance / real estate	-0.00892	0.673807	-0.013	0.9894	
11	Major Industry: mining	-0.27271	1.210423	-0.225	0.8218	
12	Major Industry: retail	2.966111	0.971299	3.054	0.0024	***
13	Major Industry: services	-0.18204	0.679848	-0.268	0.7890	
14	Major Industry: transportation / communications / utilities	1.109987	0.750035	1.48	0.1396	**
15	Census region: West	-0.14728	0.636274	-0.231	0.8171	
16	Census region: Midwest	1.815433	0.653677	2.777	0.0057	***
17	Census region: South	1.640573	0.625377	2.623	0.0090	***
18	Interaction 1: Percent Female Audit * Females exceed 30 pct?	-4.16143	2.409657	-1.727	0.0848	*
19	Interaction 2: Percent Female Audit * Restrictions Index	0.000218	0.000133	1.631	0.1035	

Signif. codes: * p < 0.10; ** p < 0.05; *** p < 0.01

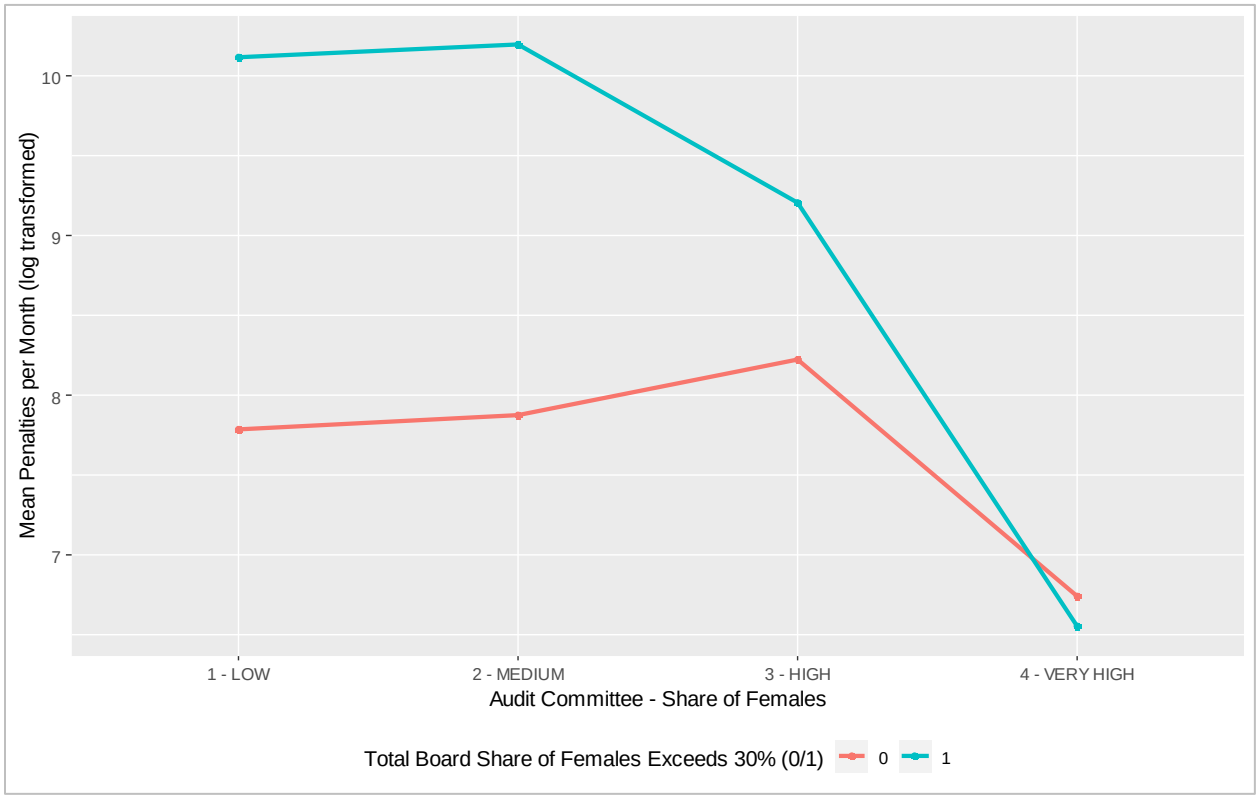
Residual standard error: 4.978 on 481 degrees of freedom
Multiple R-squared: 0.1604, Adjusted R-squared: 0.129
F-statistic: 5.105 on 18 and 481 DF, p-value: 0.00000000009334

Table 5: Two Part Hurdle model (penalties > 0, $ 000,000)

		Estimate	Std. Error	z value	Pr(>|z|)	
1	(Intercept)	12.34886	4.529048	2.727	0.0064	***
2	Percent Female	-4.00453	4.503998	-0.889	0.37395	
3	Percent Female Audit	3.6597	3.403971	1.075	0.28232	
4	Total Board: Females exceed 30 percent?	2.776506	1.051512	2.64	0.00828	***
5	Total Overall Directors	-0.12551	0.104375	-1.202	0.22918	
6	Average Penalties per Month: 2011-2015	0.001539	0.001174	1.31	0.19009	
7	Restrictions Index	-0.21432	1.20724	-0.178	0.8591	
8	Average Director Tenure	-0.09537	0.083402	-1.144	0.25282	
9	Average Director Age	-0.1268	0.068643	-1.847	0.06471	*
10	Major Industry: finance / insurance / real estate	0.215656	0.599745	0.36	0.71916	
11	Major Industry: mining	-0.7573	1.218688	-0.621	0.53434	
12	Major Industry: retail	0.065523	1.135754	0.058	0.95399	
13	Major Industry: services	-0.88316	0.727285	-1.214	0.22462	
14	Major Industry: transportation / communications / utilities	-1.57387	0.754074	-2.087	0.03687	**
15	Census region: West	-0.32359	0.577912	-0.56	0.57552	
16	Census region: Midwest	-1.09962	0.503593	-2.184	0.029	**
17	Census region: South	-1.5089	0.521947	-2.891	0.00384	***
18	Interaction 1: Percent Female Audit * Females exceed 30 percent?	-5.19114	2.718341	-1.91	0.05618	*
19	Interaction 2: Percent Female Audit * Restrictions Index	-0.59756	3.582855	-0.167	0.86754	

Signif. codes: * p < 0.10; ** p < 0.05; *** p < 0.01
Theta: count = 0.7961
Number of iterations in BFGS
Log-likelihood: -320.7 on 39

Figure 4: Visual Rendering of Interaction (total board share of females (>30 %) * audit committee share of females)[13]



4.2 Findings

Reviewing the two models, a common theme emerges: female representation on the audit committee seems to matter to average penalties when the larger board is made up of at least thirty percent females (i.e., when share of females reaches critical mass). However, reviewing the interaction term and the visual in Figure 4, it seems apparent that this critical mass component could actually result in higher penalties until and unless audit committee share of females catches up. As such, it could be the case that total board gender diversity is only beneficial from a regulatory perspective once females directors are

[13] Low: < 20 percent share of females
Medium: >= 20 percent but < 30 percent share of females
High: >= 20 percent but < 50 percent share of females
Very High: >=50 percent share of females

employed on key committees – and particularly among boards that already have a significant share of few females. In a manner of speaking, it may be important to build a strong gender diverse "bench" of directors so that the best directors can be employed on key committees.

These results seem to reinforce some key theoretical arguments. Miller and del Carmen Triana's (2014) assertion that team diversity can lead to both conflict and confusion may explain why boards with gender critical mass may not see benefits until female directors are placed on the audit committee. These results also direct our attention to the idea of social unity outweighing and marginalizing minority viewpoints from being reflected in the larger group decision (Caldwell & Barnett, 1989; Nemeth, 1986; Belliveau et al., 1996). The data here show that once the share of females on the audit committee reaches a "very high" stage (>50 percent), boards that have attained a critical mass of gender diversity (>30 percent) outperform their less diverse peers. Therefore, it could be the case the minority members (females) feel marginalized in audit committee roles until there is a sufficient quorum of females on the larger board of directors. Similarly, a board that has less than 30 percent female directors would not fare well to employ all those directors on the audit committee and expect a better result. It seems that firms with higher levels of overall board gender diversity may give rise to greater representation on the audit committee overall. As a result, these firms are better positioned to enjoy the benefits expounded by the cultural theory of risk perception (Douglas & Wildavsky, 1983) in the form of lower average regulatory penalties.

5. Conclusion

We might grant that a board of directors has a complex set of tasks before it, but as Short and Toffel (2008) suggest, enforcement activities improve compliance, even when those activities are confrontational and coercive. Staffing boards is less afterthought and more deliberate action. Penalties are routinely imposed on firms that violate federal or state regulations, and employing qualified directors requires serious contemplation on the best course of action to minimize enforcement actions. Directors are resources, and gender integration into key committees can play an integral role in risk management. In

this exploration, I have identified potential ways to minimize risk exposure based on the right balance of key committee staffing.

This study has a number of limitations and open questions. Do these results change over time? The regulatory penalty data in this analysis used time-series data (the dependent variable is calculated as an average across five years) that was converted to cross-sectional data. On the other hand, the director data was a snapshot of a single year. There is likely great value to studying these questions using a method that accounts for director demographic changes over time. A panel dataset and appropriate analysis would likely add great depth to this initial analysis.

The initial steps to avoid multicollinearity were to apply judgment to the feature selection process and, through an extensive trial and error process of testing variables and modeling approaches, this sort of variable reduction was probably sufficient. However, there are likely opportunities to reduce variables or even test other modeling approaches and regression diagnostics given the right-skewed dependent variable.

As the world digitizes and innovation disrupts regulatory response, risk emerges and the need to entrust firms to self-regulate is paramount. Technology is changing the corporation with incredible speed, and if regulators are spread too thin to effectively monitor firms on a daily basis, then the public also pays part of the cost for non-compliance. If we are to entrust firms to their own self-regulation, it becomes increasingly necessary to understand the impact of board gender diversity on regulatory penalties as a reflection of firms' ability to play by the rules. Penalties imposed by local, state, and federal regulatory agencies are one way to understand and measure adherence to rules and norms. Across the spectrum of firms, we see penalties are fewer and less expensive among firms with a strong commitment to diversify both their board and their audit committee. Second, if gender diversity is a game-changer the way prior research suggests it could be, we need to fully understand *how* diversity matters to regulatory enforcement. It is always in the best interest of corporate governors to ethically advise management so

that they may avoid costly regulator fines and extensive public damage and/or criminal conduct.[14] Board diversification may represent one strategy to instituting a self-regulatory regime.

Understanding how gender diversity affects risk acceptance and risk avoidance is key to understanding cultural theory of risk perception. Cultural norms are not static, and just because gender diversity (or share of females on the audit committee) acts as a control on management today, it may not make that statement necessarily true in the future. If risk perception is culturally informed, as culture changes and adapts to a more normative gender diversity in the broader world, the research featured in this paper may not translate into staffing solutions in a later age. Future researchers would be wise to monitor the trend in both diversity and regulatory affairs to understand how to identify the optimal "risk perceivers" in order to foster a self-regulatory regime.

[14] U.S. Bancorp agreed to pay the federal government $613 million to settle criminal charges that it did not guard against money laundering criminal activity. The Office of the Comptroller of the Currency (OCC) in late November (2018) terminated a 2015 consent order that found that U.S. Bank, the nation's fifth largest, lacked an adequate "system of internal controls" and provided "inadequate training" regarding money laundering… The end of the consent order signaled acceptance by regulators of the company's new measures to comply with anti-money laundering laws and the Bank Secrecy Act, the 1970 law that requires banks to work with the government to combat money laundering." http://www.startribune.com/government-watchdog-ends-intense-oversight-of-u-s-bank-s-fight-against-money-laundering/503447412/ Dec. 24, 2018

6. Appendix

The Pearson correlation coefficient is a measure to determine the strength of the association between two quantitative variables and provided early indication of the final result that might result in rejection of the null hypotheses.

Figure 5: Correlation Matrix

	Average Penalties per Month (2016-2020)	*Percent Female*	*Percent Female Audit*	*Total Board: Females exceed 30 percent?*	*Total Overall Directors*	*Restrictions Index*	*Average Director Tenure*	*Average Director Age*	*Average Penalties per Month (2011-2015)*
1 Average Penalties per Month (2016-2020)	**1.00**	**0.10 ****	**-0.07**	**0.16 *****	**0.04**	**0.08 ***	**-0.11 ****	**-0.06**	**0.22 *****
2 Percent Female	**0.10 ****	**1.00**	**0.38 *****	**0.79 *****	**0.03**	**0.02**	**-0.18 *****	**-0.15 *****	**0.03**
3 Percent Female Audit	**-0.07**	**0.38 *****	**1.00**	**0.29 *****	**0.06**	**0.02**	**-0.04**	**-0.04**	**-0.03**
4 Total Board: Females exceed 30 percent?	**0.16 *****	**0.79 *****	**0.29 *****	**1.00**	**0.03**	**0.03**	**-0.13 *****	**-0.12 *****	**0.08 ***
5 Total Overall Directors	**0.04**	**0.03**	**0.06**	**0.03**	**1.00**	**0.14 *****	**-0.06**	**0.05**	**0.14 *****
6 Restrictions Index	**0.08 ***	**0.02**	**0.02**	**0.03**	**0.14 *****	**1.00**	**-0.11 ****	**0.15 *****	**0.16 *****
7 Average Director Tenure	**-0.11 ****	**-0.18 *****	**-0.04**	**-0.13 *****	**-0.06**	**-0.11 ****	**1.00**	**0.52 *****	**-0.04**
8 Average Director Age	**-0.06**	**-0.15 *****	**-0.04**	**-0.12 *****	**0.05**	**0.15 *****	**0.52 *****	**1.00**	**0.06**
9 Average Penalties per Month (2011-2015)	**0.22 *****	**0.03**	**-0.03**	**0.08 ***	**0.14 *****	**0.16 *****	**-0.04**	**0.06**	**1.00**

Signif codes: * p<.10; ** p<.05; *** p<.01

Article 2

Social Networks and Corporate Boards in the S&P 500:

An Alternative Approach to Measuring Board Capital

Abstract

Prior research on the board capital construct describes two primary dimensions: breadth and depth. While board capital breadth is defined as the portfolio of director experience and extra-industry ties, board capital depth refers to the embeddedness of a director in the firm's primary industry vis-a-vis interlocking directorships. This paper compares social network modeling results to levels of industry embeddedness among S&P 500 firms and proposes an alternate approach to measuring board capital. Using 2019 Wharton Research Data Services data on S&P 500 firms and the Linkcomm package from the open-source statistical computing program R, I assess if network statistics reflect either of two potential dimensions: 1) board capital depth or 2) board capital breadth. This is the first known study to compare these two concepts using undirected social network models pertinent to the breadth / depth discussion and demonstrates that undirected networks can generate meaningful data about board capital depth and board capital breadth along with the potential for other aspects of social capital.

Introduction

Imagine a small, regional company on the cusp of receiving major cash inflows from a venture capital firm. Suppose this company is in the pre-cast concrete business and, before it participates, the VC investor wants to understand how the company's board is structured and renders decisions. Perhaps the pre-cast concrete firm replies it recruits its directors from other pre-cast concrete businesses (and related industries like general contracting) so that it stays abreast of ISO standards, safety procedures, and other related best practices. Finally, suppose that the firm believes it retains its strategic edge by way of affiliating with industry partners on its board. Academics would assess that, by interlocking with other members from the same industry, the pre-cast concrete firm is adding "depth" to the capital of its board (Hillman & Haynes, 2010). Are partnerships that add this kind of depth to the firm most desirable? Or do firms that have broader occupational heterogeneity with deliberate efforts to stay connected to the regional business community retain an advantage relative to other firms?

As centers of power, boards comprise directors, who exist within networks that exceed the scope and reach of the boardroom. Another way of describing this board connectivity is through a phenomenon known as board interlocks. Another way of describing this board connectivity is through a phenomenon known as board interlocks, which researchers "have long been interested in" because of "the influence that board interlocks may have on a variety of firm outcomes" (Zona et al., 2018, p. 589). Moreover, interlocks facilitate the transfer of human capital. Mizruchi (1996) suggested that interlocks provide benefits to both the inviting firm and the invited outside director. Shropshire (2010) suggests board interlocks are seen as conduits of best practices between firms and act as a source of capital diffusion. This research paper makes use of Hillman and Haynes (2010) notion of 'board capital.' In this definition, capital consists of both human capital (experience, expertise, reputation) and relational capital (network of ties to other firms).

Following Hillman and Haynes's (2010) lead, I imagine board capital as being measured by two separate components – breadth and depth. Furthermore, relying on social network analysis, I attempt to discern whether social network data represents a way to either measure directly or triangulate an

alternative metric for 'board capital depth' (BCD) and 'board capital breadth' (BCB). While I do not offer a replication of their research on board capital's effect on strategic change, this research represents an empirical alternative to the Hillman and Haynes depth-breadth construct and introduces network modeling as an entry point for additional research and discussion on the board capital topic. If, in fact, social network analysis represents an alternative approach to modeling interlocks and BCB and BCD, this method can be potentially leveraged in lieu of future time-intensive research and manual lookup to describe board depth and breadth.

Beginning with the theoretical framework, I first describe prior measures of BCB and BCD and how these measures have been referenced in the literature. Second, I outline the basic principles of network theory and conceptual connections to board structure and capital. Third, leveraging this background in network theory, I discuss an alternative approach to assess board capital and how this approach can be used to generate measures as part of a broader model. Using a dataset of S&P 500 firms and the director data from 2019, I demonstrate how these generated metrics compare to the original BCB and BCD measurements used within the literature.

2. Theoretical Framework

2.1 Interlocking Directorates Overview

Interlocks represent a means by which the corporate directors are connected to other firms – both those within and outside of their own industry – and can transfer information as a result of network ties (Shropshire, 2010). Interlocks are formed "when a person is on the board of directors of two or more corporations, providing a link or interlock between them" (Fich & White, 2005, p. 175) and the director creates an inter-firm linkage between the two organizations (Pennings, 1980). A foundational view holds that "boards provide advice and counsel to the firm on substantial matters such as strategy formulation, access to information outside the firm, preferential access to valuable resources through personal connections, skills and expertise and legitimacy" (Pfeffer & Salancik, 1978, as cited in Hillman & Haynes, p.1). Similarly, Shropshire (2010) and others have argued that, within the complex organizational

board framework, an individual's importance to the group can be assessed based on external business and social connections – in other words, the extent to which directors are linked across boards.

While potentially giving a board more power to assert itself independently of firms, the idea of interlocking directorates is not new. The study of interlocking directorates emerged as an interpretation of how boards function as monitors of the external environment (Eisenhardt, 1989). As stated by Mizruchi (1996):

> From the formation of US Steel and International Harvester at the turn of the century, in which every board member of both firms was personally approved by JP Morgan, firms have employed board seats as devices to monitor other firms (p. 275).

For the uninitiated, interlocking boards and directors refers to the practice of individuals serving on multiple boards across multiple corporations (Mizruchi, 1996; Shropshire, 2010). Two firms – firm A and firm B - are said to have a *direct* interlock if a director or executive of one firm (firm A) is also a director of the other (firm B), and an *indirect* interlock if a director of each (A and B) sits on the board of a third firm (firm C) (Burt, 1980; Mizruchi, 1996, Salinger, 2005;). Past social network research investigating venture capital firm interlock has referred to this linkage as "syndication" (Walske et al., 2007) where more links would equal higher syndication across a network. As noted previously, an interlock could produce benefits to the firm if it gives rise to knowledge transfer, information sharing, or adoption of a useful practice from one interlocked firm to the other (Davis, 1991; Palmer et al., 1993). This knowledge transfer can potentially result in a theoretical rise in board capital and access to new or unique information sources (Beckman & Haunschild, 2002). However, capital could decline or suffer to the extent directors do not share mental models and narratives or otherwise cognitively fail to identify with the CEO (Shropshire, 2010).

Related to this notion of connections is the idea of reciprocity. Reciprocal board interlocks occur when "an employee of firm A sits on firm B's board and at the same time an employee of firm B sits on firm A's board" (Hallock, 1999, p. 55). Following this definition, a reciprocal board interlock tie forms when one firm's executive is appointed to the board outside the director's home firm (Wither, 2017, p. 9).

In theory, we could use the idea of reciprocal interlocks to measure the extent to which directors come from similar or divergent employer pools, potentially contributing to a kind of employer and occupational diversity. This type of occupational diversity facilitates the entrance of capital, resources, and exchange of practices from adjacent firms (Shropshire, 2010).

The type of talent, skill, or risk aversion a director brings to a board will vary. For example, a board with many interlocking directors may be more likely to have passive members who are likely to "rubber stamp" management decisions and avoid actively monitoring the CEO (Zajac & Westphal, 1996). However, in Shropshire's (2010) investigation, the stronger a director's identification with the focal firm, the more likely the director is to contribute to the focal firm (2011). Other research contends that a director's identification strength affects the extent to which they engage in monitoring and resource provision (Hillman et al., 2008). Thus, it seems reasonable that industry depth may contribute to an individual director's identification with the focal firm. However, an open question is whether the quality of social capital (or information transfer) the director lends to the focal firm is better or worse because of this industry identification.

2.2. Prior Measures: Board Capital Depth and Breadth

Depth

Industry identification has implications for board capital in the aggregate. Board capital is derived from theories of human and social capital and can be observed along two primary dimensions: board capital breadth (BCB) and board capital depth (BCD) (Aberg et al., 2019; Hillman & Dalziel, 2003). According to Hillman and Haynes (2010), BCD "refers to the embeddedness of the board in the focal firm's industry" (p. 1148). As a form of industry identification, Pennings (1980) used the notion of industry embeddedness (IE) to describe upstream or downstream ties to other organizations within the same industry, and IE has been used to describe BCD (Hillman & Haynes, 2010). Researchers have noted that enhancing board capital depth can be seen as a way to provide legitimacy, as appointing directors

with ties to other important organizations from the same industry signals the firm is a legitimate enterprise (Mizruchi, 1996).

In their analysis, Hillman and Haynes (2010) defined BCD as board industry embeddedness in the focal industry based on the number of interlocks. Their method to measure BCD via interlocks was to first determine the focal firm's main industry using the SIC division-level industry classification and compare that SIC division-level classification with the director's employer classification to calculate an industry embeddedness ratio.[15] Ultimately, this ratio has been used to measure the level of BCD on a corporate board.

Breadth

The converse of BCD is board capital breadth (BCB). BCB conceptually captures "various facets of the heterogeneity of the board such as education, functional background, occupation, age, tenure, and the heterogeneity of industry ties through interlocks, or work experiences in other industries" and can be represented vis-à-vis occupational heterogeneity across the board (Hillman & Haynes, 2010, p. 1147). Unlike BCD, "Board capital breadth is indicated by functional, occupational, and relational heterogeneity" using a heterogeneity index (Hillman & Haynes, 2010, p. 1154). Based upon the taxonomy introduced by Hillman, Cannella, and Paetzold (2000), Hillman and Haynes categorized directors into one of three board functional roles—business experts, support specialists, and community influentials.[16] Using Blau's index (1977), Hillman and Haynes incorporate a measurement of occupational diversity with a

[15] "Two ratios composing board capital depth (industry interlock and industry occupation) were summed to create an index with values from 0 to 2 indicating the board's embeddedness in the focal industry, with higher values indicating higher degree of embeddedness" (Hillman & Haynes, 2010, pp. 1154-1155).

[16] "Business experts are directors with significant knowledge and expertise; support specialists include legal experts (e.g., attorneys), finance specialists, (e.g., bankers, venture capitalists, and investment bankers) as well as sales and marketing professionals (e.g., advertising executives). Community influentials include politicians, academics, or other community members who command respect and power in generally nonprofit environments. The diversity of these occupations represents occupational heterogeneity" (p. 1154).

lower limit of zero (no diversity across occupational categories) and a maximum value of three based on the number of categories (in Hillman and Haynes's example, there are three occupation categories). A value of three would indicate there was an even distribution of directors across all three categories.

The main constraint in replicating this approach is that, without having knowledge of the precise director occupation, it is not possible to create a coding scheme that identifies the functional background of each director (5,347 total from the S&P). For this reason, Hillman and Haynes (2010) focused on a subset of total firms from the S&P 500.

Depth, Breadth & Strategic Change

How do these two measures – BCD and BCB – affect firm performance? The best example comes from Hillman and Haynes (2010). Researching the relationship between breadth, depth and corporate change, the authors conclude that higher levels of board capital breadth (BCB) offer more opportunities for strategic change (i.e., the degree to which a firm's strategy varies over time) insofar as heterogeneous boards have more breadth of knowledge, creativity, and experience upon which to shape their perspective. Conversely, board capital depth (BCD) may drive *less* strategic change and foster a more conservative approach to managing the firm's business. It is with this finding in mind – relating board capital to performance – that I proceed to investigate other alternative measures of board capital, drawing on concepts from network theory.

2.3 Network Theory and Board Capital

It may be empirically desirable to imagine board capital depth and breadth through the perspective of a social network model. In this regard, two classic centrality measures are essential to this discussion: degree and betweenness . The degree centrality of a node (i.e., a director) is simply a count of how many social links or connections (i.e., edges) one director has to other directors.[17] In other words, the

[17] See Hansen's (2020) "Degree Centrality" for more information.

more connections a director has, the greater the edge count in the model and the greater the degree centrality.

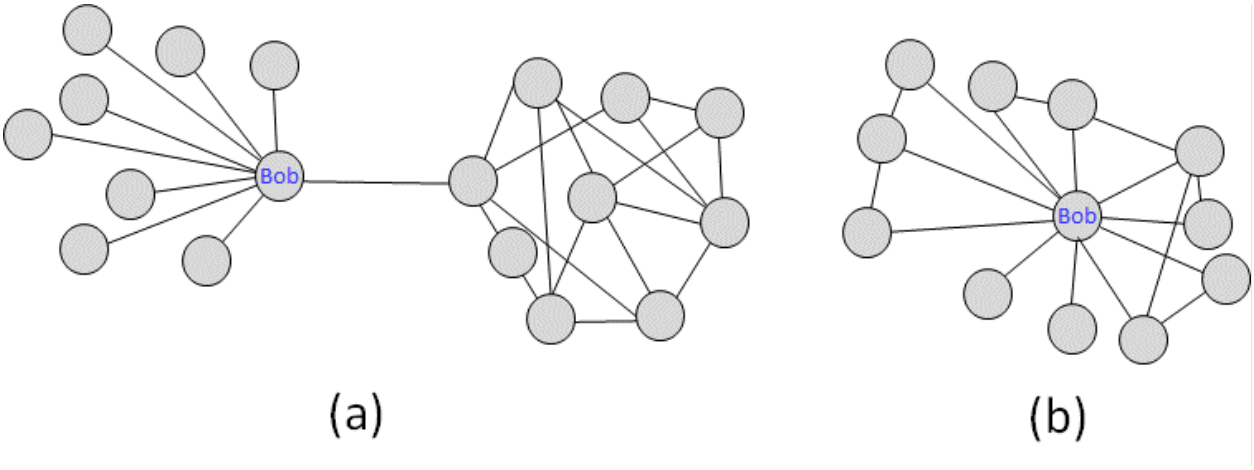
Similarly, betweenness centrality captures how much a given node (i.e., a firm) is in-between or central to other nodes.[18] For this analysis, I compare Hillman and Haynes's industry embeddedness measurement (described above) with these two network-generated measures (degrees and betweenness) in order to 1) understand how the three variables covary and 2) to make a recommendation for how firm-level network statistics could be implemented as "social capital variables" in subsequent modeling and testing.

Defining networks of interlocked directors and the level of social capital they bring requires a modeling process. While slightly different definitions may complicate the meaning of social capital, Jackson (2020) analyzes members of a network through network models. Breaking down social networks, Jackson suggests a typology of social capital that is applicable to any network. Information, brokerage, coordination, and reputation capital are four key types of social capital directors (or generic members of any network) potentially offer to their board and firm's effectiveness. For example, Jackson has us consider Marlon Brando's role in the *Godfather* as the premier type of network broker: "(Brando) never performed favors directly but was instrumental in connecting other individuals" within the network (Jackson, 2020, p. 323). Interlocking directors within a network conceivably serve the same broker function: perhaps they help facilitate the approval of a line of credit covenant or assist in recruiting a C-level executive from outside the firm.

Network theory terminology itself stems from standard graph theory, where a network is represented as a graph with a set of N nodes -- also called agents, players, or vertices (Jackson, 2010). To break this down in the form of an illustration, instead of Marlon Brando, let's imagine another "Godfather" named Bob. To orient the reader to the twin concepts of degree centrality and betweenness centrality, imagine the two example networks below where Bob is plotted.

[18] See Golbeck's (2015) "betweenness Centrality" for more information.

Figure 6: Two network examples featuring example node "Bob"



In Figure 6(a), the network model tells us Bob has a lot of social connections (a degree of 9), but the model does not necessarily show who is in the "middle" of the broader network. In this sense, Bob would be a somewhat compromised Godfather. While Bob seems to be on the periphery of network (a), in network (b) he is located toward center. Thus, in network (a) he has a higher degree centrality value but in network (b), he possesses a higher betweenness centrality value. These two values – betweenness and degrees – are central to the approach I adopt where I compare network values to Hillman and Haynes's notion of industry embeddedness (BCD).

2.4 Proposed Approach

Board Capital Depth and Industry Embeddedness Calculation

Hillman and Haynes (2010) measure depth as industry embeddedness (IE), as described above. With respect to breadth, the authors calculate this as occupational diversity. Within the framework of my research, industry embeddedness (or BCD) is easily replicated; occupational heterogeneity (or BCB) is not easily replicated. The main reason breadth, as it is conceived by Hillman and Haynes, is not easily

quantified is due to the large number of directors (e.g., 5,357 directors in the S&P 500 in 2019) and missing occupational information. Occupational information is necessary to calculate the breath or occupational heterogeneity of a board. As a result, the Hillman and Haynes approach presents an information challenge for researchers interested in capturing and analyzing BCB for any sizeable number of firms. I do not attempt to replicate their information-intensive approach to measuring BCB, and instead explore the value of social network measures – betweenness centrality and degrees centrality – as possible alternative measures of board capital.

While social network modeling is the primary focus of this paper, I did approximate Hillman and Haynes's (2010) industry embeddedness (or BCD) measurement for comparison purposes using the steps outlined below.

> **Step 1:** Calculate industry embeddedness as the percent of directors in the same industry as their employer among directors where there is employer information. For example, if I had employer information for three directors and two directors worked in the same industry as the board's firm, the firm's embeddedness percentage would equal 67 percent.
>
> **Step 2:** Calculate industry embeddedness as the percent of directors in the same industry as their employer among ALL DIRECTORS, regardless of whether I had employer information (some employer information is missing). For example, if I had employer information for three directors and two directors were from the same industry while there were ten directors on the board overall (i.e., seven directors had missing employer information), the embeddedness percentage would equal 20 percent.
>
> **Step 3:** I combine these two percentages into a simple firm-level arithmetic average. For the firm used in the example above, the resulting percentage would simply be (.67 + .2)/2 = 43.5 percent. This result is an effort to describe industry embeddedness amidst missing information. For purposes of this discussion, I am treating the embeddedness average as an approximation of the Hillman and Haynes metric (i.e., a board's embeddedness in the focal industry).

Thus, the IE measurement in this paper is a percentage ranging from 0-100 percent. As described in footnote 1, Hillman and Haynes (2010) use ratio for industry embeddedness (BCD) that ranges from 0 to 2. After computing and discussing network-generated centrality measures (below), I compare and contrast the social network data with my approximation of the Hillman and Haynes IE measure. As such, the main aim of this analysis is to compare industry embeddedness (as a measure of BCD) with network measures derived from the social network model of interlocking directors, discussed in section 2.2.

Because it is not this paper's objective to replicate both of Hillman and Haynes's (2010) metrics**,** I instead consider other forms of director capital that may augment the previous research on BCD and BCB. I assess whether alternative measurements of social capital can be reflected through a network model and subsequently adapted to other models. In this manner, degree centrality and betweenness centrality could represent potential substitutes for BCD (using the industry embeddedness calculation in this paper) – but the possibility exists that they may also be discrete social capital variables unto themselves. While I cannot conclusively say either is a substitute for BCB, this paper offers comparisons with industry embeddedness or BCD and offers suggestions for using these alternate social capital variables as part of a linear model.

Revised Approach and Research Questions

As discussed above, Hillman and Haynes (2010) find that BCB and BCD are important predictors of strategic change at the firm level. In addition, the authors find that board capital breadth and depth are not significantly correlated with one another, indicating they capture discrete dimensions within the overall board capital construct (p. 1155). While their 2010 article appears to be empirically novel, I question the somewhat restrictive method by which both BCD and BCB are operationalized and ask whether there isn't an alternative approach to measuring a corporate board's social capital. Alternatively, perhaps there is something about board social capital that these previous BCD and BCB measurements do not capture that social network models might identify.

For this paper, I extract the betweenness and degrees calculations from the network model to compare them to IE/BCD in an aggregated way. In Hillman and Haynes's (2010) conception, IE directly

measures BCD. As such, I assess whether network measures of betweenness and degrees are correlates of an approximate IE/BCD variable. If neither are correlated, I propose that betweenness centrality and degree centrality may be uniquely discrete social capital variables unrelated to BCD.

Where Hillman and Haynes (2010) have established a functional concept for board capital depth through frequent or durable intra-industry interlocks, I capture potential measures of IE/BCD for a similar sample of firms using a social network model. In this manner, I identify firm "nodes" whose well-connected members potentially add prestige, information, coordination, favors, brokerage, or other intangible value by virtue of their board membership. Leveraging technical principles of graph theory to map a network, I generate two firm-level statistics: betweenness and degrees. Each of the firms in the sample has a quantity for each network metric. For example, based upon its directors and their employers, Microsoft will have a quantity for degrees that will likely be different than the degrees for another firm, such as Oracle Corporation. Similarly, the same statement will hold true for betweenness . By capturing these two quantities across all firms in my sample, I make an aggregate comparison between the standard calculation for IE/BCD against betweenness and degrees. By doing so, I empirically establish board interlocks and make comparisons to answer the following questions:

RQ1: Is industry embeddedness (Hillman and Haynes's notion of IE/BCD) strongly and positively correlated with betweenness? In other words, is betweenness interchangeable as a measure of depth?

RQ2: Are betweenness and degrees negatively correlated with one another, indicating that they capture different dimensions of the overall board capital constructs?

Based on Shropshire's (2010) view that, within the complex organizational board framework, an individual's importance to the group is assessed based on their interlocks, if the answer to question RQ1 is "true," then I submit that betweenness represents an alternative approach to quantifying industry embeddedness and board capital depth. For example, to the extent betweenness centrality captures how

much a given node (i.e., a firm) is central to other nodes, it is possible that firm BCD represents a similar or parallel concept. Similarly, if the answers to question RQ1 and RQ2 are "false," then I submit that degrees and betweenness potentially measure some other facet of social capital, but not BCD. Because I have not replicated Hillman and Haynes's (2010) quantification of BCB (essentially, director occupational heterogeneity), I can make no definitive inference about breadth. Potential outcomes are represented in Table 6.

Table 6: Correlation Crosswalk for Centrality Measures and Industry Embeddedness

	Betweenness		
	Positive correlation	No correlation	Negative correlation
IE	betweenness centrality represents an alternative approach to quantifying industry embeddedness / board capital depth.	betweenness centrality does not represent an alternative approach to quantifying industry embeddedness / board capital depth.	betweenness centrality represents a unique and discrete social capital variable.
Degrees	Degree centrality represents an alternative approach to quantifying betweenness centrality.	Degree centrality does not represent an alternative approach to quantifying betweenness centrality.	Degree centrality represents a unique and discrete social capital variable separate from betweenness centrality.

3. Empirical Framework and Results

3.1. Data and Methods

Using Wharton Research Data Services (WRDS), I collected 2019 data at both the firm and director level among all firms and their directors within the S&P 500. Using this data, I compute a firm-level measure of industry embeddedness (IE) – the percent of intra-industry ties captured by a board. In step with Hillman and Haynes's (2010) computation, this percentage approximates their measure by combining the two industry embeddedness calculations into a simple firm-level arithmetic average.[19]

[19] Using two steps, where step 1 represents industry embeddedness as the percent of directors in the same industry as their employer (numerator) among directors where there is employer information and step 2 represents industry embeddedness as the percent of directors in the same

I then utilize the WRDS firm and director data to generate and plot director networks, using an R package known as the 'linkcomm package' (short for linked communities). This package detects clusters (known as communities) of directors and plots a network based on these community linkages.[20] While this package enables us to partition communities (i.e., groups of firms/nodes), most importantly it generates two key values from the network model: firm-level degree centrality and firm-level betweenness centrality. In sum, upon generating values of industry embeddedness (IE) for each firm in the S&P 500 along with values for betweenness centrality and degree centrality, I examine relationships between these measures to explore the research questions identified in Section 2 above.

3.2 Results

Descriptive Statistics

The primary network I am analyzing in this paper is undirected. That is, the links between the firms are bidirectional, where firm A and firm B are interlocked in the same way as same as firm B and firm A being interlocked. They each mutually share the linkage. A node in this network represents a firm, whereby firms are interlocked based upon the relationships of their director (i.e., interlocks). A link between firms – known as an edge – exists between a pair of firms if they share a director/employee during that year. Of the S&P 500 firms with 5,357 potential directors, I was able to organize and compile director (and their employer and industry) data for all 500 firms among 2,143 directors during calendar year 2019. Because not all directors have employer *and* industry information associated with them in the WRDS data, the list of directors in the network shrinks from 5,357 to 2,143. Among these 2,143 directors, there are 1,807 discrete individuals, since some directors serve on multiple boards, as shown in Table 7.

industry as their employer among ALL DIRECTORS regardless of whether there is employer information, the final industry embeddedness measure is the average of these two.

[20] For interested parties, the community detection methods in this paper are based on hierarchical clustering methods where the default method used for this paper is 'Wards D.'

Table 7: Directors and the number of boards on which they serve among total data

Serves on…	# of Directors
1 board	1505
2 boards	273
3 boards	24
4 boards	5
	1807

In step with the idea of board capital depth, where BCD is a function of industry embeddedness and the directors' current or former industry work experience, I next developed data to analyze intra-industry network data. Among the 2,143 directors, 873 directors served on boards within the same industry as their employer[21] (although this also includes cases where directors were employed by the same company upon whose boards they serve). Among these 873 directors, there were 803 unique individuals, as summarized in Table 8.

Table 8: Directors and the number of boards on which they serve among the intra-industry network only.

Serves on…	# of Directors
1 board	733
2 boards	70
	803

Model Comparison

In an effort to investigate and generate firm-level betweenness centrality and degree centrality, one primary undirected social network was identified. Initially, I explored an undirected model that paired the board firm with the director's employer among all 500 firms where the director's employer's

[21] Industry classifications are based on the Standard Industrial Classification (SIC) system. Within the scheme, there are four-digit SICs (most specific), two-digit SICs (major group), and division (least specific) encompasses a range of SIC codes. For networking purposes, it was most productive to compare division grouping among directors.

industrial classification (using the SIC-based division sector roll-up) matched the classification of the firm. This model resulted in a rather weak network (i.e., minimal networking firms) which was largely a function of too little data.

The second model generated far more robust data. This model pairs the board director with the director's employer among all 500 firms -- *regardless of industry*. In essence, Model 1 relies on a filtered dataset and Model 2 relies on a larger dataset. For example, the first column of the input file for Model 2 contains the firm (e.g., Adobe Inc.) and the second column contains the *six directors* for which we have employer data (out of a total of 11 directors where employer information is missing for five Adobe directors). Conversely, the input file for Model 1 contains only the *four director*s who work in the same general industry sector as Adobe (i.e., an effort to replicate industry embeddedness). Thus, the Model 2 input file has more records (n = 2,143) than Model 1 (n = 874). Because it is central to the comparisons made in this paper, descriptive statistics for industry embeddedness are reported and a histogram of this key variable are presented in Table 9 and Figure 7, respectively. Table 9 provides descriptive statistics associated with the second model and Figure 7 represents the distribution of Industry Embeddedness across the entire dataset (i.e., ~500 firms).

Table 9: Descriptive statistics for final network model (Model 2)

	Minimum	Maximum	Mean	Median	Standard Deviation	Skewness	Kurtosis
Betweenness Centrality	0.0	40,452.1	4,721.4	2,636.4	6,307.9	2.5	7.5
Degree Centrality	0.0	15.0	3.8	3.0	2.4	1.1	1.9
Industry Embeddedness	0.0%	85.7%	30.2%	30.0%	20.1%	0.1	-0.8

Figure 7: Histogram of Industry Embeddedness

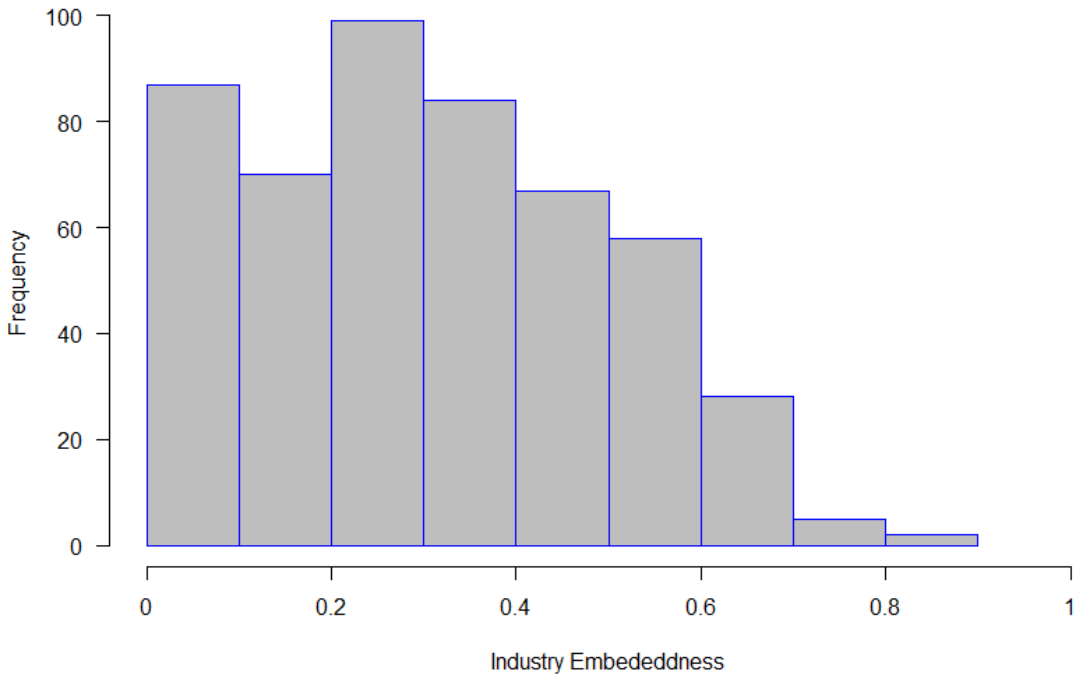


Figure 8: The Model 1 network among 18 clustered nodes of S&P 500 firms, 2019 (weaker network)

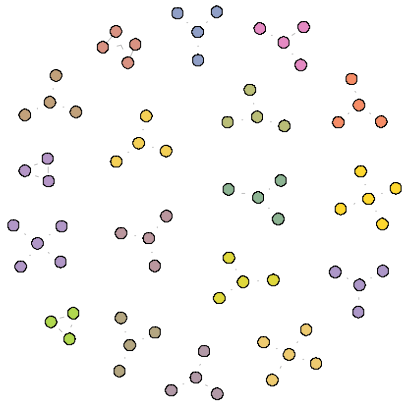


Figure 9: The Model 2 network among clustered nodes of S&P 500 firms, 2019 (stronger network)

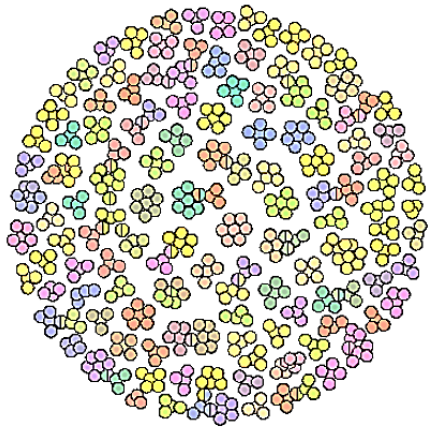


Table 9 displays descriptive statistics for three variables: betweenness centrality (Model 2), degree centrality (Model 2), and industry embeddedness (entire dataset). From this table we can see how the two network variables – betweenness and degrees – have a very different range of values. On average, though board interlocks firms have (mean) linkages to 2.4 other firms the mean betweenness centrality value represents a less normative quantity whereby the average firm has a network betweenness value of 2,476. Along with industry embeddedness, the variables in Table 9, can potentially be used within a follow-on analysis and applied toward linear or non-linear regressions to analyze the predictive power of social network data.

The visualizations in Figures 8 and 9 represent the two model choices I generated from the data. From the visualizations alone, we can see that the Model 2 graphic presents a more strongly networked set of firms. That is, we have fewer missing (betweenness and degrees) values in the final dataset.

Figure 10: Example Network Slice

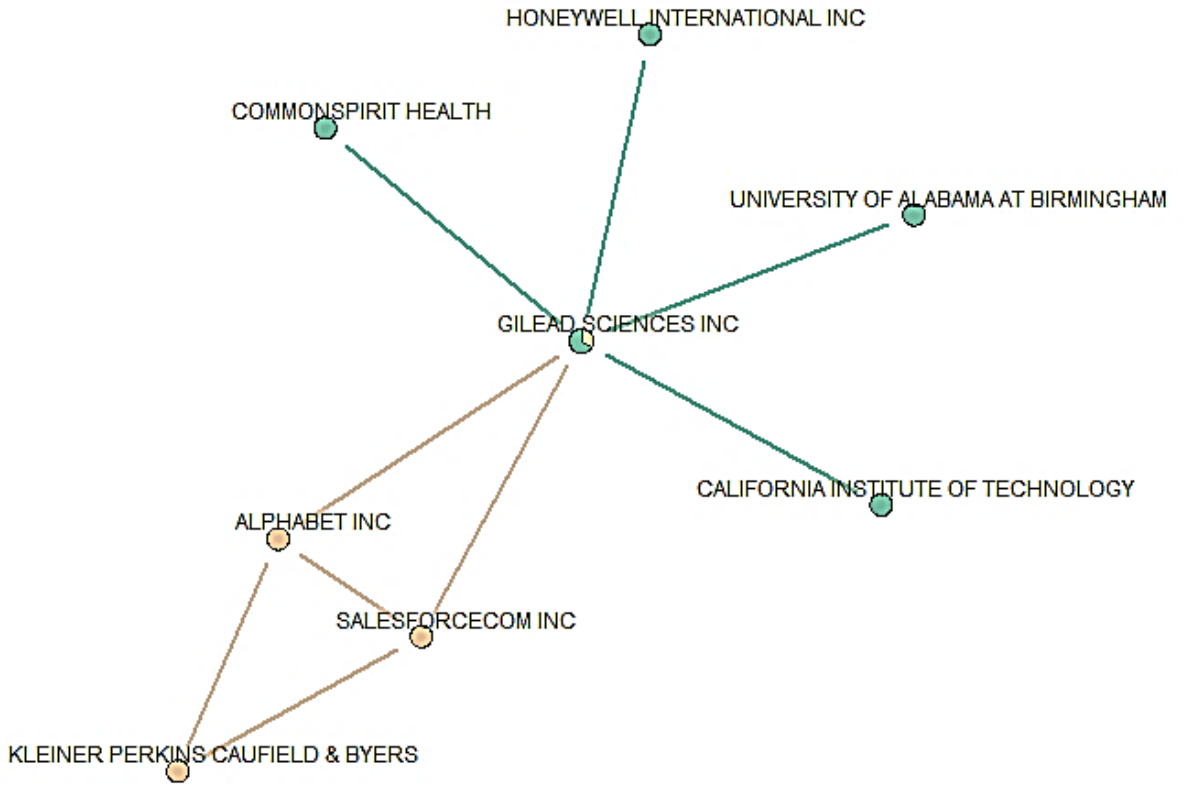


Figure 10 presents an example Model 2 network slice and how a particular firm is linked to other communities of firms. The firm **Gilead Sciences Inc.** has a betweenness centrality of 12,355.3 and a degree centrality of 8. This miniature network community displays where Gilead's directors work and/or other firms where Gilead's executives serve as directors. Gilead is a clear example of "reciprocal board interlock" where "an employee of firm A sits on firm B's board and at the same time an employee of firm B sits on firm A's board" (Hallock, 1999, p. 55).

Other examples of how high levels of betweenness and degrees relate to individual firms are presented in Figures 11 through 14. These firms are ranked according to the three key values featured in Table 9 where these firms have values at least two standard deviations above the mean. Referencing Figure 11, the firms with the highest levels of industry embeddedness appear to predominately come from real estate investment trusts or property management firms. Interestingly, in Figure 12, we see the two firms with the highest level of betweenness centrality are transportation firms (UPS and FEDEX). The firms with the greatest linkages to other firms (degree centrality) include Microsoft and FEDEX (Figure 12).

When we analyze individual firms however, Microsoft retains moderately low industry embeddedness in the Services sector at 20.2 percent while FEDEX has no directors from the same 'Transportation, Communications, Electric, Gas and Sanitary' sector on its board (i.e., 0 percent industry embeddedness). Another similar example is Target which has 11 degrees (Figure 13) and only 10.99 percent industry embeddedness within 'Retail Trade.' On the other end of the spectrum and unlike these three examples, Alphabet Inc. has relatively high degrees or director interlocks (Figure 13) but also has very high industry embeddedness (60 percent). Following along this same high degree / high IE pattern is JP Morgan Chase and Company with 10 degrees and 58.2 percent industry embeddedness. Finally, Figure 14 plots the top 20 firms on both the betweenness and degree centrality measures.

Figure 11: Industry Embeddedness Ranking

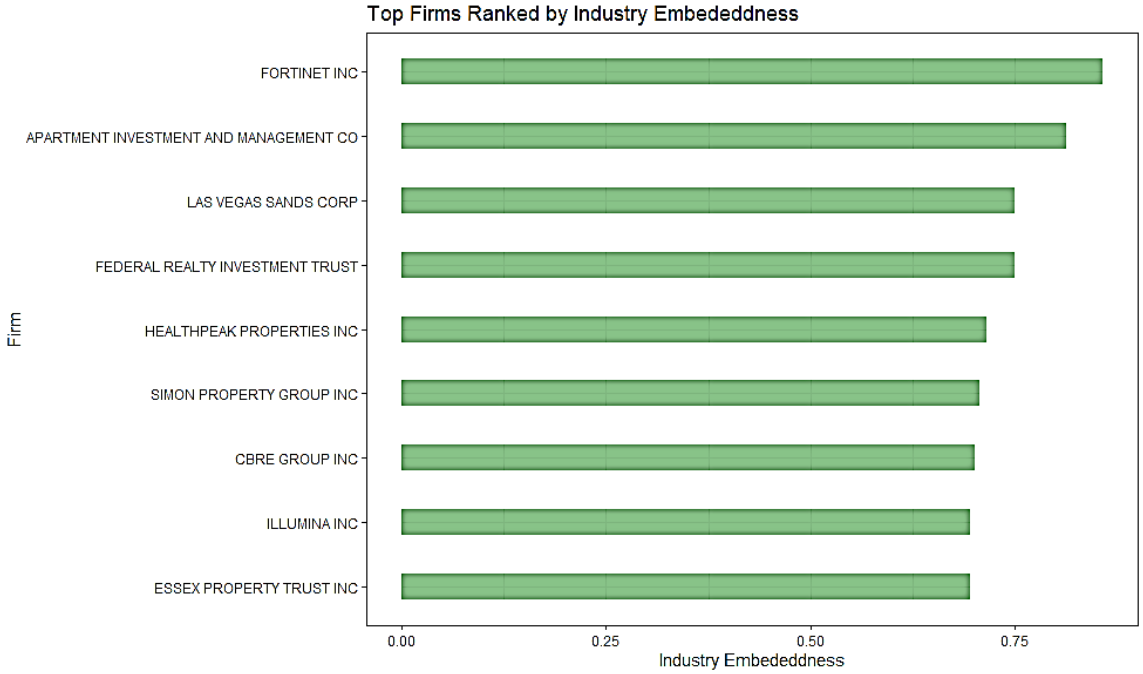


Figure 12: Betweenness Centrality Ranking

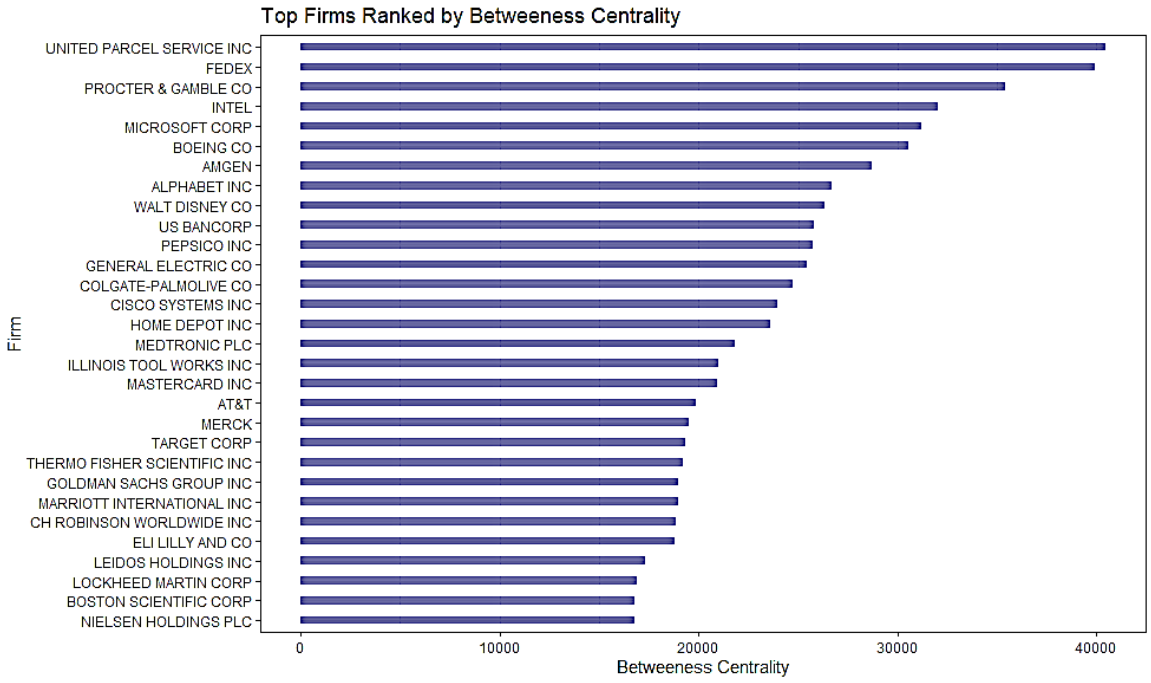


Figure 13: Degree Centrality Ranking

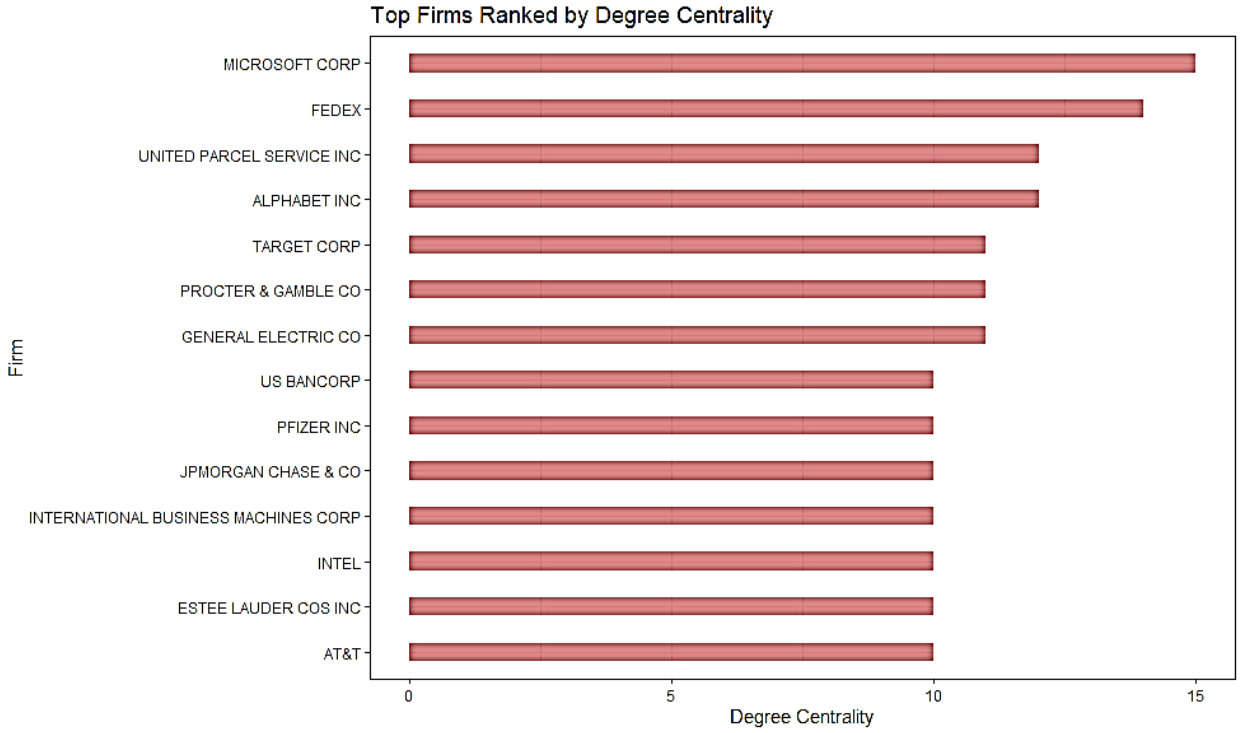
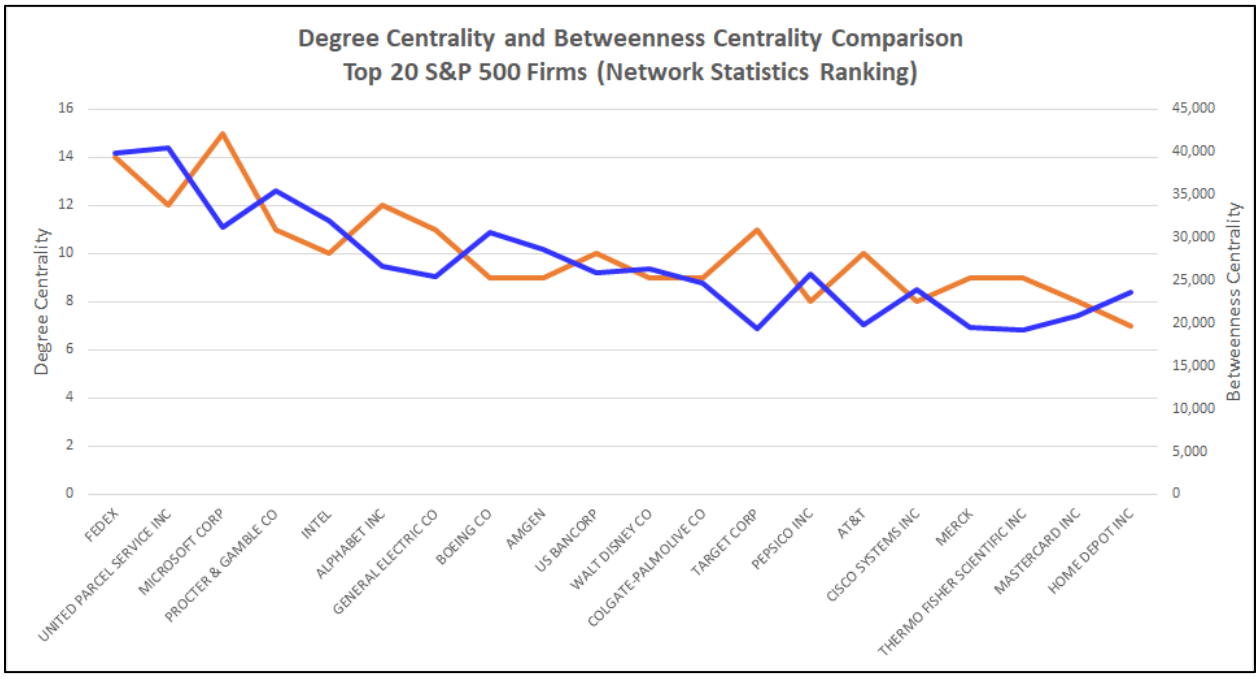


Figure 14: Overlay of Degree Centrality with Betweenness Centrality



Analysis

Leveraging the Model 2 data (the total dataset model that is not filtered intra-industry) and comparing degrees to industry embeddedness**,** I find a potential linear pattern between these measures of centrality – particularly among three industry categories. For example, among 'Finance, Insurance, and Real Estate' SICs, the number of ties associated with a particular node (degrees) may covary with my calculation of industry embeddedness average. In this industry division, where a firm has 4 or more ties to another firm through the directorial relationship, the corresponding industry embeddedness average is at least 58 percent and as high as 81 percent. Figure 15 provides pairwise correlation coefficients for these measures.

Figure 15: Correlation matrix comparing degree centrality, betweenness centrality and industry embeddedness among S&P 500 firms

	Industry Embededness Average	*Firm Betweeness Centrality*	*Firm Degrees Centrality*
Industry Embededness Average	**1.00**	**-0.07**	**-0.08** *
Betweeness Centrality	**-0.07**	**1.00**	**0.84** ***
Degrees Centrality	**-0.08** *	**0.84** ***	**1.00**

Signif codes: * p<.10; ** p<.05; *** p<.01

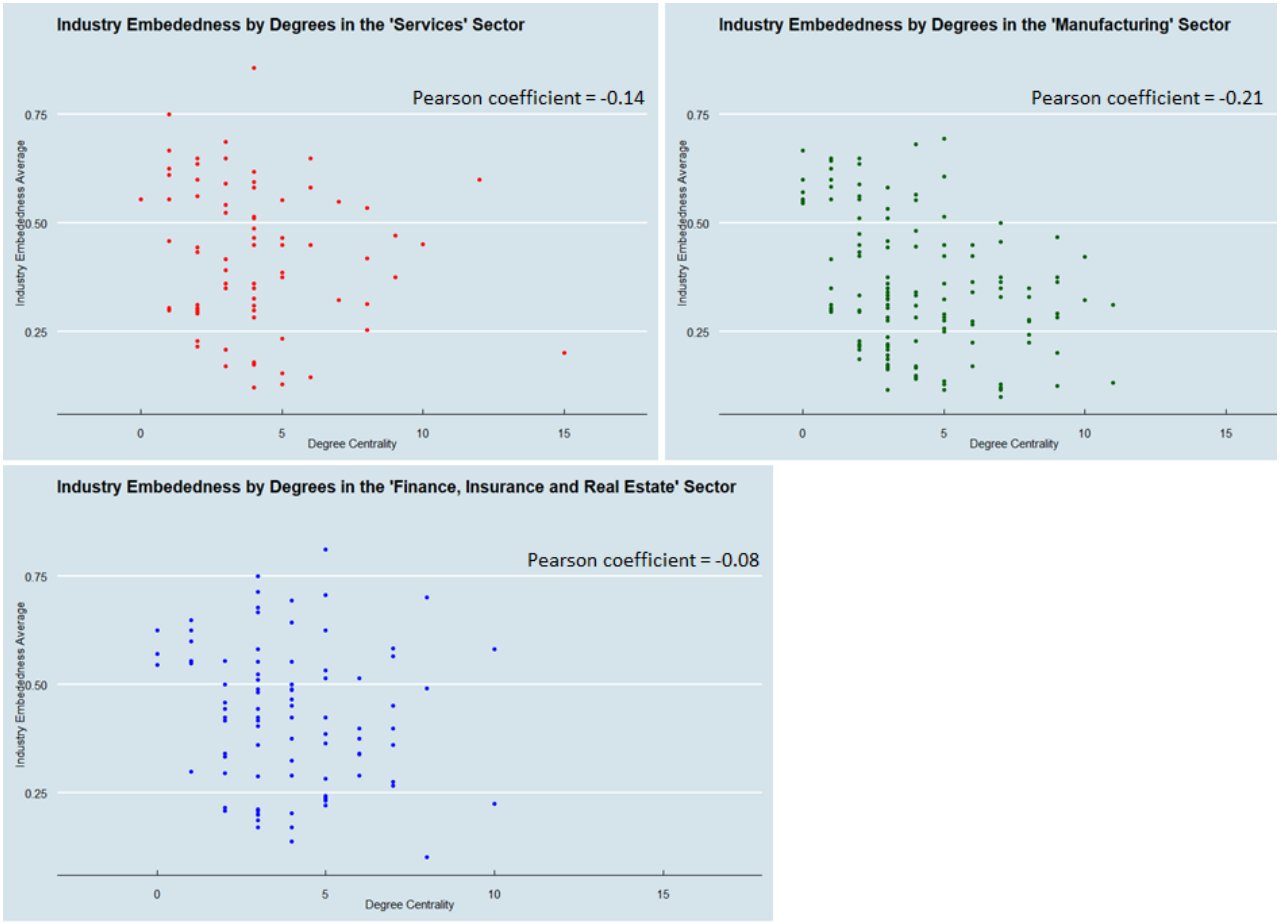
In response to the research questions:

RQ1: Is industry embeddedness (Hillman and Haynes notion of IE/BCD) strongly and positively correlated with betweenness? In other words, is betweenness interchangeable as a measure of depth?

RQ2: Are betweenness and degrees negatively correlated with one another, indicating that they capture different dimensions of the overall board capital constructs?

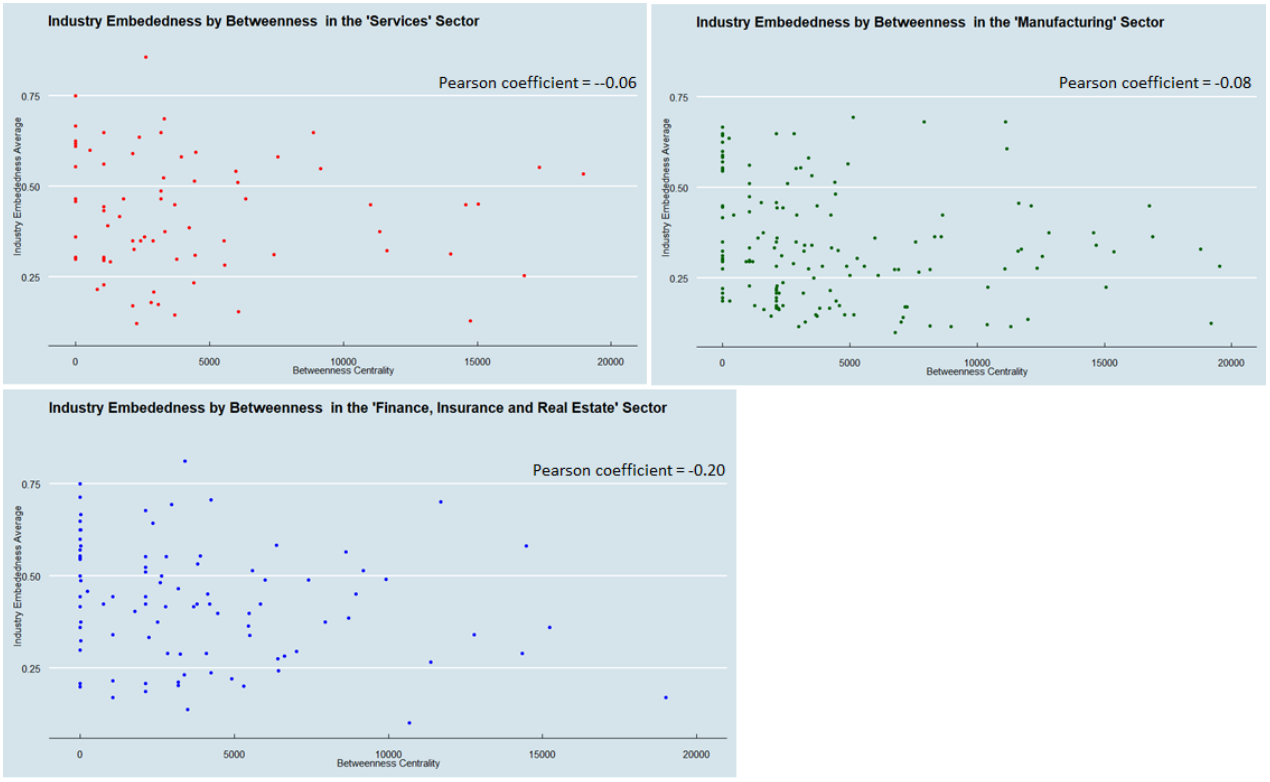
The answer to RQ1 appears to be no (coefficient = -.065). Betweenness does not seem to be a substitute for industry embeddedness, as measured by linear correlation coefficient; in fact, they seem to be weakly negatively correlated. The answer to RQ2 also seems to be in question (coefficient = .84). In fact, there appears to be a strong positive correlation between betweenness and degrees which suggest firms (within this dataset) that are connected to other firms through director interlocks rate high on both dimensions. Is the association strong enough to suggest that degree centrality could be a measurement of some other facet of board capital? To investigate further, I filtered the data on some of the industries to see if patterns emerged among certain industry segments.

Figure 16: Comparing degree centrality to industry embeddedness average among three industry categories within Model 2 population



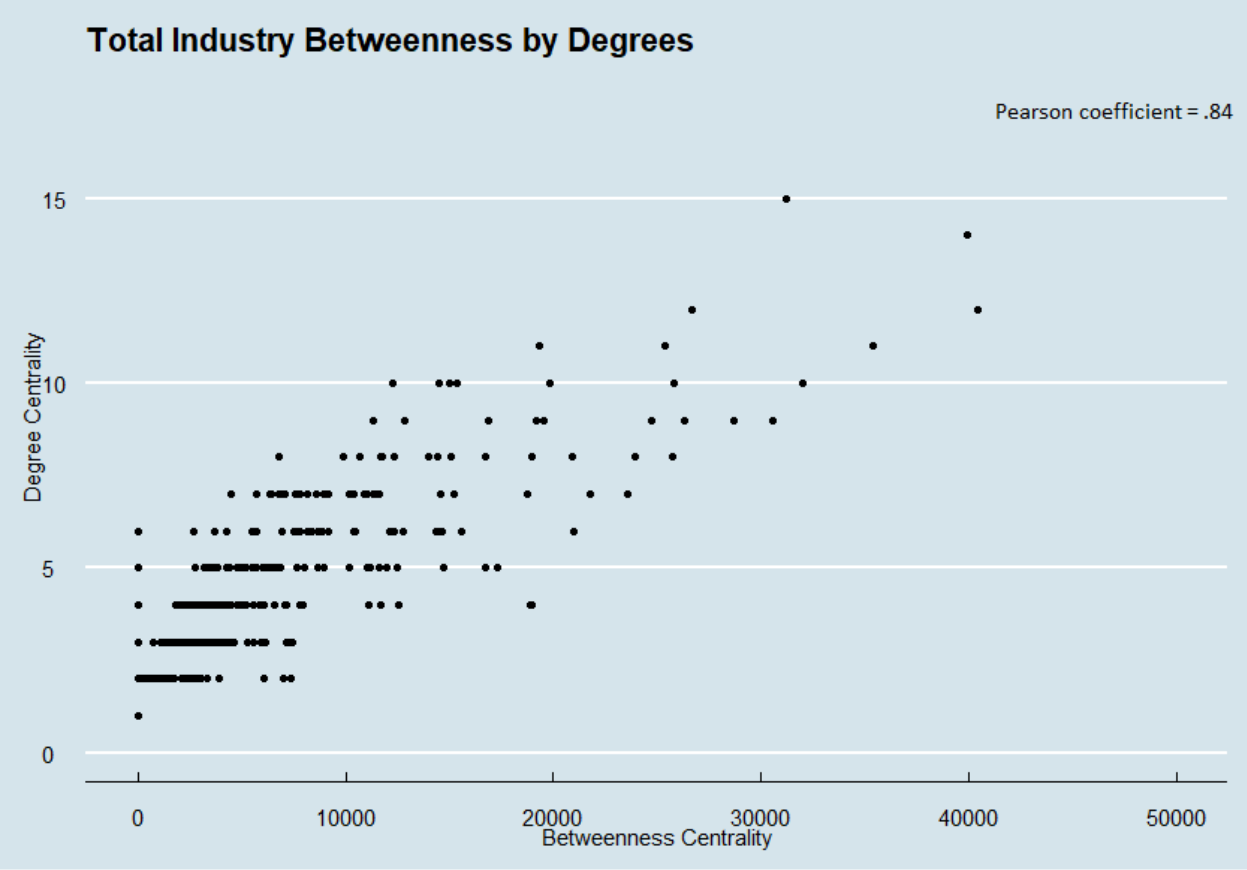
Using the Model 2 population, we see in both Figure 16 and Figure 17 there is a negative relationship between betweenness and industry embeddedness and degrees and industry embeddedness for some key industries. Within "Finance, Insurance, and Real Estate" where there are higher levels of industry embeddedness, there seem to be lower levels of degrees (links to other firms); in contrast, among the manufacturing sector, it seems there are a few more extreme cases of degrees or relationships to other directors across the S&P 500. For example, among the Manufacturing sector, 57 percent of firms have five or more links (degrees) to other firms. This compares to only 53 percent among firms overall. In summary, among these three industries in Figures 16 and 17, no director seems to have more than 15 links (degrees) to other directors.

Figure 17: Comparing betweenness centrality to industry embeddedness average among three industry categories within the Model 2 population



As shown in Figure 17, there are visual negative correlations between IE and betweenness centrality among the same three industrial sectors but, with the exception of Finance, Insurance and Real Estate, not necessarily stronger correlations than those measured for total population (Figure 15).

Figure 18: Comparing betweenness centrality to degree centrality among the total population



Finally, Figure 18 is a visual representation of the strong, positive aggregate correlation between betweenness centrality and degree centrality, reported in Figure 15. A broader observation is that, among total firms (and from Figure 14, some industrial sectors in particular), we observe that degrees are negatively correlated with industry embeddedness. Similarly, the same pattern holds true for betweenness and industry embeddedness, as represented in Figure 15 (aggregate) and Figure 17 (sector). Regardless of this negative correlation pattern, betweenness and degrees (across all industries) seem positively

correlated with each other (Figure 15 and Figure 18), suggesting that perhaps there is a set of underlying or latent factors among firms with high betweenness AND high degree centrality. In other words, perhaps these two network-generated metrics represent some unique social capital dimensions that could be reduced. In any event, they seem to measure something different than industry embeddedness.

4. Recommendation and Conclusion

This paper has studied data from the S&P 500 and plotted directors from these 500 firms into social network models. Its main contribution has been to broaden the discussion on the meaning of board capital breadth and board capital depth by studying director networks to see how they relate, primarily, to industry embeddedness – the driver of board capital depth. In theory, it seems reasonable to propose that network models contribute meaningfully to the discussion put forward by Hillman and Haynes (2010) regarding breadth and depth.

The results of this empirical analysis show that undirected networks can generate meaningful data regarding some feature of social capital. However, the precise meaning of the generated data is still somewhat elusive. Clearly, much more work needs to be done to fully grasp the relationships presented here, but several interesting questions were raised that contribute to new areas of discussion. Despite these questions, there seem to be some observable patterns from the data. For example, it seems to be the case that firms with lower industry embeddedness often have more links to other directors (e.g., Microsoft, FEDEX, Target) overall within the S&P 500 network – although there are exceptions (Alphabet, JP Morgan Chase). Were we to consistently observe this pattern and relationship between industry embeddedness and degrees, perhaps we could assert something about degrees that would make it a unique measurement in discussions relative to social capital? Also, perhaps it makes sense to explore the merger of betweenness and degrees into another abstraction or feature of social capital. Drawing some preliminary conclusions from this 2019 dataset, there are several things that should be continuously researched and investigated. First, it would be worth determining whether network degrees are consistently negatively correlated with industry embeddedness. Second, betweenness centrality and

degree centrality may be measuring the same thing. A multivariate approach or dimension reduction technique (e.g., principal components) is recommended to assess whether these two statistics represent a single underlying variable.

Using Hillman and Haynes's (2010) foundation as a starting point, I used the SIC industrial classification scheme as the industry identifier as their research did. Moving forward, I recommend the S&P 500 dataset be modified and adopt the more updated North American Industrial Classification System (NAICS) versus the more traditional SIC codes as an indicator of industry. NAICS represents a current and up-to-date indicator of the current industrial climate that did not exist nearly one hundred years ago when the SIC system was first instituted.

As we think about "industry embeddedness," it is worth considering whether "strategic industries" form a kind of counterweight to industry embeddedness. While Hillman and Haynes (2010) use three occupational categories to code BCB, the occupational value of a director may be extended to include industry embeddedness and depth. Therefore, future analysts should consider developing a strategic industry "cross-walk" template. For example, it may be equally interesting to understand how an organization stacks its board with directors from venture capital firms, law offices, blue-chip consultants, or other strategic partners just as much as it recruits directors from the same industry. This other kind of industry embeddedness may represent another form of self-serving corporate strategy to link it board members and gain industry insight advantage. Finally, consider the impact of geography. Perhaps a regional view of networks would provide a very different result. For example, if we were to focus on a network within a single state or census region, we may find more nodal overlap among both the intra-industry and total director population with fewer noticeable differences between non-overlapping and overlapping networks. This regional characteristic may suppress any differences between the two network types.

The current paper has implications for both the study and the practice of board composition. From the data and plots, we see differing levels of industry embeddedness as it relates to board degree centrality. The decision to pursue greater board capital depth or breadth may be highly deliberate or

inadvertent. Unfortunately, this paper does not provide conclusive evidence that either betweenness or degrees represents a substitute for industry embeddedness (BCD). In any case, it seems the network model generates social capital data that merits further investigation. But if there is a link to BCB or BCD, more work has to be done to uncover the relationship to the network.

This paper avoids discussion of the purpose of a board (e.g., whether they were instituted as monitors on behalf of regulators) and does not comment on whether greater depth or breadth contributes to increased performance. Certainly, boards offer a unique or fresh perspective to management, where each director represents some kind of human asset. It seems clear that identification of a board into a clear BCD or BCB segment or strata would offer consultative benefit to research that seeks to unlock the value of director capital and link it to a wide range of performance metrics. Perhaps understanding the relationship of betweenness centrality and degree centrality to firm performance in a follow-on paper will help refine the discussion of board capital's effect on and firm performance.

5. Appendix

Degree centrality: The degree centrality of a vertex is a normalized value representing the number of edges touching a vertex. An edge is a count of how many social connections a node of the total number of connections linked to a vertex[22]. The more connections a director has, the greater the edge count in the model. Vertices with low degree centrality will usually reside on the periphery of a network. For a vertex i, its degree centrality is given by:

$$D(i) = \frac{1}{(n-1)} \sum_{j=1}^{n} Aij$$

where A_{ij} is the ij-th element of the adjacency matrix A of the graph and n is the number of vertices in the graph.

betweenness centrality: A central measure of the importance of a given vertex is its 'betweenness.' This metric represents the centrality of a node within a social network; conveyed as an index, it represents how frequently the vertex lies on shortest paths between any two vertices in the network. A firm with high betweenness is critical to the flow of information through a network and act as bridges to other firms across the network. A geodesic path is defined as a path (sequence of vertices connected by edges) between vertices u and v with the fewest possible edges (the shortest route), and denote the number of geodesics as σuv and denote σuv(i) as the number of geodesic paths through u and v that pass-through vertex i via[23]:

$$B(i) = \frac{1}{(n-1)(n-2)} \sum_{u,v=1, u \neq i \neq v} n \frac{\sigma uv(i)}{\sigma uv}$$

Vertices with high betweenness centrality represent hubs that many paths pass through and represent either highways or bottlenecks for the flow.

[22] https://www.sciencedirect.com/topics/computer-science/degree-centrality
[23] https://www.sciencedirect.com/topics/computer-science/degree-centrality

Article 3

Director Relationships & Regulatory Penalties in the S&P 500

Abstract: This paper examines the relationship between regulatory penalties and board interlocks, as measured by two primary measures: betweenness centrality and degree centrality. In addition, this paper incorporates additional measures of board characteristics (e.g., board and audit committee diversity, board size, and board independence) to assess which of these features contributes to a model that predicts average regulatory penalties. Examining financial penalties between 2016 – 2020 for firms in the S&P 500, I advance a model that describes and predicts the types of firms that are at greatest risk for agency-imposed financial penalties. The output suggests three variables – in different contexts – contribute to such a predictive model: the level of board independence, director influence, and board industry embeddedness.

1. Introduction

Navigating the complicated regulatory ecosystem requires boards to sometimes function as "monitors" to ensure compliance with rules issued by state and federal agencies (Van Loo, 2018, p. 3). For example, as of this writing, the Occupational Safety and Health Administration's (OSHA) is empowered to enforce a workplace COVID-19 vaccine mandate.[24] As the regulation language states:

> Covered employers must develop, implement, and enforce a mandatory COVID-19 vaccination policy, with an exception for employers that instead adopt a policy requiring employees to either get vaccinated or elect to undergo regular COVID-19 testing and wear a face covering at work in lieu of vaccination.

While this regulation does not reflect statutory law because the rule was not crafted through a legislature, its effect is generally binding (Buthe, 2011, p. 55). The future of the pandemic is anything but predictable. However, absent an alternative legal ruling, we can be reasonably confident that when a firm with 100 or more employees fail to comply with the mandate, a regulatory penalty will be issued against that firm.

Beyond workplace safety, fines can be imposed for a wide range of misconduct: banking and lending discrimination, water quality, environmental pollution, safety issues, or price-fixing. During 2020, U.S. public corporations were fined nearly $14 billion by federal agencies (Good Jobs First, n.d.). Of this total public corporate pie, about 78.5 percent of federal penalties were paid by financial services firms like Wells Fargo and Goldman Sachs ranking highest (Good Jobs First, n.d.). If the boards of these firms were actively engaged in monitoring Goldman's violation of the Foreign Corrupt Practices Act – which involved bribing high-ranking government officials in Malaysia and the Emirate of Abu Dhabi (U. S. SEC, 2020) – or Wells Fargo's illegal sales practices between 2002 and 2016 (U.S. DOJ, 2020), then some directors may need remedial oversight function training.

[24] There are multiple legal and editorial opinions circulating, but the Federal Register is the primary source: COVID-19 Vaccination and Testing; Emergency Temporary Standard, 86 FR 61402 Reg. (November 5, 2021).

This paper posits that regulatory penalties are connected to a board of director's monitoring capabilities. Here, I theorize that a board's ability to provide regulatory and risk oversight is, in part, driven by the networked aspects of directors while holding constant other board compositional characteristics. Influenced by an informal board hierarchy, it seems necessary to consider the network of board member relationships external to the firm and the implications those relationship have upon penalty imposition. The goal of this article is to combine audit committee diversity data[25] from Article 1 with social network data (i.e., betweenness centrality and degree centrality) from Article 2[26] as independent variables in order to test the relationship between these variables and the dependent variable: average monthly regulatory penalties. The purpose of merging this data is threefold. First, I want to determine if industry embeddedness (IE) as an extension of a board's capacity to monitor management is negatively related to regulatory penalties. Second, this analysis will determine whether board independence is negatively correlated with penalties. Finally, this will be the first time I test the relationship between social network measures and regulatory penalties, holding all other variables constant.

To what extent do networked directors reduce average penalties and to what extent do they indicate board capital levels? Social network measures may possibly capture a social capital dimension of board structure and governance. In their pioneering study, Hillman and Haynes (2010) relied on director level data to model against two outcome variables: 1) strategic variation, the degree to which a firm's strategy varies over time; and 2) strategic deviation, divergence from industry norms. Their model indicated board capital breadth – which for their study was defined as occupational heterogeneity and referred to as 'BCB' – had a statistically significant relationship with strategic variation, thereby indicating firms with higher levels of BCB were more dynamic and adaptable to strategic change. Board capital depth (i.e., BCD) referred to the level of industry embeddedness (IE) within a board, or the

[25] Magistad, E. P. (2021). Who pays the penalty? Board gender diversity and regulatory fines among the S&P 500. Working paper.
[26] Magistad, E. P. (2021). Social networks and corporate boards in the S&P 500: An alternative approach to measuring board capital. Working paper.

number of directors employed within the same industry as their director's position firm. One supposition is that boards that are higher on the BCD dimension and lower on BCB may be more risk averse and less likely to innovate or think strategically.

Firms should have greater levels of social capital are better able to overcome external environment's uncertainties (Taljaard et al., 2015), whereas occupational heterogeneity is critical for creative ideas (Nielsen & Nielsen, 2013) influences the cognitive capabilities of directors (Akram, et al., 2020). Midavaine et al. (2016) find that a heterogeneous board on occupation and social dimensions offers more resources to the firm, while others have shown occupational heterogeneity elevates the collective cognitive capacity of the board's decision-making (Athmen & Samia, 2017) and can significantly influence the performance of the board (Burke et al., 2019). When heterogeneous groups work together, their information processing abilities are augmented by their range of diverse experience (Kim, 2014).

Veltrop and Molleman (2019) analyze board heterogeneity in relation to regulatory penalties and risk mitigation. They find that board compositional factors affect the board's role in strategic decision making and that informal hierarchy within the board network differently shapes how boards monitor and advise top management. Veltrop and Molleman suggest boards of directors are social groups with an informal hierarchy defined as a rank ordering of individuals, where that rank is based on the amount of influence they bring to bear on their positions as directors. Little is published about whether this kind of director influence has bearing on monitoring and regulatory oversight.

Regardless, monitoring by the board of directors serves as a kind of self-regulatory function, and Short and Toffel (2011) find that organizations are more likely to self-regulate when they are subject to heavy regulatory surveillance. On the other hand, regulatory agencies function as external "monitors" whose power arises from their authority to ensure compliance with rules issued by the same agencies (Van Loo, 2018).

Based upon Veltrop and Molleman's (2019) observations, board social capital (vis-à-vis industry embeddedness) may also drive risk reduction and – through extension – drive average regulatory penalties

lower because directors focus on monitoring management. However, this claim is largely an exploratory hypothesis without literature to support it. As such, using three social capital variables – industry embeddedness, betweenness centrality and degree centrality – I integrate them into a model to predict average regulatory penalties incurred by the firm. Thus, boards that innovate through social capital dynamism may be able to reduce their average penalty exposure. Admittedly, Hillman and Haynes's (2010) notion of strategic variation is not equivalent to penalty reduction, but penalty reduction – as a strategic goal – represents a form of innovation.

Research on board interlocks has demonstrated that board interlocks promote information and process exchange (Connelly et al., 2011; Shipilov et al., 2010; Westphal et al., 2001) whereas some research has applied the notion of "industry embeddedness" to explore these interlocks (Hillman & Haynes, 2010). Board independence theory (Naseem et al., 2017; Zahra & Pearce, 1989) and theory on board size (Aggarwal, 2013) contributes to the remainder of the theoretical discussion here. Using social network data, the central research question this article raises is whether highly influential directors (i.e., higher betweenness centrality and degree centrality) bring more monitoring effectiveness to the board? Additionally, is this influence affected by 1) the board size and 2) the level of board independence?

Building on this general theoretical foundation, this research makes four primary contributions. First, I use a response variable (regulatory penalties) that receives less attention in the literature as a performance metric despite the fact this variable is directly connected to a primary board function explored in the literature (Boyd, 1995; Daily, 1996). Second, I calculate industry embeddedness to test the relationship of one board interlock measure to the issue of regulatory penalties. Third, I apply social network data (betweenness centrality and degree centrality) to the issue of regulatory penalties. In this manner, I test whether firms with higher level of betweenness centrality and degree centrality are more adept at scanning the risk ecosystem and avoiding regulatory penalties. Finally, I test an interaction between betweenness centrality and degree centrality with 1) board size and 2) board independence. The high-level findings indicate there is evidence (with caveats) to support the idea that the interaction between degree centrality and board independence (the percentage of independent directors) seems to

predict a lower overall penalty average. Similarly, evidence suggests firms with a higher betweenness centrality and a higher percentage of independent directors also seem to be associated with lower average penalties. This indicates boards that have highly influential and independent directors may be part of a combination that produces lower average regulatory penalties.

In summary, I specify a model using the archival dataset[27] to regress several features against regulatory penalties. During this study I also control for firm characteristics including the following attributes: firm size and board committee member independence. This final model yields practical observations about corporate governance strategies to mitigate risk through key board and committee composition. The findings suggest that under varying conditions, the level of board independence, director influence, and board industry embeddedness contributes to a model that predicts average regulatory penalties.

2. Theoretical Framework

2.1 Regulatory Penalties, Board Gender Diversity, and Board Interlocks[28]

The role of regulatory agencies as "monitors" arises from their authority to regularly collect nonpublic information from firms to ensure compliance with rules issued by agencies (Van Loo, 2018, p. 3). In the United States, for example, the Food and Drug Administration (FDA) is empowered and required to keep unsafe food off of grocery store shelves. Firm misconduct can comprise all manner of wrongdoing: banking and lending discrimination, water quality, environmental pollution, safety issues,

[27] See articles 1 and 2, section 3.

[28] In this paper, I am introducing variables such as firm size and board member independence that requires some additional theoretical foundation, beyond that provided in Articles 1 and 2 of this dissertation. Section 2.1 offers a discussion of some of the important topics relative to the dependent variable whereas section 2.2 – 2.6 will cover the integration of new theory to integrate the addition of firm size and board member independence. Section 4 (Results and Findings) will integrate these features with the existing features from the archival dataset including the social network measures of betweenness centrality and degree centrality.

price-fixing, and an array of other cases resolved by federal and state regulatory agencies (Mattera, 2020). When firms fail to follow regulatory rules, the costs to the firm can be extensive.

The extent to which regulatory penalties act as a performance indicator directly tied to the monitoring and oversight functions of corporate boards is not well documented. However, potential losses from reputational damage and penalties undercut a firm's profits and may serve as a deterrent (Aoki & Coiffi, 2000; Gray & Scholz, 1991; Gray & Shadbegian, 2005; Thornton et al. 2005; Mendelhoff & Gray, 2005; Shimshack & Ward, 2005). A board, in its capacity to scan the external environment and monitor top management, can be a force to ensure compliance with rules and laws. In the absence of internal processes, programs, controls and disclosure protocols, a firm's ability to self-regulate – the extent to which the legal environment and regulator enforcement activities are merely symbolic - may be insufficient (Short & Toffel, 2011). Short and Toffel find that organizations are more likely self-regulate when they are subject to heavy regulatory surveillance. Thus, one primary tool to self-regulate and scrutinize an organization from the inside is through its process of selecting directors and organizing board committees.

2.2 Explanatory Variable #1: Industry Embeddedness

In the spirit of understanding board interlocks, I continue to refer to Hillman and Haynes's (2010) notion of 'board capital' as part of a broader social capital construct. Scholars typically rely on a resource provision perspective when examining boards' impact (e.g., Hillman & Dalziel, 2003), and in line with Resource Dependence theory, some of the most important resources that directors bring to the board are their advanced knowledge and social connections (Pfeffer & Salancik, 1978). Board capital is derived from ideas based upon human and social capital (Aberg et al, 2019; Hillman & Dalziel, 2003) and can be observed along two primary dimensions – *breadth* and *depth* (Hillman & Haynes, 2010). In a similar vein, Pennings (1980) used the notion of industry embeddedness (IE) to describe upstream or downstream ties to other organizations within the same industry. Therefore, enhancing board capital depth can be seen as a way provide legitimacy where appointing directors with ties to other important organizations signals

the firm is a legitimate enterprise (Mizruchi, 1996). Moreover, research has shown that IE can influence organizational strategy and policy decisions related to monitoring and risk-taking (Hansin, 2017).

Leveraging prior insights and upon analyzing the two primary dimensions from the network model, neither betweenness centrality and degree centrality seem to be a substitute for industry embeddedness.[29] However, the archival data contains a calculation for industry embeddedness that is put to use in this study. Thus, it seems reasonable to experiment in this model with IE to understand its relationship with regulatory penalties. Also, it makes sense to use this approach in concert with the two social capital variables (betweenness centrality and degree centrality) derived from the network in order to explore the relationship between director capital and regulatory penalties.

2.3 Explanatory Variable #2: Board Member Independence

Corporate boards can be the subject of great scrutiny. In the spirit of advancing director and board integrity within the governance process, during 2001 the United States Security Exchange Commission adopted amendments to render boards of investment companies more independent. In summary:

> The Commission is adopting amendments to certain exemptive rules under the Investment Company Act of 1940 to require that, for investment companies that rely on those rules: independent directors constitute a majority of their board of directors; independent directors select and nominate other independent directors; and any legal counsel for the independent directors be an independent legal counsel.[30]

There are various perspectives on board independence, which equates to the practice of staffing boards with non-employees or outsiders relative to the target firm. Some evidence points to the notion

[29] For a full discussion of centrality measures, see section 3.2 of Magistad, E. P. (2021). Social networks and corporate boards in the S&P 500: An alternative approach to measuring board capital. Working paper.

[30] https://www.sec.gov/rules/final/34-43786.htm

that independent boards are not a cure-all or antidote for performance (however that is measured). In the words of Hillman and Dalziel (2003):

> The (Security Exchange Commission) amendments significantly tightened requirements for director independence and demand increased disclosure of board composition, all in an attempt to 'enhance the independence and effectiveness of boards of directors (U.S. SEC, 2001). We suggest the anticipated enhancements may not be achieved, and we contend that board independence is not the panacea for effectiveness it is thought to be (p.393).

Others contend that, because boards inadvertently compel directors to "conform to the social norms of 'group think' and limit frank discussion or dissent" (Barclift, 2011, p. 13), independence can be a way of opening up the lines of communication and fostering open discussion. Despite pessimism in some corners about board independence, these legal perspectives maintain new disclosure requirements giving rise to CEO and director independence will bring about additional transparency and candid debate. Barclift (2011) asserts the following:

> The new (federal disclosure) rules will force the boards of public companies to engage in greater oversight of risk and disclose such risk. More importantly, the disclosures on board leadership structure will likely increase the overall independence of the board, allowing for improvements in frank discussion among board members. (p. 20)

Turning to firm performance, there is debate in the literature as to whether board independence adds value, and the results here are inconclusive. Past research has identified a negative relationship between board independence and firm performance in the United States. Baysinger and Butler (1985) and Hermalin and Weisbach (1991) found no significant association between the percentage of outsiders on the board (i.e., board independence) and same-year measures of corporate performance (ROE). Larcker et al. (2007) investigated the association between corporate governance measures and various financial reporting metrics (e.g., operating income, return on assets) but found mixed results. Larcker et al. believed these mixed results are partially attributable to the difficulty in producing reliable and valid measures for corporate governance. Bhagat and Black (2002) found no relationship between overall board

independence and four distinct measures of firm performance (Tobins' Q, return-on-assets, market-adjusted stock returns and ratio of sales-to-assets) measured over a 3-year window. Among Canadian firms, Park and Shin (2004) argue that the "monitoring competencies of outside directors are likely to increase with their tenure" but to date the authors "find no evidence that the average tenure of outside directors improves the effectiveness of the monitoring" (p. 433).

In a somewhat opposite findings, empirical evidence has documented that board independence is associated with improved performance (Zahra & Pearce 1989; Pearce & Zahra 1991; Pfeffer, 1972). In Bangladesh, Rashid (2015) finds that board independence can reduce agency costs (i.e., implying the board is a better monitor) but that this result varies with some characteristics of the firm such as size and director tenure. Other analyses have used board independence variables to control for the effects of firm size and industry, and the results are mixed (Naseem et al., 2017). In Pakistan, "after controlling for size of firm, board size and audit committee independence are positively linked with a firms' financial performance, whereas board independence and gender diversity are negatively associated with a firms' financial performance" (Naseem et al., 2017, p. 281). Thus, the conclusion points to the idea that board independence matters – but only under certain conditions.

2.4 Central Hypotheses

In addition to the main effects of the independent variables from the archival data, there are a number of interaction possibilities to consider. Board independence theory (Naseem et al., 2017; Zahra & Pearce, 1989) and theory on board size (Aggarwal, 2013) guide us to view two possible new variable interactions: firm size interacted with social capital and board independence interacted with social capital. That is, are more heavily networked directors (i.e., higher betweenness centrality and degree centrality) affected by the 1) the board size and 2) the level of board independence?

Breaking down director typology through this exploration of director networks, board independence and board size will give rise to different attention to monitoring where fewer penalties represents a type of risk management innovation through greater board capital depth (Hillman & Haynes,

2010). A firm's ability to self-regulate through the effectiveness of its board monitoring function is a testable hypothesis. To the extent higher industry embeddedness (IE) is indicative of a stronger monitoring function, I propose the following hypothesis.

Hypothesis 1*: As* industry embeddedness *increases, average regulatory penalties will decrease, ceteris paribus.*

Next, as we contemplate board independence and its interactive effect, some initial observations from the literature suggest independence promotes transparency and frank discussion. Here, I apply Naseem's (2017) finding that audit committee independence represents an important control on oversight. However, as I reviewed the dataset for this analysis, it appeared one hundred percent of audit committees in the 2019 S&P 500 sample were independently staffed by non-employees. So rather than rely on Naseem's finding that audit committee independence may be correlated with improved performance, I turn to Zahra and Pearce (1989) and the notion that board independence writ large can mitigate or offset risk. As such, I pose the following revised hypothesis.

Hypothesis 2*: As board independence increases, average regulatory penalties will decrease, ceteris paribus.*

As a function of risk management practices, board independence may be better understood than a subject like board interlocks where researchers have demonstrated that board interlocks promote information and process exchange (Connelly et al., 2011; Shipilov et al., 2010; Westphal et al., 2001). Directors who observe and imitate other boards' practices may be likely to accept them as normatively appropriate parts of the decision-making process (Westphal et al., 2001). Krause et al. (2019) assert the directors who are interlocked "act as conduits of information between organizations, reducing the uncertainty and increasing the cognitive legitimacy of new structures and practices, ultimately spreading these innovations across the interlock network like circuits conducting electricity" (p. 283). This research asserts that that board interlocks often result in mimetic behavior that has been deemed a sort of "coercive isomorphism." Coercive isomorphism refers to the organizational similarity that emerges when interlocked organizations exert reciprocal pressures on each other (DiMaggio & Powell, 1983).

Furthermore, using network analysis, Bilgili finds that a directors' centrality within an organization's board is an important predictor of interorganizational imitation and corporate strategic activity (2017). Thus, while there is a dearth of literature on to what extent networked board affect regulatory penalties, it stands to reason that interlocked boards may exhibit some of the same behaviors or attributes (Krause et al., 2019).

Applying coercive isomorphism to this article on regulatory penalties, imitation could influence how boards monitor from one organization to the next. By extension, this imitation could potentially affect regulatory penalties. That is, if a highly influential director (i.e., high betweenness centrality or high degree centrality) is interlocked with an organization that has received a high rate of average penalties, it seems reasonable to suggest the director may bring an attribute to the interlocked board that encourages, say, better monitoring.

The research here defines board interlocks through the use of social network data employing the twin metrics of "betweenness" and "degrees." While high betweenness centrality or high degree centrality values could potentially represent a reflection of the abstract social capital idea, I have inconclusive results about the precise meaning of these two variables relative to either coercive isomorphism or board capital.[31] However, in an exploratory vein, I test the relationship of these variables to the dependent variable. Hypotheses three and four can be stated as follows:

> ***Hypothesis 3***: *As betweenness centrality increases, average regulatory penalties will decrease, ceteris paribus.*
>
> ***Hypothesis 4***: *As degree centrality increases, average regulatory penalties will decrease, ceteris paribus.*

[31] Magistad, E. P. (2021). Social networks and corporate boards in the S&P 500: An alternative approach to measuring board capital. Working paper, section 3.2

While there is some research on how board interlocks give rise to coercive isomorphism (Krause et al., 2019), the latter two hypotheses are admittedly exploratory in nature, as there is limited research on social network features of boards and relationships to board governance and regulatory penalties.

2.5 Control Variable #1: Audit Committee Gender Diversity

As a board-sanctioned group, the audit committees represent a key monitoring oversight capability on behalf of the firm. Audit committees are charged with oversight of financial reporting, disclosure along with regulatory compliance and risk management activities (De Kluyver, 2013). There is also evidence to suggest women are believed to be capable of playing a better monitoring and advisory role in the board compared to men (Adams & Ferreira, 2004; Daily et al., 1999) as well as how the Cultural Theory of Risk Perception explains why that may be the case (Douglas & Wildavsky, 1983). Chen et al. (2016) assert that if "female directors are capable of being a better monitor and advisor as many people believe, we should observe favorable economic consequences as a result of increasing female board representation in addition to enhanced monitoring of financial reporting quality" (p. 600). To the extent we view females as better monitors, it seems reasonable to think gender diversity could affect regulatory or enforcement outcomes. For these reasons, Adams and Ferreira's (2009) and Reddy (2019) have reported female directors are more likely to be assigned to audit, nominating, and corporate governance committees.

Research suggests that gender-diverse boards allocate more effort and investment to monitoring. Considering the tenets of the Cultural Theory of Risk Perception (Douglas & Wildavsky, 1983), it is reasonable to posit that gender diversity acts as a control on management since a wider range of views from people who perceive risk differently increases the incentive to monitor the firm and its potential missteps. In conjunction with Kirsch's (2017) observation that gender diversity can positively affect ethical behavior, it stands to reason those regulatory violations will be lower as the result of 1) disproportionately higher female representation on the audit committee and 2) their attendant risk aversion and purported higher standards of ethical behavior.

2.6 Control Variable #2: Firm size

While prior corporate governance research has defined the relationship between corporate governance and firm performance (where performance measures vary widely), controlling for firm size dynamics takes place using different methods. Of note, the size features have varied whereby some research uses market capitalization as a variable (Gompers et al., 2003; Hillman & Haynes, 2010; Larcker et al., 2007), some relies on board size and the number of directors (Aggarwal, 2013; Ashbaugh-Skaife et al., 2006; Hillman & Haynes, 2010;) and some leverages the size of individual board committees and their effect on financial metrics (Larcker et al., 2007). Aggarwal (2013) summarizes the above findings and notes the size of the board is believed to have a significant impact on a firm's performance with a positive impact on measures like Return on Assets and Return on Equity.

In this article, I leverage board size (measured as the total number of directors) and expect it to have an impact on the dependent variable, regulatory penalties. Although much of the past body corporate governance research has focused on financial performance (ROE, ROA, etc.), the performance metrics have varied widely (Ueng, 2016). This paper will diverge from Hillman and Haynes's (2010) prior research in its choice of dependent variable. However, Hillman and Haynes's examination of corporate governance's impact on strategic change and variation (i.e., the difference in the 'fundamental pattern of present and planned resource deployments') employs one of the same constructs I quantify: namely board capital depth. The reasoning here is that companies who pay fewer penalties must have developed some sort of decision-making approach to managing risk complemented by director experience or knowledge. For this reason, I adopt the same board size metric used by Hillman and Haynes as a control variable for this project – total number of directors. In their findings, the relationship between board size and strategic variation was statistically significant and the estimate was slightly negative. Given Veltrop and Molleman's (2019) finding that board compositional factors affect the board's role in strategic decision making, we might expect that regulatory penalties are affected by these factors, as well. Applying a multiple regression model, I estimate that regulatory penalties are a function of a set of independent variables, as described in the equation below.

Average Penalties ($) per Month = $ß_0$
+ $ß_1$ Percent Female
+ $ß_2$ Percent of Females on Audit Committee
+ $ß_3$ Dummy (>30 Percent of Females on Board)
+ $ß_4$ Total Overall Directors
+ $ß_5$ Percent Independent Directors
+ $ß_6$ Historic Penalties (Average Penalties per Month: 2011-2015)
+ $ß_7$ Restrictions Index (High/Low)
+ $ß_8$ Average Tenure
+ $ß_9$ Average Director Age
+ $ß_{10}$ Firm betweenness Centrality
+ $ß_{11}$ Firm Degree Centrality
+ $ß_{12}$ Industry Embeddedness Average

Other controls[32]
+ $ß_{13\text{-}17}$ Industry
+ $ß_{18\text{-}20}$ Region
+ $ß_{21\text{-}28}$ Interaction Terms + e_i

3. Empirical Framework

3.1 Overview of Data

To test the hypotheses described above, I revisit the empirical framework and archival data from the 2019 Standard & Poor's 500 list of firms (including director data) and link it to the 2016-2020 enforcement actions as tabulated by the Violations Tracker (VT) penalties database where 500 observations from the S&P 500 (firms) are represented in the database. All firms in the dataset are large market capitalization firms, representing nine industries at the major classification Standard Industrial Classification (SIC) code level. The boards comprise 5,357 individual directors. Table 11 includes descriptive statistics for the variables used in the statistical analysis. Since director data for S&P 500 firms was extracted using Wharton Research Data Services (WRDS) ISS data to collect information at both the firm and director level across the S&P 500, research assistants or data coders were not employed;

[32] Reference categories were selected based on either the largest categories ("East" for Region and "Manufacturing" for Industry) or for continuous variables those that had values closest to the category mean ("financial offenses" for Percentage).

therefore, inter-rater reliability is not a factor in the analysis. WRDS and ISS is a subscription-based trusted source for historical governance and director data. Since each of the 500 firms from the index is represented in the dataset, a sampling strategy was not applied.

Dependent variable

Average regulatory penalties per firm are measured using the VT data among 2016-2020 federal or state enforcement actions. According to the site:

> The basic violation data was obtained from the websites of the federal agencies, the Justice Department and the state attorneys general. In some cases, the data for a particular agency could be downloaded all at once. In other cases, we had to "scrape" the information from website tables or extract the information from official press releases posted on those sites. In all cases we initially gathered data going back to the beginning of 2010, and in September 2017 we extended the coverage back to the beginning of 2000. Much of the data for that ten-year expansion came from online sources but for some agencies we needed to supplement that with Freedom of Information Act requests. The litigation data comes mainly from federal and state court dockets.[33]

In essence, the penalties data is derived from a sophisticated document scraping enterprise. I calculated the penalty per month as the sum of penalties for each firm over five years (numerator) then simply divided by the number of months (denominator) to derive an average monthly value. Conceptually, a firm with many small penalties has the potential to look similar to a firm with a few large penalties. The working research assumption is that a lower average penalty amount indirectly represents the extent to which a firm has the capacity to self-regulate and monitor the firm's activities (Short & Toffel, 2010).

Independent variables and interactions

The list of independent variables in this paper is expanded to include archival data variables as well as the network variables. As annotated above, the list of independent variables is primarily drawn

[33] Violation Tracker | User Guide (goodjobsfirst.org)

from WRDS and VT data of the S&P 500 firms as well as generated from calculated variables. In this regard, I include 1) Firm betweenness Centrality, 2) Firm Degrees Centrality, as well as 3) Firm Industry Embeddedness Average (along with interaction terms that also include these variables) as part of the model.

Table 10: Variable Descriptions (* indicates addition from Article 1)

Variable	Description	Source
Penalty per Month (DV)	The sum of penalties (2016-2020) divided by 60 months.	Good Jobs First Violation Tracker database
Percent Female	The number of females serving on the board divided by the total board size.	Wharton Research Data Services ISS Governance data
Percent Female Audit	The number of females serving on the audit committee divided by the total committee size.	Wharton Research Data Services ISS Governance data
Females exceed 30 percent?	Binary variable indicating whether the 'Percent Female' variable is equal or greater than .30.	Wharton Research Data Services ISS Governance data
Average Penalties per Month: 2011-2015	The sum of penalties (2011-2015) divided by 60 months.	Good Jobs First Violation Tracker database
Highly Regulated Industry (via Restrictions Index)	Derived from the RegData datasets[34] which capture the restrictiveness of an industry by counting words and phrases indicating a specific prohibited or required activity, called regulatory restrictions. Coded as follows: 1= highly regulated, 0 = not highly regulated.	RegData 2.2
Average Tenure (years)	The mean director tenure (years).	Wharton Research Data Services ISS Governance data
Average Director Age	The mean director age.	Wharton Research Data Services ISS Governance data
Total Overall Directors	The number of total directors serving on the board.	Wharton Research Data Services ISS Governance data
Firm betweenness Centrality*	The extent to which a given node (firm) is "in-between" or central other nodes.	Article 2 model output
Firm Degrees Centrality*	The connectedness of a given node (firm) to others; the number of edges or link to other nodes.	Article 2 model output
Industry Embeddedness Average*	Industry embeddedness is the percent of directors serving on a board in the same industry as their employer.	Calculated from Wharton Research Data Services ISS Governance data
Percent of Independent Directors*	The percentage of directors not employed by the target firm.	Calculated from Wharton Research Data Services ISS Governance data
Major Industry	Major classification level among the Standard Industrial Classifications; Industry divisions are dummy coded in the dataset and 'manufacturing' constitutes the largest set of observations and, therefore, the reference category.	Wharton Research Data Services ISS Governance data
Region	Census Bureau-designated region (South, Midwest, West, Northeast) plus U.S. firms that have incorporated off-shore. Regions are dummy coded in the dataset and Northeast is the largest set of observations and therefore, the reference category.	Wharton Research Data Services ISS Governance data

[34] McLaughlin, P. A., & Sherouse, O. (2019). RegData 2.2: A panel dataset on US federal regulations. *Public Choice*, *180*(1), 43-55.

3.2 Descriptive Statistics

Descriptive statistics are reported in Table 11. The histogram of the base and transformed dependent variable, a five-year average of penalties per month, are presented in Figures 19 and 20. There is data for all 500 firms with a notable exception. The share of females of the audit committee could only be derived for 471 of the 500 firms' directors. Also noteworthy is the relationship of current average penalties (2016-2020) to historical penalties (2011-2015). The historical values (which were used in the models) were higher during the earlier period, suggesting that political factors may influence these dollar values over time. Finally, some variables' lack of level uniqueness presented a problem for model stability. An absence of data cardinality can present problems for specific models and leads to insufficient data for the model output.[35] For example, the dummy variables that were used for the agriculture, construction and wholesale trade industries had so few positive values that they generated errors for Model 2 (described below). For this reason, these three dummy variables – as well as the off-shore variable for region - were omitted from the second count model that omitted observations with penalties that equaled zero. Board independence is generally high across all S&P 500 firms, but there are notable differences across the dataset where anywhere from two-thirds to one hundred percent of directors fall within this range of board independence.

[35] A phenomenon known as "indicator saturation" when there are more variables (K) than observations (N) or so many predictor variables with so few levels that it is unlikely the indicator will add much predictive power. For more, see: Santos, C., Hendry, D. F., & Johansen, S. (2008). Automatic selection of indicators in a fully saturated regression. *Computational Statistics, 23*(2), 317–335. https://doi.org/10.1007/s00180-007-0054-z

Figure 19: Histogram of average penalties per month for S&P 500 firms, 2016-2020 (excludes average monthly penalties > $500,000, 85 firms omitted)

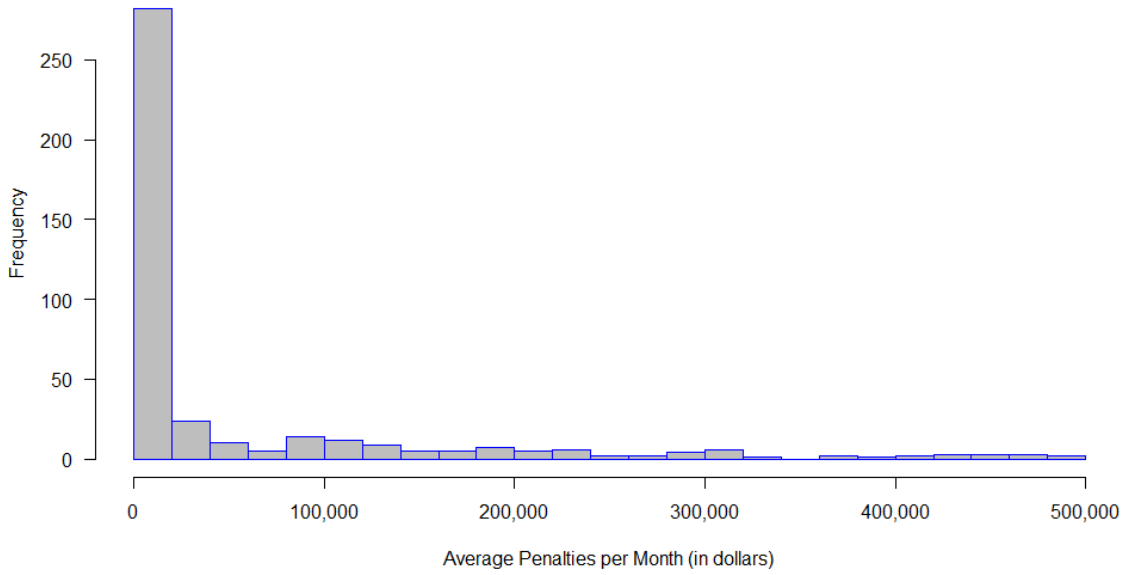


Figure 20: Histogram of logged average penalties per month for S&P 500 firms, 2016-2020 (excludes average monthly penalties > $500,000, 85 firms omitted)

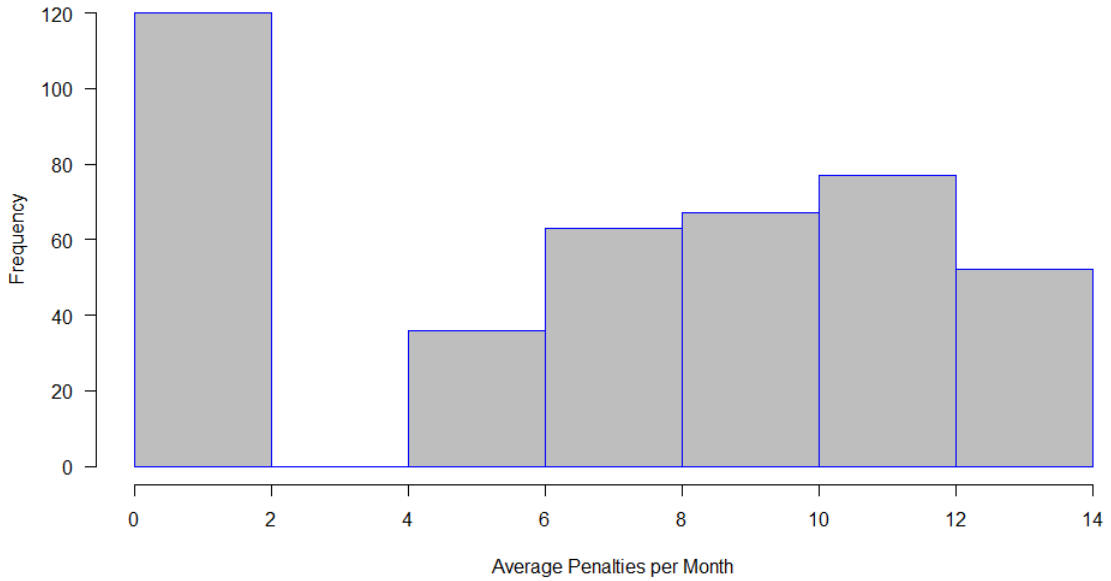


Table 11: Descriptive Statistics

Variable	n	min	max	mean	sd	median	skewness	kurtosis
Penalty per Month - 2016-2020 ($ 000)	500	0	150,176	1,673	9,824	7	10.60	131.28
Female Participation								
Percent Female	500	0.08	0.56	0.26	0.09	0.25	0.53	0.40
Percent of females - audit committee	471	0.00	1.00	0.30	0.19	0.25	0.34	-0.15
Female > 30 percent (binary)	500	0.00	1.00	0.35	0.48	0.00	0.63	-1.61
Historic Penalties								
Average Penalty per Month: 2011-2015 ($ 000)	500	0	1,044,216	5,534	54,446	12	15.94	280.11
Regulated Industry								
Highly Regulated (where value = 'yes')	500			0.49				
Director Characteristics								
Average Tenure	500	0.0	29.1	8.3	3.5	7.6	1.24	3.60
Average Director Age	500	51.3	76.9	62.6	3.3	62.7	-0.03	1.00
Total Overall Directors	500	5	27	10.7	2.1	11	1.14	7.50
Board Capital and Board Independence								
Betweenness	500	0	40,452.1	4,721.4	6,307.9	2,636.4	2.48	7.45
Degrees	500	0	15	3.8	2.4	3.0	1.12	1.86
Industry Embeddedness %	500	0	0.86	0.30	0.20	0.30	0.12	-0.80
Percent Independent (non-employee)	500	.67	1.00	0.88	.06	.90	-1.25	2.11
Major Industry								
Agriculture, Forestry & Fishing	500			0.00				
Construction	500			0.01				
Finance, Insurance & Real Estate	500			0.19				
Manufacturing	500			0.36				
Mining	500			0.04				
Retail Trade	500			0.07				
Services	500			0.16				
Transportation, Communications Electric, Gas & Sanitary service	500			0.14				
Wholesale Trade	500			0.03				
Region								
Northeast	500			0.27				
Off-Shore	500			0.05				
West	500			0.22				
Midwest	500			0.21				
South	500			0.25				

3.3 Empirical Strategy

As seen from the histograms, most companies do not incur high average regulatory penalties. In fact, during the 2016-2020 period covered by this paper, 120 of 500 firms incurred no penalty at all. This absence of penalties results in a dataset with an excess of zeros distributed across the dependent variable. In such instances where we have non-negative continuous outcomes that are skewed and contain excessive zero observations, standard statistical techniques like regression and GLM should be used with great caution. Another approach to deal with this issue is known as zero-inflated modeling (Boulton & Wilford, 2018). Given that caveat, in this paper I undertake both a traditional OLS regression coupled with a zero-inflated modified count technique known as the Hurdle model. My intent is to review the two modeling approaches to see if a similar story emerges between the two models and report the intersection of those results.

As with Article 1,[36] the same analytical tension between multicollinearity and theory exists. Lavery, et al. (2019) argues that when predictors are correlated, parsimony is a proper econometric goal for model implementation. In order to balance theory and practice, for this paper, a tradeoff takes place between parsimony and theory. Mitigating this tension, research suggests that when collinear variables are applied mainly as control variables, the model can proceed using the highly correlated predictors (Allison, 2012). Thus, during each model iteration in this paper – like Article 1 - I retain the full complement of predictor variables in order to see where theory is sustained by the addition of these predictors and where theory is potentially challenged.

Apart from ordinary least squares regression and a Hurdle model, other models and approaches were tested and considered. For example, significant outliers were identified so that the dataset could be potentially partitioned to assess the influence of outlier data.[37] Similarly, because the distribution of the dependent variable is such that 120 firms had penalty values equal to zero (i.e., firms that paid no penalty

[36] Magistad, E. P. (2021). Who pays the penalty? Board gender diversity and regulatory fines among the S&P 500. Working paper.
[37] Outliers were defined as exceeding +/- 3 standard deviations from the mean value.

over the past five years), the data distribution is right-skewed. As a violation of multiple regression, one technique to correct this skewness is through a variable transformation on one or both sides of the equation. For the OLS portion of this analysis, a log transformation of the dependent variable was the only transformation technique that was ultimately adopted.

4. Results and Findings

4.1 Results

Tables 3-6 presents four distinct models:

- Table 3: OLS Model = All core variables with logged DV (without any IV interactions).
- Table 4: OLS Model = All core variables with logged DV (with IV interactions).
- Table 5: Two-part Hurdle model = All core variables with logged DV (without any IV interactions).
- Table 6: Two-part Hurdle model = All core variables with logged DV (with IV interactions).

Hypothesis 1 tests whether board industry embeddedness matters to monitoring vis-à-vis lower average regulatory penalties. Similarly, Hypothesis 2 tests whether board independence drives average regulatory penalties lower. Hypotheses 3 and 4 test whether greater betweenness or degrees changes drives average regulatory penalties lower. As noted earlier, this is an exploratory hypothesis without literature support. However, the output may lead readers to draw tentative conclusions or inspire questions for additional research on the board capital subject.

Hypothesis 1 is supported in Table 15, alone. Hypothesis 2 is supported by the Hurdle regression in Table 14. Hypothesis 3 is mainly supported by Table 15 where betweenness centrality has a significant relationship ($p<0.001$) with lower average regulatory penalties. Conversely, degree centrality in Table 15, while statistically significant, shows a directionally different estimate than hypothesized. Thus, most hypotheses are supported to varying degrees, but the support for the exploratory hypotheses (number three) may represent the strongest evidence.

The common strands between the OLS and Hurdle regressions suggest that the control variables are important. Audit committee gender diversity is associated with lower average penalties in the OLS models (i.e., the data that includes a right-skewed dependent variable) in Table 12 and through interactions in Table 13, where audit committee gender diversity is associated with lower average regulatory penalties and board size is associated with higher average penalties. In the Hurdle models, audit committee gender diversity is associated with lower average regulatory penalties in an interaction with the broader board diversity threshold flag.[38] Board size does not seem to matter in the Hurdle models.

Furthermore, average industry embeddedness (IE) seems to matter only among firms that are accustomed to paying penalties (i.e., the Hurdle model) in minimizing the costs. Moreover, the same can be said of independent directors. Among firms accustomed to paying penalties, having a higher percentage of independent directors might minimize monetary enforcement actions or average penalties. Finally, reviewing Table 15, betweenness centrality (a measurement of director influence in a network) seems to have a statistically significant albeit modest impact on lowering average regulatory penalties.

There is limited evidence here that interactions play much of a role. In the OLS model (Table 13), there is a slight interaction between betweenness and the percent of independent directors with respect to lowering penalties. Figure 21 illustrates the relationship between betweenness centrality and regulatory penalties under high, medium and low board independence conditions. The visual results indicate that among medium board independence conditions, firms with high betweenness centrality experience lower average penalties. Therefore, among all firms with or without penalty data (Table 13), betweenness centrality (i.e., a measurement of director influence) tends to matter most among firms with a higher percentage of independent directors.

[38] See article #1: Magistad, Eric P., (2021). Who Pays the Penalty? Board Gender Diversity and Regulatory Fines among the S&P 500. Working paper.

Table 12: OLS Regression Model (with log transformed dependent variable) without interactions

		Estimate	Std. Error	t value	Pr(>|t|)	
	(Intercept)	0.93371249	6.03594489	0.155	0.87713	
1	Percent Female	-0.64509344	4.10056102	-0.157	0.87506	
2	Percent Female Audit	-2.74693068	1.19346186	-2.302	0.02178	**
3	Total Board: Females exceed 30 percent?	1.05078445	0.73499333	1.43	0.15347	
4	Total Overall Directors	0.31289867	0.11959141	2.616	0.00917	***
5	Percent Independent	-6.1339363	4.15425724	-1.477	0.14046	
6	Average Penalties per Month: 2011-2015	0.00890455	0.00405291	2.197	0.02849	**
7	Restrictions Index	0.03223021	0.4966426	0.065	0.94828	
8	Average Director Tenure	-0.17878589	0.079185	-2.258	0.02441	**
9	Average Director Age	0.15059273	0.08198061	1.837	0.06684	*
10	Firm Betweeness Centrality	0.00011088	0.00006328	1.752	0.08037	*
11	Firm Degree Centrality	0.07550289	0.17413586	0.434	0.66478	
12	Industry Embeddedness Average	-2.44998353	1.54653941	-1.584	0.11381	
13	Major Industry: finance / insurance / real estat	0.64827931	0.66407722	0.976	0.32945	
14	Major Industry: mining	0.06716607	1.16237175	0.058	0.95395	
15	Major Industry: retail	2.84810911	0.9270099	3.072	0.00224	***
16	Major Industry: services	0.05584778	0.67283085	0.083	0.93388	
17	Major Industry: transportation / communicatior	0.87061529	0.85272117	1.021	0.30778	
18	Census region: West	-0.17724779	0.61454321	-0.288	0.77315	
19	Census region: Midwest	2.01388873	0.62112434	3.242	0.00127	***
20	Census region: South	1.83189997	0.59978677	3.054	0.00238	***

Signif. codes: * p < 0.10; ** p < 0.05; *** p < 0.01

Residual standard error: 4.751 on 479 degrees of freedom
Multiple R-squared: 0.187, Adjusted R-squared: 0.1531
F-statistic: 5.509 on 20 and 479 DF, p-value: 0.0000000000008361

Table 13: OLS Regression Model (with log transformed dependent variable and interactions)

		Estimate	Std. Error	t value	Pr(>|t|)	
	(Intercept)	2.340731	8.383208	0.279	0.7802	
1	Percent Female	-1.45956	4.136926	-0.353	0.72439	
2	Percent Female Audit	-0.8004	2.713423	-0.295	0.76814	
3	Total Board: Females exceed 30 percent?	2.577826	1.039493	2.48	0.01349	**
4	Total Overall Directors	0.582643	0.251928	2.313	0.02117	**
5	Percent_Independent	-10.8503	7.842017	-1.384	0.16713	
6	Average Penalties per Month: 2011-2015	0.008775	0.004138	2.12	0.0345	**
7	Restrictions Index	-0.36895	0.54768	-0.674	0.50085	
8	Average Director Tenure	-0.15342	0.079721	-1.925	0.05489	*
9	Average Director Age	0.144563	0.0823	1.757	0.07965	*
10	Firm Betweeness Centrality	0.001505	0.001006	1.495	0.13547	
11	Firm Degree Centrality	-2.02523	2.475487	-0.818	0.41371	
12	Industry Embeddedness Average	-2.33537	1.546388	-1.51	0.13166	
13	Major Industry: finance / insurance / real estate	0.511478	0.667752	0.766	0.44408	
14	Major Industry: mining	-0.21231	1.174902	-0.181	0.85668	
15	Major Industry: retail	2.991718	0.937811	3.19	0.00152	***
16	Major Industry: services	0.015259	0.673155	0.023	0.98193	
17	Major Industry: transportation / communications / utilities	0.445216	0.868882	0.512	0.60861	
18	Census region: West	-0.18878	0.613136	-0.308	0.7583	
19	Census region: Midwest	1.794819	0.626284	2.866	0.00435	***
20	Census region: South	1.66509	0.60185	2.767	0.00589	***
21	Interaction 1: Percent Female Audit * Females exceed 30 percent?	-4.84037	2.371097	-2.041	0.04177	**
22	Interaction 2: Percent Female Audit * Restrictions Index	0.000239	0.000128	1.877	0.06108	*
23	Interaction 4: Independence * Betweeness	-2.17659	1.195824	-1.82	0.06937	*
24	Interaction 3: Independence * Degrees	3.90307	2.758779	1.415	0.15779	
25	Interaction 5: Total Directors * Betweeness	0.039469	0.036715	1.075	0.28293	
26	Interaction 6: Total Directors * Degrees	-0.11377	0.087981	-1.293	0.19659	
27	Interaction 7: Percent Female Audit * Betweeness	0.409694	0.322061	1.272	0.20397	
28	Interaction 8: Percent Female Audit * Degree	-0.56952	0.870329	-0.654	0.51319	

Signif. codes: 0 '*****' 0.001 '****' 0.01 '***' 0.05 '**' 0.1 '*'

Residual standard error: 4.728 on 471 degrees of freedom
Multiple R-squared: 0.2083, Adjusted R-squared: 0.1612
F-statistic: 4.425 on 28 and 471 DF, p-value: 0.000000000003666

Table 14: Two Part Hurdle Model (penalties > 0, $ 000,000) without interactions

		Estimate	Std. Error	z value	Pr(>|z|)	
	(Intercept)	20.0153541	4.74846561	4.215	0.000025	***
1	Percent Female	-0.5809564	3.61326796	-0.161	0.87226	
2	Percent Female Audit	-1.1002273	0.98920231	-1.112	0.26604	
3	Total Board: Females exceed 30 percent?	1.25929119	0.63935657	1.97	0.04888	**
4	Total Overall Directors	-0.0576311	0.11753656	-0.49	0.6239	
5	Percent Independent -	-14.274491	4.36854779	-3.268	0.00108	***
6	Average Penalties per Month: 2011-2015	0.00151729	0.00118382	1.282	0.19995	
7	Restrictions Index	-0.6253221	0.50965405	-1.227	0.21984	
8	Average Director Tenure	-0.2303272	0.09071876	-2.539	0.01112	**
9	Average Director Age	-0.037947	0.06503675	-0.583	0.55958	
10	Firm Betweeness Centrality	0.00003121	insufficient data			
11	Firm Degree Centrality	-0.0589202	0.03942198	-1.495	0.13502	
12	Industry Embeddedness Average	-1.1686296	1.49032502	-0.784	0.43296	
13	Major Industry: finance / insurance / real estate	1.17902491	0.54012354	2.183	0.02904	**
14	Major Industry: mining	0.00420665	1.07808796	0.004	0.99689	
15	Major Industry: retail	1.5400123	0.84810383	1.816	0.0694	*
16	Major Industry: services	-0.3000046	0.63180095	-0.475	0.6349	
17	Major Industry: transportation / communications / utilities	-1.0612142	0.78267812	-1.356	0.17514	
18	Census region: West	-0.7577356	0.50666578	-1.496	0.13478	
19	Census region: Midwest	-1.1146205	0.47558731	-2.344	0.01909	**
20	Census region: South	-1.1512506	0.50005367	-2.302	0.02132	**

Signif. codes: * p < 0.10; ** p < 0.05; *** p < 0.01

Theta: count = 1.0314
Number of iterations in BFGS optimization: 42

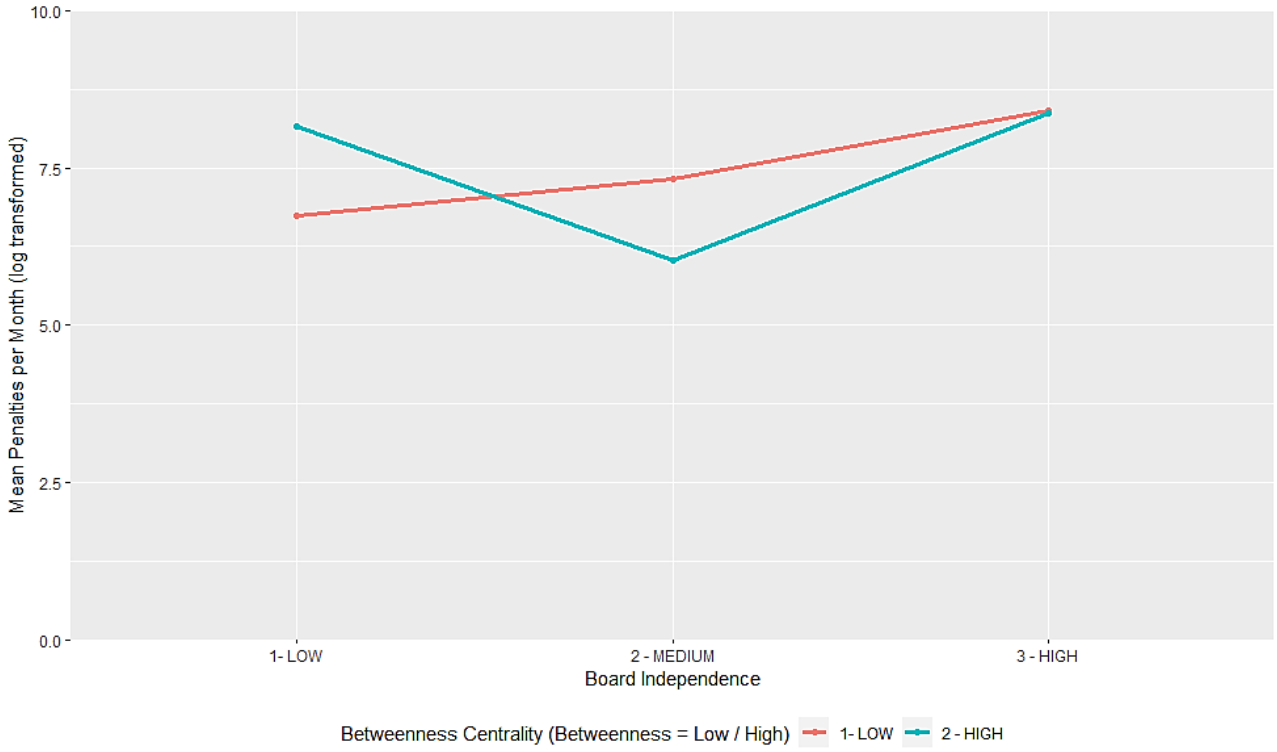
Table 15: Two Part Hurdle Model (penalties > 0, $ 000,000) with interactions

		Estimate	Std. Error	z value	Pr(>|z|)	
	(Intercept)	17.11247862	6.58894701	2.597	0.0094	***
1	Percent Female	0.51500304	7.49744984	0.069	0.945236	
2	Percent Female Audit	6.91120607	4.39486878	1.573	0.11582	
3	Total Board: Females exceed 30 percent?	3.10692613	2.1880766	1.42	0.155627	
4	Total Overall Directors	0.33826738	0.40427457	0.837	0.402746	
5	Percent Independent -	10.30438905	6.49936937	-1.585	0.112865	
6	Average Penalties per Month: 2011-2015	0.00345292	0.00129696	2.662	0.007761	***
7	Restrictions Index	-0.86135862	1.09623298	-0.786	0.432017	
8	Average Director Tenure	-0.16693531	0.10337506	-1.615	0.106343	
9	Average Director Age	-0.11370208	0.06710832	-1.694	0.090207	*
10	Firm Betweeness Centrality	-0.00162281	0.00007926	-20.475	0.0000002	***
11	Firm Degree Centrality	4.09198715	0.6744937	6.067	0.00000131	***
12	Industry Embeddedness Average	-3.48623138	1.72664736	-2.019	0.043479	**
13	Major Industry: finance / insurance / real estate	0.34319681	0.55425242	0.619	0.53578	
14	Major Industry: mining	-2.25262451	1.14762674	-1.963	0.049663	**
15	Major Industry: retail	0.07117783	1.79349117	0.04	0.968343	
16	Major Industry: services	-0.96287483	0.75584648	-1.274	0.202698	
17	Major Industry: transportation / communications / utilities	-2.06501024	0.78861137	-2.619	0.008831	***
18	Census region: West	-1.48624518	0.67035204	-2.217	0.026615	**
19	Census region: Midwest	-3.05105216	0.80981542	-3.768	0.000165	***
20	Census region: South	-1.8030737	0.74147557	-2.432	0.015027	**
21	Interaction 1: Percent Female Audit * Females exceed 30 percent?	-9.76682611	5.2402679	-1.864	0.062349	*
22	Interaction 2: Percent Female Audit * Restrictions Index	0.00017521	0.00060714	0.289	0.772905	
23	Interaction 3: Independence * Betweeness	0.79502356	0.57713863	1.378	0.16835	
24	Interaction 4: Independence * Degrees	-2.31783939	1.39712153	-1.659	0.097114	*
25	Interaction 5: Total Directors * Betweeness	0.06704932	0.0422942	1.585	0.112896	
26	Interaction 6: Total Directors * Degrees	-0.17393112	0.11730926	-1.483	0.138162	
27	Interaction 7: Percent Female Audit * Betweeness	0.68418815	0.55863625	1.225	0.220671	
28	Interaction 8: Percent Female Audit * Degree	-1.36972572	1.39200042	-0.984	0.325116	

Signif. codes: * p < 0.10; ** p < 0.05; *** p < 0.01

Theta: count = 1.609
Number of iterations in BFGS optimization: 58
Log-likelihood: -300.5 on 59 DF

Figure 21: Visual Rendering of Interaction (Percent Board Independence * betweenness Centrality Segment)[39]



[39] Low: <= 80 percent independent
Medium: > 80 percent but <= 90 percent independent
High: > 90 percent independent

4.2 Findings

The results raise questions and pose answers relative to the application of social network data. While I am not in a position to assert what facet of social capital or definitive influence that betweenness centrality or degree centrality represents, the results do tell us something about the relationship of these data to average regulatory penalties. Moreover, based on Hillman and Haynes's (2010) results where the authors find board capital depth (i.e., industry embeddedness) to be negatively correlated against their board capital breadth construct (i.e., occupational heterogeneity), these results suggest a similar pattern (see correlation matrix, Figure 22). Among all firms (Table 13), I find where firm betweenness centrality is high (i.e., greater influential director nodes), penalties are likely to be modestly lower when coupled with a higher percentage of independent directors. Among firms that have a recent history of penalties, a higher industry embeddedness average (what Hillman and Haynes, 2010, call board capital depth) seems to be associated with lower average regulatory penalties (Table 15).

Reviewing the four models, some patterns are also consistent among the control variables: female representation on the audit committee seems to matter to average penalties when the larger board is made up of at least thirty percent females (i.e., when share of females reaches critical mass). This analysis upholds the earlier finding that total board gender diversity is only beneficial from a regulatory perspective once females directors are employed on key committees, particularly among boards that already have a significant share of females.[40]

Following Hillman and Haynes's (2010) focus on the role of board capital as a predictive construct, I use social network data to approximate some – albeit undefined – dimension of social capital. Essentially, I am interested in whether social network models can substitute (or how they might substitute) for labor-intensive coding schemes based on director industry or occupation categories. By offering an alternative approach, I respond to calls in the strategic management literature (as Hillman and

[40] See Article 1: Magistad, Eric P., (2021). Who Pays the Penalty? Board Gender Diversity and Regulatory Fines among the S&P 500. Working paper, section 4.1.

Haynes suggest) urging researchers to operationalize board capital variables appropriately (Harrison & Klein, 2007). Specific to the board capital topic, a future research goal should be to ensure these social capital measures are logically designed.

5. Conclusion

At this point, we should contemplate whether these results change over time. The regulatory penalty data in this analysis used time-series data (the dependent variable is calculated as an average across five years) that was converted to cross-sectional data, whereas the director data was a snapshot of a single year (2019). There is likely great value to studying these questions using a method that accounts for director demographic temporal changes. Moreover, to the extent we are interested in board capital as a strategic management topic and its impact on performance, there is likely great value in evaluating the social network data shifts year-over-year, as well.

Precision and accuracy are of paramount concern. Future research can help establish the reliability of these results; do other analysts find complementary results using similar data and methods? betweenness centrality or degree centrality may or may not represent some dimension of board social capital and director influence. Can these metrics be re-created with some amount of reliability? And where validity is concerned, a measurement cannot be valid unless it is first proven to be reliable. Despite these concerns, even if social network data does not truly reflect board social capital in some direct or indirect way, understanding the relationship of these data to regulatory enforcement actions still seems like a model worth developing.

Initially, it seems that many things influence average regulatory penalties: average industry embeddedness, share of females on an audit committee, the gender diversity of the broader board (and establishing the right balance of male to female directors) along with how boards provide influential members. For now, it seems the largest S&P 500 companies are the most central and have the most links to other nodes (firms) in the network. Where these firms pay penalties at all (>$0 average), their director linkages to other firms seems to predict higher penalty averages, although the higher director betweenness

of a board seems to drive penalties modestly lower. When we separate the firms with excess zeros (penalties) from the non-zero firms, the social capital constructs in this paper tend to predict higher or lower penalties based upon interactions and whether we are using betweenness or degrees. In fact, both these metrics are positively correlated (Figure 22), and future research could likely be well-served by developing a composite board capital measurement using social network data. Future research should also endeavor to capture multiple facets of board capital including directors' occupational background and compare this occupational heterogeneity against social network data. Doing so will contribute to both model robustness and help reviewers understand what we actually have in our hands using social network data.

6. Appendix

A correlation matrix for variables in this analysis is included below. The Pearson correlation coefficient measures the strength of the linear association between two quantitative variables before controlling for the influence of other variables.

Figure 22: Correlation Matrix

		Average Penalties per Month (2016-2020)	*Percent Female*	*Percent Female - Audit Committee*	*Percent Female >30% Percent?*	*Total Overall Directors*	*Percent Independent Directors*	*Restrictions Index*	*Average Director Tenure*	*Average Director Age*	*Firm Betweeness Centrality*	*Firm Degrees Centrality*	*Industry Embeded-ness Average*	*Average Penalties per Month (2011-2015)*
1	Average Penalties per Month (2016-2020)	1.00	0.10 **	-0.07	0.16 ***	0.04	0.00	0.08 *	-0.11 **	-0.06	0.07	0.06	0.00	0.22 ***
2	Percent Female	0.10 **	1.00	0.38 ***	0.79 ***	0.03	0.18 ***	0.02	-0.18 ***	-0.15 ***	0.15 ***	0.13 ***	0.02	0.03
3	Percent Female - Audit Committee	-0.07	0.38 ***	1.00	0.29 ***	0.06	0.04	0.02	-0.04	-0.04	0.03	0.06	0.05	-0.03
4	Percent Female >30 Percent?	0.16 ***	0.79 ***	0.29 ***	1.00	0.03	0.13 ***	0.03	-0.13 ***	-0.12 ***	0.13 ***	0.10 **	0.01	0.08 *
5	Total Overall Directors	0.04	0.03	0.06	0.03	1.00	0.21 ***	0.14 ***	-0.06	0.05	0.29 ***	0.37 ***	-0.19 ***	0.14 ***
6	Percent Independent Directors	0.00	0.18 ***	0.04	0.13 ***	0.21 ***	1.00	0.14 ***	-0.36 ***	-0.09 *	0.07	0.10 **	-0.24 ***	0.06
7	Restrictions Index	0.08 *	0.02	0.02	0.03	0.14 ***	0.14 ***	1.00	-0.11 **	0.15 ***	-0.07	-0.03	-0.25 ***	0.16 ***
8	Average Director Tenure	-0.11 **	-0.18 ***	-0.04	-0.13 ***	-0.06	-0.36 ***	-0.11 **	1.00	0.52 ***	-0.08 *	-0.07	0.10 **	-0.04
9	Average Director Age	-0.06	-0.15 ***	-0.04	-0.12 ***	0.05	-0.09 *	0.15 ***	0.52 ***	1.00	-0.13 ***	-0.11 **	0.01	0.06
10	Firm Betweeness Centrality	0.07	0.15 ***	0.03	0.13 ***	0.29 ***	0.07	-0.07	-0.08 *	-0.13 ***	1.00	0.84 ***	-0.07	0.08 *
11	Firm Degrees Centrality	0.06	0.13 ***	0.06	0.10 **	0.37 ***	0.10 **	-0.03	-0.07	-0.11 **	0.84 ***	1.00	-0.08 *	0.14 ***
12	Industry Embededness Average	0.00	0.02	0.05	0.01	-0.19 ***	-0.24 ***	-0.25 ***	0.10 **	0.01	-0.07	-0.08 *	1.00	-0.02
12	Average Penalties per Month (2011-2015)	0.22 ***	0.03	-0.03	0.08 *	0.14 ***	0.06	0.16 ***	-0.04	0.06	0.08 *	0.14 ***	-0.02	1.00

Signif codes: * p<.10; ** p<.05; *** p<.01

Conclusion and Recommendations

Interlocking Directorates among the S&P 500:

Social Networks, Gender Diversity, and Corporate Governance:

Conclusion

The research contained by this three-article series points to a number of conclusions that relate to board composition goals. In Article 1, I analyzed firm-level data in order to understand the impact board composition has upon regulatory compliance. The results indicate there may be concrete steps firms can take to ensure regulatory compliance by adjusting board membership and committee assignments. As such, if we entrust firms to this sort of self-regulation, it is increasingly necessary to understand the impact board gender diversity has upon regulatory penalties.

Using data from all 500 firms in the S&P index, I formulated hypotheses about the relationships between regulatory penalties and board composition data based on theory and past research. Subsequently, I tested those hypotheses using the S&P firm-level data. In summary, the findings indicate there seems to be a linkage between gender diversity and risk perception which supports the "white male effect" discussed in prior research that shows men are more likely to hold individualistic attitudes and risk skepticism in greater proportions compared to the general population (Finucane et al., 2000; Palmer, 2003). Alternatively, another view holds a variance in risk perceptions across discrete segments that reflects status competition among groups who subscribe to opposing cultural worldviews rather than an inherent gender-determined bias (Douglas & Wildavsky, 1983). Using either explanation, the research presented in Article 1 shows average penalties are fewer and less expensive among firms with a greater commitment to add gender diversity to both their board and their audit committee. Second, if gender diversity is influential to the degree this current and prior research suggests, we need to fully understand how diversity matters to regulatory enforcement. As such, board and audit committee diversification may represent a best practice to instituting an effective self-regulatory regime.

In addition to the share of females on an audit committee along with the gender diversity of the broader board, social capital and board interlock variables seem to influence regulatory penalties. Among the subset of firms that have experienced penalties over a five-year period, firms that have greater director linkages to other firms (degree centrality) have higher penalty averages although higher levels of director betweenness centrality seems to drive penalties modestly lower. Conversely, director degree centrality

combined with the percentage of independent directors seems to drive penalties lower, where the interaction between these two variables yields a lower penalty average. In other words, director degree linkages can be negative resulting in higher penalties unless those linkages are among firms with a higher rate of independent directors which consequently yields lower penalties. Additionally, industry experience seems to matter as well. Among this same subset of firms that experienced some penalties over a five-year period, industry embeddedness average (i.e., the amount of director industry experience shared between the employer firm and director firm) seems to predict lower average penalties.

Conversely, among the base of all 500 firms (i.e., those with or without penalties history), firms with a higher betweenness centrality and a higher percentage of independent directors also seem to be associated with lower average penalties. This suggests that boards that comprise highly influential and independent directors may incur lower average penalties.

In summary, under specific conditions, both audit committee diversity and board interlocks seem to predict lower average regulatory penalties, with some caveats. These caveats should guide future researchers to monitor the trend in both board diversity and regulatory affairs to understand how to identify the optimal "risk perceivers" (beyond simple gender delineation) in order to foster an effective self-regulatory regime. Future research should also endeavor to capture multiple facets of board capital including directors' occupational background and compare this occupational heterogeneity against social network data. Making these sorts of comparisons will help future researchers and their corporate audiences understand the dynamics behind social network data and the more traditional data to which they may correspond.

Additionally, future research should identify whether these results change over time. The regulatory penalty data in this analysis used time-series data – the dependent variable is calculated as an average across five years – that was converted to cross-sectional data. However, the director data was a snapshot of a single year (2019). Thus, there is likely great value to studying these questions using a panel method that accounts for both board demographic and temporal changes. To the extent we are interested

in board capital as a strategic management topic and its impact on risk and performance, there is also potential value in evaluating the social network data shifts year-over-year.

Future research can also help establish the reliability of these results; do other analysts find complementary outcomes using similar data and methods? Betweenness centrality or degree centrality may reflect some aspect of board social capital, but comparing these data to other traditional measures (e.g., occupational heterogeneity of board members) will enable greater variable precision and improve modeling efforts that endeavor to predict regulatory penalties based upon board composition and attributes.

Where the main contribution of Article 1 was to consider gender diversity as an independent variable and to introduce a novel outcome variable (regulatory penalties), the contribution of Article 2 and Article 3 integrated gender diversity with board interlock data. For readers with a vested interest in the regulatory penalty topic (and how to predict or avoid them), there are several practical observations listed throughout this report. Even so, corporate governance strategies designed to mitigate regulatory risk would be wise to interrogate the generalizations listed in this report. However, it could also prove beneficial for firms to explore how their key board committees are structured and how they weigh director influence relative to director risk perception biases. Finally, future research could regularly incorporate regulatory penalties as a target risk variable to investigate corporate governance and gain a broader appreciation for board effectiveness.

References

Åberg, C. (2019). Service tasks of board of directors: A literature review and research agenda in an era of new governance practices. *European Management Journal, 37*(5), 648–663.

Adams, R. B., & Ferreira, D. (2009). Women in the boardroom and their impact on governance and performance. *Journal of Financial Economics, 94*(2), 291–309.

Adrison, V. (2008). *Estimating the effect of penalties on regulatory compliance* [Doctoral dissertation, Georgia State University]. ProQuest Dissertations Publishing.

Aggarwal, P. (2013). Impact of sustainability performance of company on its financial performance: A study of listed Indian companies. *Journal of Business and Management, 13*(3).

Aldrich, H. E., & Zimmer, C. (1986). Entrepreneurship through social networks. In D. L. Sexton & R. W. Smilor (Eds.), *The art and science of entrepreneurship* (pp. 3-23). Ballinger.

Alexander, C. R. (1999). On the nature of the reputational penalty for corporate crime: Evidence. *Journal of Law and Economics, 42*(S1), 489–526.

Allison, P.: When can you safely ignore multicollinearity? Statistical Horizons Blog, 10 September. http://statisticalhorizons.com/multicollinearity (2012). Accessed 13 February 2022.

Almazan, A., & Suarez, J. (2003). Entrenchment and severance pay in optimal governance structures. *Journal of Finance, 58*, 519-547.

Amason, A. C. (1996). Distinguishing the effects of functional and dysfunctional conflict on strategic decision making. *Academy of Management Journal, 39*, 123–148.

Anderson, M., & Fienberg, S. (1999). *Who counts? The politics of census-taking in contemporary America*. Russell Sage.

Aoki, K., & Coiffi, J. W. (2000). Poles apart: Industrial waste management regulation and enforcement in the United States and Japan. In R. A. Kagan & L. Axelrod (Eds.), *Regulatory encounters* (pp. 213–245). University of California Press.

Ashbaugh-Skaife, H., Collins, D. W., & LaFond, R. (2006). The effects of corporate governance on firms' credit ratings. *Journal of Accounting and Economics, 42*, 203–243.

Athmen, B., & Samia, B. (2017). The importance of human resources in corporate governance. *Mediterranean Journal of Social Sciences, 8*(4–1), 161–164. https://doi.org/10.2478/mjss-2018-0086

Barclift, Z. J. (2011). Governance in the public corporation of the future: The battle for control of corporate governance. *Chapman Law Review, 15*(1), 1-22. https://open.mitchellhamline.edu/facsch/410/

Baysinger, B., & Butler, H. (1985). Corporate governance and the board of directors: Performance effects of changes in board composition. *Journal of Law, Economics, and Organization, 1*(1), 101-124.

Becker, G. S. (1968). Crime and punishment: An economic approach. *The Journal of Political Economy, 76*(2), 169-217.

Beckman, C. M., & Haunschild, P. R. (2002). Network learning: The effects of partners' heterogeneity of experience on corporate acquisitions. *Administrative Science Quarterly, 47,* 92-124.

Belliveau, Maura, O'Reilly, C. A., & Wade, J. B. (1996). Social Capital at the Top: Effects of Social Similarity and Status on CEO Compensation. *Academy of Management Journal*, 39(6), 1568–1593.

Belsley, David A.; Kuh, Edwin; Welsch, Roy E. (1980). *Regression Diagnostics: Identifying Influential Data and Sources of Collinearity*. New York: Wiley.

Bernile, G., Bhagwat, V., & Yonker, S. E. (2017). Board diversity, firm risk, and corporate policies. *SSRN*, 1-97. https://dx.doi.org/10.2139/ssrn.2733394

Bhagat, S., & Black, B. (2002). The non-correlation between board independence and long-term firm performance. *Journal of Corporation Law, 27*(2), 231-274.

Blau, P. M. (1977). *Inequality and heterogeneity: A primitive theory of social structure*. Free Press.

Boulton A. J., & Williford, A. (2018). Analyzing skewed continuous outcomes with many zeros: A tutorial for social work and youth prevention science researchers. *Journal of the Society for Social Work and Research, 9*, 721–740. https://dx.doi.org/10.1086/701235

Boyd, B. (1990). Corporate linkages and organizational environment: A test of the resource dependence model. *Strategic Management Journal, 11*, 419-430.

Boyd, B. (1995). CEO duality and firm performance: A contingency model. *Strategic Management Journal, 16*, 301-312.

Boylan, R. T., & Long, C. X. (2003). Measuring public corruption in the American States: A survey of State House reporters. *State Politics and Policy Quarterly 3*(4), 420-438.

Brammer, S., Millington, A., & Pavelin, S. (2007). Gender and ethnic diversity among UK corporate boards. *Corporate Governance: An International Review, 15*(2), 393–403.

Burke, J. J., Hoitash, R., & Hoitash, U. (2019). The heterogeneity of board-level sustainability committees and corporate social performance. *Journal of Business Ethics, 154*(4), 1161–1186.

Burrell, G., & Morgan, G. (1979). *Sociological paradigms and organizational analysis*. Heinemann.

Büthe, M. (2011). *The new global rulers: The privatization of regulation in the world economy*. Princeton University Press.

Byrd, D. T., & Mizruchi, M. S. (2005). Bankers on the board and the debt ratio of firms. *Journal of Corporate Finance, 11*, 129–173.

Carpenter, M. A., Geletkanycz, M. A., & Sanders, W. G. (2016). Upper echelons research revisited: Antecedents, elements, and consequences of top management team composition. *Journal of Management, 30*(6), 749–778. https://doi.org/10.1016/j.jm.2004.06.001

Chen, N., Ni, X., & Tong, J. Y. (2015). Gender diversity in the boardroom and risk management: A case of R&D investment. *Journal of Business Ethics, 136*(3), 599–621. https://doi.org/10.1007/s10551-014-2528-6

Connelly, B. L., Johnson, J. L., Tihanyi, L., & Ellstrand, A. E. (2011). More than adopters: Competing influences in the interlocking directorate. *Organization Science, 22*, 688–703.

Conyon, M., & Peck, S. (1998). Board control, remuneration committees, and top management compensation. *Academy of Management Journal, 41*, 146-157.

Core, J. E., Holthausen, R. W., & Larcker, D. F. (1999). Corporate governance, chief executive officer compensation, and firm performance. *Journal of Financial Economics*, 51(3), 371-406.

Creary, S. J., McDonnell, M.-H., Ghai, S., & Scruggs, J. (2019, March 27). When and why diversity improves your board's performance. *Harvard Business Review*. https://hbr.org/2019/03/when-and-why-diversity-improves-your-boards-performance

Daily, C. (1996). Governance patterns in bankruptcy reorganizations. *Strategic Management Journal, 17*, 355-375.

Daily, C. M., & Dalton, D. R. (1993). Board of directors' leadership and structure: Control and performance implications. *Entrepreneurship: Theory and Practice, 17*, 65-81.

Dalton, Daily, C. M., Johnson, J. L., & Ellstrand, A. E. (1999). Number of Directors and Financial Performance: A Meta-Analysis. *Academy of Management Journal*, 42(6), 674–686.

Davis, G. F. (1991). Agents without principles? The spread of the poison pill through the intercorporate network. *Administrative Science Quarterly, 36*, 583-613.

De Kluyver, C. (2013). *A primer on corporate governance* (2nd ed.). Business Expert Press.

del Carmen Triana, M., Miller T. L., & Trzebiatowski, T. M. (2014). The double-edged nature of board gender diversity: Diversity, firm performance, and the power of women directors as predictors of strategic change. *Organization Science, 25*(2), 609–632. https://doi.org/10.1287/orsc.2013.0842

DiMaggio, P. J., & Powell, W. W. (1983). The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields. *American Sociological Review, 48*, 147–160.

DiMaggio, Paul J. and Powell, Walter W. (1991). 'Introduction'. In P. J. DiMaggio and W. Powell (Eds.). *The New Institutionalism and Organizational Analysis*, pp. 1–38. Chicago: University of Chicago Press.

Distelhorst, G., Stroehle, J., & Yang, Duanyi (2020). Certifiably responsible? Self-regulation and market response in China. *SSRN*. http://dx.doi.org/10.2139/ssrn.3593837

Douglas, M., & Wildavsky, A. B. (1983). *Risk and culture: An essay on the selection of technical and environmental dangers*. University of California Press.

Dutton, J. E., & Duncan, R. B. (1987). The creation of momentum for change through the process of strategic issue diagnosis. *Strategic Management Journal, 8*, 279-295.

Eisenhardt, K. M. (1989). Agency theory: An assessment and review. *The Academy of Management Review, 14*, 57–74.

Emery, L., & Faccio, M. (2020). Exposing the revolving door in executive branch agencies. *SSRN*. http://dx.doi.org/10.2139/ssrn.3732484

Feinstein, J. (1989). The safety regulation of U.S. nuclear power plants: Violations, inspections, and abnormal occurrences. *The Journal of Political Economy, 97*(1), 115–154. https://doi.org/10.1086/261595

Finucane, M. L., Slovic, P., Mertz, C. K., Flynn, J., & Satterfield, T. A. (2000). Gender, race, and perceived risk: The "white male" effect. *Health, Risk and Society, 2*(2), 159–172.

Flynn, J., Slovic, P., & Mertz, C. K. (1994) Gender, race, and perception of environmental health risks. *Risk Analysis, 14*, 1101-1108.

Francoeur, C., Labelle, R., & Sinclair-Desgagné, B. (2008). Gender diversity in corporate governance and top management. *Journal of Business Ethics, 81*(1), 83–95.

Frooman, J. (1997). Socially irresponsible and illegal behavior and shareholder wealth: A meta-analysis of event studies. *Business and Society, 36*(3), 221–249.

Funk, W., & Seamon, R. (2009). *Examples and explanations: Administrative law* (4th ed.). Aspen Publishers.

Golbeck. (2015). Introduction to Social Media Investigations: A Hands-On Approach. Elsevier Science & Technology Books.

Gompers, P., Ishii, J., & Metrick, A. (2003). Corporate governance and equity prices. *The Quarterly Journal of Economics, 118*(1), 107-155.

Good Jobs First (n.d.). Violation tracker. https://www.goodjobsfirst.org/violation-tracker

Graham, J., Li, S., & Qiu, J. (2007). *Corporate misreporting and bank loan contracting*. National Bureau of Economic Research. http://www.nber.org/papers/w13708.pdf.

Gray, W., & Scholz, J. T. (1991). Analyzing the equity and efficiency of OSHA enforcement. *Law and Policy, 13*, 185-214.

Gray, W., & Shadbegian, R. (2005). When and why do plants comply? Paper mills in the 1980s. *Law and Policy*, 27, 238-261.

Gu, X. L., Xin Y., & Teng, F. (2016). Does [sic] external enforcement actions have governance effect? Discussion on the duality of stock price synchronicity indicators. *Nankai Business Review, 19*(5), 41-54.

Hallock, K. F. (1999). Dual agency: Corporate boards with reciprocally interlocking relationships. In J. Carpenter & D. Yermack, (Eds.), *Executive compensation and shareholder value: Theory and evidence* (pp. 55-75). Kluwer Academic Publishers.

Hambrick, D. C, Finkelstein, S., Cho, T. S., & Jackson, E. M. (2005). Isomorphism in reverse: Institutional theory as an explanation for recent increases in intraindustry heterogeneity and managerial discretion. *Research in Organizational Behavior, 26*, 307-350. https://doi.org/10.1016/S0191-3085(04)26008-7

Hambrick, D. C. (2007). Upper echelons theory: An update. *The Academy of Management Review, 32*(2), 334–343. https://doi.org/10.5465/amr.2007.24345254

Hambrick, D. C., & Mason, P. A. (1984). Upper echelons: The organization as a reflection of its top managers. *Academy of Management Review, 9*, 193-206.

Hansen, Schneiderman, B., & Smith, M. A. (2011). Analyzing social media networks with NodeXL insights from a connected world (1st edition). M. Kaufmann.

Harrison, D. A., & Klein, K. J. (2007). What's the difference? Diversity constructs as separation, variety or disparity in organizations. *Academy of Management Review, 32*, 1199–1228.

Hastie, T.J. and Tibshirani, R.J. (1990), *Generalized Additive Models*, New York: Chapman and Hall.

Hermalin, B. & Weisbach, M. S. (1991). The Effects of Board Composition and Direct Incentives on Firm Performance. Financial Management, 20(4), 101–112.

Hermalin, B., & Weisbach, M. (2003). Boards of directors as an endogenously-determined institution: A survey of the economic literature. *Economic Policy Review 9*, 7-26.

Hillman, A. J. (2005). Politicians on the board: Do connections affect the bottom line? *Journal of Management, 31,* 464–481.

Hillman, A. J., & Dalziel, T. (2003). Board of directors and firm performance: Integrating agency and resource dependence perspectives. *Academy of Management Review*, *28*(3), 383–396.

Hillman, A. J., & Haynes, K. T. (2010). The effect of board capital and CEO power on strategic change. *Strategic Management Journal 31*(11), 1145-1163.

Hillman, A. J., Cannella, A. A., & Paetzold, R. L. (2000). The resource dependence role of corporate directors: Strategic adaptation of board composition in response to environmental change. *Journal of Management Studies, 37,* 235-255.

Hillman, A. J., Nicholson, G., & Shropshire, C. (2008). Directors' multiple role identities, identification and board monitoring and resource provision. *Organization Science, 19,* 441-456.

Hillman, A.J., Shropshire, C., & Cannella, A. (2007). Organizational predictors of women on corporate boards. *The Academy of Management Journal, 50*(4), 941-952.

Hillman, A.J.., Withers, M. C., Collins, B. J. (2009). Resource dependence theory: A review. *Journal of Management, 35*(6), 1404–1427. https://doi.org/10.1177/0149206309343469

Huff, A. S. (1982). Industry influences on strategy reformulation. *Strategic Management Journal 3*(2), 119–131.

Huse, M. (2005). Accountability and creating accountability: A framework for exploring behavioural perspectives of corporate governance. *British Journal of Management, 16,* 65–80.

Hyland, M. M., & Marcellino, P. A. (2002). Examining gender on corporate boards: A regional study. *Corporate Governance, 2*(4), 24–31.

Jackson, M. O. (2010). An overview of social networks and economic applications. In J. Benhabib, A. Bisin, & M. O. Jackson (Eds.), *Handbook of Social Economics* (pp. 1-96). Elsevier.

Jackson, M. (2020). A typology of social capital and associated network measures. *Social Choice and Welfare, 54*(2), 311-336.

Janney, J. J., Gove, S. (2011). Reputation and corporate social responsibility aberrations, trends, and hypocrisy: Reactions to firm choices in the stock option backdating scandal. *Journal of Management Studies, 48*(7), 1562–1585.

Joecks, J., Pull, K., & Vetter, K. (2013). Gender diversity in the boardroom and firm performance: What exactly constitutes a "critical mass?" *Journal of Business Ethics, 118*(1), 61–72.

Johnson, W. C., & Xie, W, & Yi, S. (2014). Corporate fraud and the value of reputations in the product market. *Journal of Corporate Finance, 25*, 16-39.

Kanter, R. (1977). Some effects of proportions on group life: Skewed sex ratios and responses to token women. *American Journal of Sociology, 82*(5), 965–990.

Karpoff, J. M. (2012). Does reputation work to discipline corporate misconduct? In T. G. Pollock & M. L. Barnett (Eds.), *Oxford handbook of corporate reputation* (pp. 361–382). Oxford University Press.

Karpoff, J. M., Lee, D. S., & Martin, G. S. (2008). The cost to firms of cooking the books. *Journal of Financial and Quantitative Analysis, 43*(3), 581–611.

Kim, K. (2014). Board heterogeneity: Double-edged sword? Focusing on the moderating effects of risk on heterogeneity-performance linkage. *Academy of Strategic Management Journal, 13*(1), 129-145.

Kirsch, A. (2017). The gender composition of corporate boards: A review and research agenda. *The Leadership Quarterly, 29*(2), 346-364. https://doi.org/10.1016/j.leaqua.2017.06.001

Kleit, A. N., Pierce, M. A., & Hill, R. C. (1998). Environmental protection, agency motivations, and rent extraction: The regulation of water pollution in Louisiana. *Journal of Regulatory Economics, 13*(2), 121-137.

Krause, R., Wu, Z., Bruton, G. D., & Carter, S. M. (2019). The coercive isomorphism ripple effect: An investigation of nonprofit interlocks on corporate boards. *Academy of Management Journal, 62*(1), 283–308. https://doi.org/10.5465/amj.2017.0064

Larcker D. F., Richardson, S.A., & Tuna, I. (2007). Corporate governance, accounting outcomes, and organizational performance. *Account Review, 82*(4), 963–1008.

Lavery, Matthew Ryan, Acharya, Parul, Sivo, Stephen A. & Xu, Lihua (2019) Number of predictors and multicollinearity: What are their effects on error and bias in regression? *Communications in Statistics - Simulation and Computation*, 48:1, 27-38.

Lester, R. H., Hillman, A., Zardkoohi, A., & Cannella, A. A. (2008). Former government officials as outside directors: The role of human and social capital. *Academy of Management Journal, 51*, 999–1013.

Luoma, P., & Goodstein, J. (1999). Stakeholders and corporate boards: Institutional influences on board composition and structure. *Academy of Management Journal, 42*, 553-563.

Lynall, M. D., Golden, B. R., & Hillman, A. J. (2003). Board composition from adolescence to maturity: A multitheoretic view. *Academy of Management Review, 28*, 416-431.

Makkai, T. & Braithwaite, J. (1991). Criminological Theories and Regulatory Compliance. *Criminology* (Beverly Hills), 29(2), 191–220.

Marinescu, I. E., Qiu, Y., & Sojourner, A. J. (2020). Wage inequality and labor rights violations. *SSRN*. http://dx.doi.org/10.2139/ssrn.3673495.

Marquis, & Tilcsik, A. (2016). Institutional Equivalence: How Industry and Community Peers Influence Corporate Philanthropy. *Organization Science* (Providence, R.I.), 27(5), 1325–1341. https://doi.org/10.1287/orsc.2016.1083.

McLaughlin, P. A., & Sherouse, O. (2016). The impact of federal regulation on the 50 states. *SSRN*. http://dx.doi.org/10.2139/ssrn.2939260

Mendelhoff, J., & Gray, W. (2005). Inside OSHA's black box: What is the link between inspections, citations, and reductions in different injury type? *Law and Policy, 27*, 219-237.

Meyer, John W. and Rowan, Brian (1977) 'Institutionalized organizations: Formal structure as myth and ceremony.' *American journal of sociology* 83: 340–363.

Midavaine, J., Dolfsma, W., & Aalbers, R. (2016). Board diversity and R & D investment. *Management Decision, 54*(3), 558–569. https://doi.org/10.1108/MD-09-2014-0574.

Miller, C. C., Burke, L. M., & Glick, W. H. (1998). Cognitive diversity among upper-echelon executives: Implications for strategic decision processes. *Strategic Management Journal, 19*, 39–58.

Mishina, Y., Dykes, B. J., Block, E. S., & Pollock, T. G. (2010). Why "good" firms do bad things: The effects of high aspirations, high expectations, and prominence on the incidence of corporate illegality. *Academy of Management Journal, 53*(4), 701–722.

Mitnick, B. M. (1973). *Fiduciary rationality and public policy: The theory of agency and some consequences* [Paper presentation]. Annual Meeting of the American Political Science Association, New Orleans, LA, United States.

Mizruchi, M. S. (1996). What do interlocks do? An analysis, critique, and assessment of research on interlocking directorates. *Annual Review of Sociology, 22*(1), 271–298. https://doi.org/10.1146/annurev.soc.22.1.271.

Moscovici, S., & Zavalloni, M. (1969). The group as a polarizer of attitudes. *Journal of Personality and Social Psychology, 12*, 125-135.

Nadler, D. A. (2004, May). Building better boards. *Harvard Business Review*, 102-111.

Naseem, M., Xiaoming, S., Riaz, S., & Rehman, R. (2017). Board attributes and financial performance: The evidence from an emerging economy. *Journal of Developing Areas, 51*(3), 281-297.

Nemeth, C. J. (1986). Differential contributions of majority and minority influence. *Psychological Review, 93*, 23-32.

Nishii, L. H., Gotte, A., & Raver, J. L. (2007). *Upper echelon theory revisited: The relationship between upper echelon diversity, the adoption of diversity practices and organizational performance*. Cornell University CAHRS Working Paper Series. https://ecommons.cornell.edu/bitstream/handle/1813/77344/WP07_04_Upper_Echelon.pdf

Palmer, D. A., Jennings, P. D., & Zhou, X. (1993). Late adoption of the multidivisional form by large U.S. corporations: Institutional, political, and economic accounts. *Administrative Science Quarterly, 38*, 100-131.

Palmer, C. G. S. (2003). Risk perception: Another look at the 'white male' effect. *Health, Risk & Society*, 5(1), 71.

Park, Y. W., & Shin, H. H. (2004). Board composition and earnings management in Canada. *Journal of Corporate Finance, 10*(3), 431-457.

Pearce, J. A., & Zahra, S. A. (1991). The relative power of board of directors: Association with corporate performance. *Strategic Management Journal, 12*(2), 135–153.

Pennings, J. M. (1980). *Interlocking directorates: Origins and consequences of connections among organizations' boards of directors*. Jossey-Bass.

Pfeffer J. (1972). Size and composition of corporate boards of directors. *Administrative Science Quarterly, 21*, 218–228.

Pfeffer J., & Salancik G. R. (1978). *The external control of organizations: A resource dependence perspective*. Harper and Row.

Pitcher, P., Chreim, S., & Kisfalvi, V. (2000). CEO succession research: Methodological bridges over troubled waters. *Strategic Management Journal, 21*, 625-648.

Post, C., & Byron, K. (2015). Women on boards and firm financial performance: A meta-analysis. *Academy of Management, 58*(5), 1546–1571. https://doi.org/10.5465/amj.2013.0319

Provan, K. G. (1980). Recognizing, measuring, and interpreting the potential/enacted power distinction in organizational research. *Academy of Management Review, 5*, 549-560.

Ralston DA, Holt DH, Terpstra RH, et al. (2007) The impact of national culture and economic ideology on managerial work values: a study of the United States, Russia, Japan, and China. *Journal of International Business Studies* 39(1): 8–26.

Rashid, A. (2015). Revisiting agency theory: Evidence of board independence and agency cost from Bangladesh. *Journal of Business Ethics, 130*(1), 181–198.

Reddy, J., & Jadhav, A. M. (2019). Gender diversity in boardrooms - A literature review. *Cogent Economics and Finance, 7*(1), https://doi.org/10.1080/23322039.2019.1644703

Reguera-Alvarado, N., Fuentes, P., & Laffarga, J. (2017). Does board gender diversity influence financial performance? Evidence from Spain. *Journal of Business Ethics, 141*(2), 337-350.

Rindova, V. (1999). What corporate boards have to do with strategy: A cognitive perspective. *Journal of Management Studies, 36*, 953-975.

Rogers, J. (2020, December 10). *Nasdaq diversity proposal puts thousands of company boards on notice*. S&P Global Market Intelligence. https://www. spglobal. com/marketintelligence/en/news-insights/latest-news-headlines/nasdaq-diversity-proposal-puts-thousands-of-company-boards-on-notice-61558109

Rosener, J. B. (1990). Ways women lead. *Harvard Business Review*. https://hbr.org/1990/11/ways-women-lead

Sah, R. K., & Stiglitz, J. E. (1991). The quality of managers in centralized versus decentralized organizations. *The Quarterly Journal of Economics, 106*, 289-295.

Salinger, L. (2005). *Encyclopedia of white-collar & corporate crime* (2nd ed.). Sage Publications.

Scott W (2001) Institutions and Organizations. Thousand Oaks: Sage, 2nd Ed.

Sealy, R., Singh, V., & Vinnicombe, S. (2007). *The Female FTSE report 2007: A year of encouraging progress*. International Centre for Women Leaders at the Cranfield School of Management. https://dspace.lib.cranfield.ac.uk/handle/1826/3992

Shimshack, J. P., & Ward, M. B. (2005). Regulator reputation, enforcement, and environmental compliance. *Journal of Environmental Economics and Management, 50*, 519-540.

Shipilov, A. V., Greve, H. R., & Rowley, T. J. (2010). When do interlocks matter? Institutional logics and the diffusion of multiple corporate governance practices. *Academy of Management Journal, 53*, 846–864.

Short, J. L., & Toffel, M. W. (2008). Coerced confessions: Self-policing in the shadow of the regulator. *Journal of Law, Economics and Organizations, 24*, 45–71.

Short, J. L., & Toffel, M. W. (2010). Making self-regulation more than merely symbolic: The critical role of the legal environment. *Administrative Science Quarterly, 55*(3), 361–396. https://doi.org/10.2189/asqu.2010.55.3.361

Shropshire, C. (2010). The role of the interlocking director and board receptivity in the diffusion of practices. *Academy of Management Review, 35*(2), 246-264.

Simpson, D., Nowlan, J., Gradel, T. J., Zmuda, M. M., Sterrett, D., & Cantor, D. (2012). *Chicago and Illinois, leading the pack in corruption*. University of Illinois at Chicago, Department of Political Science and the Illinois Integrity Initiative of the University of Illinois' Institute for Government and Public Affairs. https://pols.uic.edu/wp-content/uploads/sites/273/2018/10/ac_leadingthepackd3c9.pdf

Thornton, Dorothy, Gunningham, N. A., & Kagan, R. A. (2005). General Deterrence and Corporate Environmental Behavior. *Law & Policy*, 27(2), 262–288.

Toffel, M., & Short, J. (2011). Coming clean and cleaning up: Does voluntary self-reporting indicate effective self-policing? *The Journal of Law and Economics, 54*(3), 609-649.

Torchia, M., Calabrò, A., & Huse, M. (2011). Women directors on corporate boards: From tokenism to critical mass. *Journal of Business Ethics, 102*(2), 299–317.

Ueng, C. (2016). The analysis of corporate governance policy and corporate financial performance. *Journal of Economics and Finance, 40*(3), 514-523.

United States Department of Justice. (2020, February 21). *Wells Fargo agrees to pay $3 billion to resolve criminal and civil investigations into sales practices involving the opening of millions of accounts without customer authorization*. https://www.justice.gov/opa/pr/wells-fargo-agrees-pay-3-billion-resolve-criminal-and-civil-investigations-sales-practices

United States Securities and Exchange Commission. (2020, October 22). *SEC charges Goldman Sachs with FCPA violations*. https://www.sec.gov/news/press-release/2020-265

van Ees, H., & van der Laan, G. (2012). Boards and board effectiveness. In T. Clarke & D. Branson (Eds.), *The SAGE handbook of corporate governance* (pp. 183-195). Sage Publications.

Van Loo, R. (2018). Regulatory monitors: Policing firms in the compliance era. *Columbia Law Review, 119*(2). https://columbialawreview.org/content/regulatory-monitors-policing-firms-in-the-compliance-era/

Vasquez, V. (2014). *Towards achieving clean water goals: An evaluation of California's mandatory minimum penalty enforcement program* [Doctoral dissertation, University of California Los Angeles]. ProQuest Dissertations Publishing.

Veltrop, D. B., & Molleman, E. (2019). Board informal hierarchy and board performance. In J. Gabrielsson, W. Khlif, & S. Yamak (Eds.), *Research handbook on boards of directors* (pp. 16-30). Edward Elgar Publishing. https://doi.org/10.4337/9781786439758.00009

Walske, J. M., Zacharakis, A., & Smith-Doerr, L. (2007). Effect of venture capital syndication networks on entrepreneurial success. *Frontiers of Entrepreneurship Research, 27*, 38–52.

Watson, W. E., Kumar, K., & Michaelsen, L. K. (1993). Cultural diversity's impact on interaction process and performance: Comparing homogeneous and diverse task groups. *Academy of Management Journal, 36*, 590-602.

Westphal, J. D., & Milton, L. P. (2000). How experience and network ties affect the influence of demographic minorities on corporate boards. *Administrative Science Quarterly, 45*, 366–398.

Westphal, J. D., Seidel, M. D. L., & Stewart, K. J. (2001). Second-order imitation: Uncovering latent effects of board network ties. *Administrative Science Quarterly, 46*, 717–747.

Yermack, D. (1996). Higher market valuation for firms with a small board of directors. *Journal of Financial Economics, 40*, 185–211.

Zahra, S. A., & Pearce, J. A. (1989). Boards of directors and corporate financial performance: A review and integrative model. *Journal of Management, 15*, 291-334.

Zajac, E. L, & Westphal, I. D. (1996). Director reputation, CEO board power, and the dynamics of board interlocks. *Administrative Science Quarterly, 41*, 507-529.

Zhang, X., Bartol, K. M., Pfarrer, M. D., & Khanin, D. M. (2008). CEOs on the edge: Earnings manipulation and stock-based incentive misalignment. *Academy of Management Journal*, *51*(2), 241–258.

Zona, F., Gomez-Mejia, L. R., & Withers, M. C. (2018). Board interlocks and firm performance: Toward a combined agency–resource dependence perspective. *Journal of Management*, *44*(2), 589–618. https://doi.org/10.1177/0149206315579512