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The logo for the Nordic Journal of Business (NJB). It features the letters 'NJB' in a bold, dark green, serif font. Above the letter 'J' is a stylized graphic element consisting of two curved, overlapping shapes in shades of green and gold, resembling a leaf or a flame.

# Nordic Journal of Business

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# Editor's Letter

This issue of the *Nordic Journal of Business* includes two peer-reviewed articles. The first article by Mansoor Afzali and Jukka Kettunen focuses on the social networks of directors in privately-held Finnish and Swedish firms and examines whether well-connected boards influence firm performance. In the second article, Anna-Mari Simunaniemi, Martti Saarela, Matti Muhos, Santeri Halonen, Eeva Leinonen, Heli Kurikkala and Markus Rytinki investigate short-term crisis management among solo entrepreneurs during the COVID-19 pandemic.

I hope you enjoy reading the interesting articles included in this issue of the *Nordic Journal of Business*.

**Sami Vähämaa**

Editor

Nordic Journal of Business

# Boardroom Centrality and Firm Performance: Evidence from Private Firms

Mansoor Afzali and Jukka Kettunen

## Abstract

We study the link between boardroom centrality and operating performance in private firms. We argue that the centrality-performance relationship is stronger for private firms whose increased connectedness is likely to provide certification benefits, decrease transaction costs by reducing information asymmetry, and improve access to critical resources. Using a sample of Finnish and Swedish private firms, we find that private firms with more central boards have better performance, growth, and efficiency than private firms with less central boards. Moreover, in a sample of private and public firms, we find that private firms with greater eigenvector centrality outperform size-matched public firms. Subsample analyses further show that networks are crucial for young firms. This is consistent with the view that better-connected directors provide firms with informational resources when they need them the most. Overall, our findings show that boardroom interlocks are positively associated with immediate economic benefits to private firms.

## Keywords:

Boardroom centrality, social networks, firm performance, firm growth, firm efficiency, private firms, public firms

## Acknowledgments:

We thank Sami Vähämaa (the editor) and an anonymous referee whose comments helped significantly improve the paper. We are also grateful to Gonul Colak, Jesper Haga, John Christian Langli, Minna Martikainen, Hanna Silvola, and seminar participants at Hanken School of Economics and the 3<sup>rd</sup> Annual Scandinavian Accounting Research Conference in Norway.

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Mansoor Afzali is an Assistant Professor of Accounting at Hanken School of Economics, Finland. Jukka Kettunen is an Assistant Professor of Accounting at Copenhagen Business School, Denmark.

## 1. Introduction

Boardroom centrality is the establishment of networks through directorship interlocks, and it plays a crucial role in the exchange of information and resources (Javakhadze, Ferris, and French, 2016). Despite this role, the studies on firm performance do not examine the role of boardroom centrality in private firms. The closest ones focus on entrepreneur's social and collaborator networks (for a review, see Stam, Arzlanian, and Elfring, 2014). However, such studies primarily rely on cross-sectional surveys and small samples and do not provide a unanimous prediction on whether the association of boardroom centrality and performance among private firms should be positive or negative. Therefore, this study aims to test the performance implications of boardroom centrality in private firms.

Besides its novelty, two other reasons make this question particularly interesting to study in the private-firm setting. First, results on the association of boardroom centrality and firm performance are mixed even among public firms (e.g., Ferris, Jagannathan, and Pritchard, 2003; Fich and Shivdasani, 2006; Cashman, Gillan, and Jun, 2012; Horton, Millo, and Serafeim, 2012; Larcker, So, and Wang, 2013; Hauser, 2018). Moreover, the literature has shown that private firms differ from public firms in various ways including their investment policies (Caballero, Engel, and Haltiwanger, 1995; R. W. Cooper and Haltiwanger, 2006; Asker, Farre-Mensa, and Ljungqvist, 2011), financial constraints (Beck, Demirgüç-Kunt, and Maksimovic, 2005; Hope, Thomas, and Vyas, 2011), capital structure decisions (Brav, 2009), types of dividend smoothing (Michaely and Roberts, 2012), use of corporate jets (Edgerton, 2012), CEO compensation-performance sensitivity (Gao and Li, 2015), and the responses to economic uncertainty (Afzali, Colak, and Fu, 2021). Furthermore, Gao and He (2019) show that private and public firms differ in their board composition. Such differences can be particularly relevant to the association between boardroom centrality and firm performance.

The extant literature provides many explanations as to why private and public firms may differ in their board composition. Board composition can be seen as a rational response to the needs, uncertainty, and changing conditions of the operating environment (Harris and Raviv, 2008; Linck, Netter, and Yang, 2008). For instance, compared to public firms, access to finance can constitute a such need and a critical growth constraint for private firms (Beck and Demirgüç-Kunt, 2006). According to the resource dependence theory (Pfeffer and Salancik, 1978), managers cope with uncertainty and inter-organizational dependence by attempting to reduce others' power over them and if possible, gain power over the other. One option to achieve this is to engage in inter-firm collaboration e.g., through board interlocks especially if the inter-organizational dependence is high (Pfeffer and Salancik, 1978; Finkelstein, 1997).

However, the performance implications of boardroom centrality appear ambiguous in prior literature. For example, Cashman et al. (2012) argue that it can have either a positive or negative effect on performance, depending on the context and the sample. In particular, the research that focuses on the centrality-performance relationship in public firms finds both negative and positive implications. On the one hand, directors with multiple directorships can be seen as too "busy" and therefore negatively affect firm performance (Fich and Shivdasani, 2006; Hauser, 2018). On the other hand, such directors can provide firms with critical channels of information and resource exchange that positively influences firm performance (Horton, Millo, and Serafeim, 2012; Larcker, So, and Wang, 2013).

In private firms, additions to boards are likely to be related to attaining critical resources and coping with growth constraints, which can facilitate different collaborations and partnerships that positively affect performance (BarNir and Smith, 2002; Wyncarczyk and Watson,

2005). For example, Javakhadze et al. (2016) find that such collaborations not only contribute to stricter contract enforcement and more efficient decision-making but also to improving access to capital that thereby reduces transaction costs. Hence, we argue that greater boardroom centrality in private firms is likely to have substantial benefits with respect to organizational legitimacy, transaction costs, and sustainable value creation. For instance, since private firms are more opaque (Ball and Shivakumar, 2005; Burgstahler, Hail, and Leuz, 2006) and have more stringent loan contract terms compared to public firms (Ackert, Huang, and Ramírez, 2007), appointing well-connected directors to their boards can increase their credibility. Moreover, if boardroom centrality is seen as a valuable and rare resource, it can help improve access to critical resources, build sustainable competitive advantage, and support long-term value creation (Barney, 1991). Therefore, we hypothesize that boardroom centrality is likely to be positively associated with the performance of private firms. Consistent with the resource-dependence view, we further argue that since private firms have greater information needs, boardroom centrality can be more important to them than to public firms.

To empirically test these hypotheses, we construct a boardroom network using directorship interlocks in small- and medium-sized private enterprises that operate in Finland and Sweden.<sup>1</sup> The foundation for choosing this sample rests on the comprehensive mandatory public disclosures in the Nordic region. Nordic countries require private firms to file financial statements and information on board members and executives in the national trade registers that are publicly accessible. Such data are difficult to obtain from the US, where private firms are not subject to public disclosure. In Finland and Sweden, the relatively high taxation, tax-driven financial reporting of private firms, low threshold for statutory audits, and low ratio of the gray economy to GDP mitigate the concerns that central boards would systematically and materially inflate or deflate their reported performance. Overall, our sample provides an extensive mapping of information routes through board interlocks and high-quality disclosures of firm performance. This information enables us to reduce data inaccuracies and helps us in correctly estimating the centrality-performance relation in private firms.

We use the Bureau van Dijk's Orbis database to get director-level as well as accounting information for our sample. Orbis provides data on boards with unique identification numbers for each director, appointment, resignation, and validity date as well as an indicator of whether the director is current or previous. We use this information to construct a boardroom network comprised of 107,022 unique directors belonging to 34,019 unique Finnish and Swedish firms. For network construction, we include both public and private firms. Following studies on the network theory of social capital (Lin 1999), we use four distinct but related measures of boardroom centrality. We calculate the degree, closeness, and eigenvector centrality in boardrooms as well as their aggregate dyadic constraint that Horton et al. (2012) refer to as the "brokerage position".

Using these measures, we find that well-connected firms have significantly higher future performance than less-connected ones. Specifically, well-connected firms have higher one-year-ahead changes in their returns on assets and returns on equity as well as growth in sales

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<sup>1</sup> Granular and high-quality Nordic data is previously used to study firm performance and board structure (Eisenberg, Sundgren, and Wells, 1998), dividend-based earnings management (Kasanen, Kinnunen, and Niskanen, 1996), and determinants of foreign currency denominated debt (Keloharju and Niskanen, 2001). The replication of such studies in different institutional settings suggests that results obtained from using Nordic data are largely generalizable. For instance, the negative association between board size and firm performance documented by Eisenberg et al. (1998) is also reported in the U.S. by Yermack (1996). Similarly, Daniel, Denis, and Naveen (2008) report similar patterns of dividend-based earnings management in the U.S. as documented by Kasanen et al. (1996).

and assets. These associations hold after controlling for the influence of industry, year, size, age, sales growth, tangibility, financial slack, and capital expenditure. To assess the effect of networks on performance efficiency, we use two tests. In the first test, we look at the one-year-ahead financial slack (ratio of cash and cash equivalents scaled by total assets). We find that better networking boards hoard less cash as compared to worse networking firms. Our second test uses the one-year-ahead changes in sales per employee as a measure of productivity. We find that firms with well-connected boards have better employee productivity than firms with less-connected boards. Consistent with our prediction, we also find some evidence that private firms with greater eigenvector centrality have better one-year-ahead returns on assets and sales growth than size-matched public firms.

A potential limitation of our study is the assumption that formal networks such as directorship interlocks are the primary channels of information and resource exchange. In practice, managers can also have connections that are informal and not related to their profession. Although our network measures might not capture the total breadth of a director's network, there are several factors that mitigate these concerns. Specifically, the informal and formal networks are positively correlated (Hwang and Kim, 2009) as informal connections to other organizations complement formal ones because they can be used strategically to manage resource dependence (Westphal, Boivie, and Chng, 2006). Furthermore, the directors holding the most formal connections (i.e., board seats) can be too busy to efficiently manage a firm, which might result in weaker profitability (Fich and Shivdasani, 2006; Hauser, 2018). Therefore, our network measures are most likely to under, not overestimate the boardroom centrality-performance relationship.

Our findings can also have several alternative causal explanations. For instance, research has shown that directors are attracted to and are more likely to accept positions on better-connected boards (Masulis and Mobbs, 2014). Similarly, directors can prefer sitting on boards that are performing well. In these cases, our findings may simply reflect a match between quality directors and, as Larcker et al. (2013) refer to them, "prestigious firms". To mitigate these endogeneity concerns, we perform three tests.

First, we test the positive centrality-performance relationship in a subsample of firms that have the same degree of centrality in the current and the previous year. Since there are no changes in their direct networks, any increase in informational networks can potentially be exogenous to these firms. We continue to find a positive centrality-performance relationship. This finding suggests that increases in future performance can be attributed to the level of connectedness of the current board and mitigates concerns that the firm's prestige can lead to better connections. Second, we look at determinants of boardroom networks and find no evidence of past performance inducing a change in our network measures. In our third specification, we study a unique sample of firms that initiate a directorship interlock and compare them to a set of firms that remain isolated for the entire sample period. We find that newly-interlocked firms outperform those that never form an interlock during the sample period. This further implies that firms benefit from having an extended boardroom network and illustrates that the positive centrality-performance relationship is not likely to be due to endogenous matching.

Our study makes two distinct contributions. First, we study the relationship between boardroom centrality and the performance and efficiency of private firms – a research setting never studied before. The other studies in this line of literature primarily focus on the centrality-performance relationship in public firms. For instance, Horton et al. (2012) examine listed firms in the UK and find that boardroom centrality is positively associated with stock



returns and accounting performance. Larcker et al. (2013) replicate these findings in the US and further show that better-connected firms receive more positive analyst forecast errors than worse-connected firms. Our study adds to this line of research by showing that private firms with well-connected boards outperform those with less-connected boards. We also find that well-connected private firms hoard less cash. Javakhadze and Rajkovic (2019) find similar evidence for public firms from 39 countries.

Second, we compare the dynamics of boardroom networks in private and public firms and find some evidence that private firms benefit more from network centrality than public firms. Other studies have found several differences between private and public firms. For instance, Brav (2009) studies the lending behaviors of private and public firms and finds that private firms almost exclusively rely on private debt financing and avoid external financing. Gao and Li (2015) compare the compensation packages of CEOs in private and public firms. Their results show that compared to similar private firms, CEOs in public firms are paid 30 percent more. Furthermore, the CEO compensation-performance sensitivity is greater in public firms than in private firms. More recently, Afzali et al. (2021) study the behavior of private and public firms during economic uncertainty. They find that while private firms engage in cheating on taxes, public firms pay more bribes to mitigate economic uncertainty. Our findings extend the literature on public and private firm differences by indicating that the boardroom centrality-performance link is more important to private firms than to public firms.

The remainder of the paper is organized as follows: Section 2 presents a literature review. In Section 3, we describe the data and give sample statistics on boardroom networks. We discuss our results and robustness tests in Section 4. Section 5 provides alternative explanations and additional analyses. Section 6 concludes.

## 2. Related literature and hypotheses development

Recent studies that have explored the role of social networks constitute a relatively new research avenue in corporate finance and financial accounting literature. Information is disseminated in the network of directors and executives, and it produces power and economic rents to those who can access and exploit it. The classical agency theory (Jensen and Meckling, 1976) provides hypotheses for studying whether principals or agents benefit from the information disseminated in the network. Accordingly, earlier applications of social networks to corporate financing focus on managerial entrenchment and the monitoring of executives (Horton, Millo, and Serafeim, 2012; El-Khatib, Fogel, and Jandik, 2015).

A larger and more recent strand of literature examines how board interlocks can bring shareholders various economic benefits, such as lowering the tax burden (Brown, 2011; Brown and Drake, 2014), increasing innovation (Su, Xiao, and Yu, 2019), increasing access to financing and investment (Intintoli, Kahle, and Zhao, 2018), and improving credit ratings (Benson, Iyer, Kemper, and Zhao, 2018). Most of these studies use data on public firms from North America. Fewer studies have combined social networks with performance which according to Drucker (1954) is the ultimate test of the validity of business models.<sup>2</sup>

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<sup>2</sup> A related stream of literature also focuses on individual networks and their significance for cost of capital (Engelberg, Gao, and Parsons, 2012), access to finance (Javakhadze, Ferris, and French, 2016), corporate risk-taking (Ferris, Javakhadze, and Rajkovic, 2017), and insider trading (Afzali and Martikainen, 2021).

### 2.1 Boardroom centrality and firm performance

Boardroom centrality can have either a positive or negative effect on performance depending on the context and sample (Cashman, Gillan, and Jun, 2012). Well-connected, but busy boards are negatively associated with performance according to studies focusing on large firms (Fich and Shivdasani, 2006; Hauser, 2018). However, for boards to be classified as “busy” at least half of their independent directors should serve on three or more boards. According to Ferris et al. (2003) busy boards are mostly associated with large listed firms which is supported by approximately half of the multiple directorships being observed in Forbes 500 firms. They find that for firms in Compustat with total assets in excess of \$100 million, only 6 percent of the directors that are “busy” hold three or more board seats. In the S&P 500 firms, the negative association between board busyness and performance has been attributed to inefficient monitoring (Fich and Shivdasani, 2006).

By contrast, the association of boardroom centrality and firm performance is positive in a broader sample that also includes non-S&P 500 firms. For instance, Horton et al. (2012) study a panel of over 4,000 UK firms and find that on average, connected boards have better future stock returns and returns on assets. Similarly, studying a sample of publicly traded firms in the US, Larcker et al. (2013) find a positive relation between boardroom centrality and firm performance that is represented by characteristic-adjusted returns, growth in returns on assets, and positive analyst forecast errors. These findings on the relationship between boardroom centrality and firm performance are both polarized and sample-dependent. The combination of the lack of research on boardroom centrality in private firms, contradictory findings related to network centrality, and the significant differences in board structures between small private and large listed firms (Linck, Netter, and Yang, 2008) constitute the main reasons for revisiting the relationship between boardroom centrality and performance in the private firm setting.

### 2.2 Board structure in private and public firms and hypothesis development

The board structures of private and public firms are substantially different (Gao and He, 2019). Generally, the board structure is determined by balancing between the costs and benefits of monitoring and advising: monitoring limits entrenchment; while advising assists with the development, strategy, and growth of the firm (Linck, Netter, and Yang, 2008). The demand for monitoring as a determinant of board structure is typically studied with the agency theory (Li, 1994; Bathala and Rao, 1995; Boone, Casares Field, Karpoff, and Raheja, 2007). Private firms have greater external governance needs (i.e., higher agency costs) and therefore have a higher proportion of outside directors on the board than public firms (Gao and He, 2019).

The importance of board networks is illustrated by the multitude of examples that demonstrate their potential in improving private firms' access to critical resources. Such examples typically include access to financing (Beck and Demircuc-Kunt, 2006), credibility (Certo, 2003), and means of collaboration (Barney, 1991). To improve access to critical resources, firms can enter into formal or informal interfirm collaborations; the likelihood of which increases the higher the interdependence of the firms. According to the resource dependence theory, managers cope with such interorganizational dependence and environmental uncertainty by attempting to gain a competitive advantage over their peers (Pfeffer and Salancik, 1978; Finkelstein, 1997). Hence, the board structure can be seen as a rational response to the changing conditions of the external environment (Linck, Netter, and Yang, 2008).

Director appointments are not exogenous of firm operations but are reflections of shocks that change the optimal number of directors (Harris and Raviv, 2008). Consequently, the board's size and composition are systematically related to the needs of the firms' environment and those that do not adjust to such needs have suboptimal performance (Pfeffer and Salancik, 1978). In comparison to pub-

lic firms, private firms face more serious growth constraints related to critical resources such as financing, management expertise, and qualified personnel. For instance, their access to external financing is more limited (Beck and Demirguc-Kunt, 2006) as illustrated by creditors requiring more collateral and covenants while charging higher prices on debt for private firms (Ackert, Huang, and Ramirez, 2007). Additions to the board can improve access to financing. For instance, in startup firms, increasing boardroom centrality by appointing independent directors can serve as an important mechanism to balance power between the entrepreneur and investors thereby improving access to financing (Broughman, 2013). Similarly, in a country with bank-dominated financial markets, a bank officer may be one of the early additions to the board for a growing private firm (Eisenberg, Sundgren, and Wells, 1998).

Prestigious well-connected boards can increase the credibility and organizational legitimacy of small, opaque firms. Building on the signaling theory, Certo (2003) finds that prestigious boards can improve IPO performance. To increase credibility, firms can seek to appoint outside CEOs to their boards (i.e., certification hypothesis) typically from firms that are geographically close and have similar financial and investment policies, and comparable governance (Fahlenbrach, Low, and Stulz, 2010). According to the certification hypothesis, the successful recruitment of such a CEO to the board demonstrates to external parties that a business leader who is considerate of their reputation thinks highly enough of the firm to join its board. Moreover, the certification effect might exist even though the director may be too busy to actively contribute to the board: the appointment might still serve as a quality stamp for the firm that thus, secures its current value (Fahlenbrach, Low, and Stulz, 2010).

Collectively these studies indicate that boardroom centrality is likely to be beneficial to firms, especially during the early life cycle of a growth-oriented firm. Specifically, it can improve access to critical resources such as advisory, certification, legitimacy, strategic partnerships, and financing that can positively contribute to firm performance. Consistent with these arguments, we formulate the following hypothesis with respect to boardroom centrality:

H1a: Boardroom centrality is positively associated with the performance and growth of private firms.

Boardroom centrality assists firms in operating more efficiently with fewer financial buffers and slack resources. Specifically, boardroom centrality relaxes the critical growth constraint of private firms, that is, the access to external financing that in turn reduces the sensitivity of investment to internal financing (Javakhadze, Ferris, and French, 2016). Similarly, Chuluun et al. (2017) find that for well-connected firms, innovation activities are associated with lower uncertainty and spreads for bond yields. Trust from the financiers allows firms to operate with a lower cash buffer and less slack resources. Slack represents potentially usable resources that can be directed to the achievement of organizational goals (George, 2005). Organizations use both financial and social slack to improve performance (F. Daniel, Lohrke, Fornaciari, and Turner, 2004). Financial slack is a predictor of risk-taking (Wiseman and Bromiley, 1996). For example, the dot-com bubble (1999-2002) and the financial crisis of 2008 decreased risk-taking as represented by investment in growth options and innovation. Subsequently, these crises were accompanied by the accumulation of cash which demonstrates that especially cash and cash equivalents are used to finance growth options and R&D (Jalilvand and Kim, 2013). Collectively, these studies indicate that better access to external financing allows firms to seize growth opportunities and operate more efficiently with less of a financial buffer and less slack resources.

Boardroom centrality can also positively influence employee productivity. This influence can happen for example through advising, facilitating IT-investments, and improving access to higher quality workers. Specifically, skilled labor is one of the most important resources in building a competitive advantage (Barney, 1991) and hence a potential growth constraint for private firms. According to the

upper echelon theory (Hambrick and Mason, 1984), organizational outcomes are to a large extent influenced by the characteristics of the top management. This influence means that success in attracting high-quality directors can have a positive effect on the efficiency of the whole organization. Building on the upper echelon theory, Chuang et al. (2009) find that top managers' age and education are associated with the extent of IT adoption. This association supports the idea of nominating directors that can identify the IT investments needed to maintain market position and to improve efficiency. Among private firms, those growing and becoming international may be able to offer more attractive jobs and hence attract more skilled labor (Gomez-Mejia, 1988).

Collectively, boardroom centrality improves access to financing that lowers the need to hoard more cash, and enhances access to high-quality workers that potentially result in higher employee productivity. Consequently, we formulate the following hypothesis:

H1b: Boardroom centrality is positively associated with lower financial slack (greater efficiency) and higher employee productivity in private firms.

The literature shows that private firms differ from public firms with respect to their board composition (Gao and He, 2019). For example, private firms hire more outside directors than public firms. Hiring well-connected directors can assist both private and public firms in reducing information asymmetries and giving the firm a competitive advantage over its competitors. Public firms, however, have several channels of information and resource exchange such as publicly available performance metrics and analyst forecasts on competitors as well as access to a wealth of resources through institutional shareholders. In contrast, private firms are more opaque (Ball and Shivakumar, 2005; Burgstahler, Hail, and Leuz, 2006) and potentially have fewer channels of information and resource exchange. Therefore, we argue that the positive centrality-performance relationship can be more relevant to private than to public firms. We formulate our second hypothesis as follows:

H2: In comparison to similar public firms, boardroom centrality is associated with higher performance and growth in private firms.

### 3. Research design

#### 3.1 Construction and description of boardroom network

We obtain our sample from the Bureau van Dijk's Orbis database which is a data resource for private and public firm firms. Orbis contains financial and corporate structure information for over 300 million firms worldwide.<sup>3</sup> It provides data on boards with unique identification numbers for each director, appointment, resignation, and validity dates, as well as an indicator of whether the director is current or previous.<sup>4</sup> We use this information to construct a network comprised of 107,022 unique directors belonging to 34,019 unique Finnish and Swedish private and public firms.<sup>5</sup> Our final sample for network construction, which includes both public and private firms,

<sup>3</sup> Studies have used Orbis to assess the relationship between ownership and bank versus public debt (Lin et al. 2013), public tax return disclosure (Hoopes, Robinson, and Slemrod, 2018), firm listing status (Bartholdy and Olson, 2017), and measurement of the value of intangibles (Clausen and Hirth, 2016), among others.

<sup>4</sup> Orbis has a higher frequency of updating data than the databases used in other studies. The updating frequency for Finland is twice a month and weekly for Sweden. Orbis also follows all registered firms in Finland without restrictions on sector or area as well as directly verifying the accuracy of information provided from the firm itself every year provided that it has more than nine employees.

<sup>5</sup> We initially start with a sample of Nordic firms but drop Danish firms due to unavailable financial data, Norwegian firms due to unavailable board-level data, and Icelandic firms due to fewer observations.

is comprised of 515,927 director-year observations for the period from 2012 to 2017.<sup>6</sup> Using this data, we construct an undirected and unweighted network for each board based on their shared directorates.

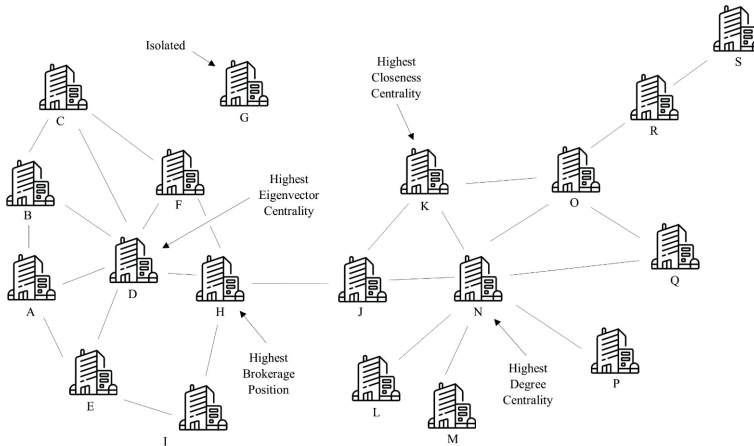
### 3.2 Network measures

We use four measures of social networks based on the literature.<sup>7</sup> Following Horton et al. (2012) and Larcker et al. (2013), we use closeness centrality, brokerage position, degree centrality, and eigenvector centrality to measure board connectedness for each year. These measures are defined as follows and illustrated in Figure 1.

**Figure 1**

Measures of boardroom centrality.

This figure presents a sample network of firms established through director interlocks. Firm G is isolated since it does not have any direct connections to other firms in the network. Firm N has the highest degree centrality since it has a direct connection to seven other firms. Firm K has the highest closeness centrality since the distance between it and all other firms in the network is the shortest. Firm H has the highest brokerage position because it connects two unconnected subnetworks within the entire network. Firm D has the highest eigenvector centrality since it not only has multiple direct connections to other firms but the firms that it is connected to are also relatively well-connected. Further descriptions of Closeness Centrality, Brokerage Position, Degree Centrality, and Eigenvector Centrality are detailed in subsection 3.2.



*Degree Centrality* measures a firm’s total number of direct connections. Presumably, a firm is more central if it possesses relatively more channels of information exchange. Degree centrality illustrates the number of first-degree linkages to outside boards. Mathematically, it can be expressed by Eq. (1).

$$Degree\ Centrality_i = \sum_{k \neq i} u(i, k) \tag{1}$$

where  $u(i, k)$  represents a direct link between firm  $i$  and  $k$ . In Figure 1, firm N has the highest degree of centrality since it has a direct link with seven other firms.

<sup>6</sup> Excluding public firms from the sample would make our network incomplete and therefore affect the performance-centrality relationship.

<sup>7</sup> The main reasoning behind using four different measures is not only to reduce measurement error but to also provide robust results across different measures that capture different aspects of network centrality. While the four measures are similar, their effect on the outcome variable may be different. For instance, Goergen, Renneboog, and Zhao (2019) show that a director’s degree and eigenvector centrality have statistically significant effects on insider trading but closeness centrality is statistically insignificant.

*Closeness Centrality* measures the centrality of a firm by capturing how close it is to all other firms in the network. Since closeness centrality captures the centrality of a firm within the entire network, it considers both direct and indirect ties with other firms. A higher measure of closeness indicates that a firm is better networked and more central. Firms with a higher closeness measure can access information quickly and more accurately than firms with a lower closeness measure. Mathematically, the measure can be expressed by Eq. (2).

$$Closeness\ Centrality_i = \frac{N - 1}{\sum_{k \neq i} v(i, k)} \tag{2}$$

where  $v(i, k)$  represents the distance between firms  $i$  and  $k$ . Hence, *Closeness Centrality* is the inverse of the mean distance between firm  $i$  and any other firm reachable from it in a network of  $N$  firms. In Figure 1, firm K has the highest closeness centrality since it is more central to several subnetworks within the entire network.

*Brokerage Position*, on the other hand, captures the degree of relative informational advantage a firm has over other firms in the network. It measures the extent to which a firm can serve as a broker of information. It is based on the concept of structural holes (Burt, 1995, 2005). It gives firms the informational advantage to serve as a link between disconnected or loosely connected networks, thus giving them wider and faster access to information and more control over its diffusion. Mathematically, it can be expressed by Eq. (3) and (4).

$$Brokerage\ Position_i = 1 - AGGREGATE\ DC_i \tag{3}$$

$$DC = \left( P_{ik} + \sum_q P_{iq} P_{qk} \right)^2, \quad \text{for } p \neq i, k \tag{4}$$

where the aggregate dyadic constant (Eq. (4)) measures the redundancy of a firm's ties. The proportion of firm  $i$ 's relations invested in firm  $k$  is denoted by  $P_{ik}$ ; the sum of products in the parenthesis is the extent of firm  $i$ 's relations invested in firm  $q$ 's relations that in turn are invested in firm  $k$ . The total sum of the terms in the parenthesis is the proportion of firm  $i$ 's relations that are directly or indirectly invested in its connections with firm  $k$ . In Figure 1, firm H connects two large subnetworks within the entire network and therefore has the highest brokerage position.

These measures primarily capture the strength of direct connections or the centrality of the nodes in a network. However, another important measure of centrality is eigenvector centrality that not only considers the direct connections but also the strength of indirect connections (See Goergen et al. (2019) for a more detailed description of eigenvector centrality). A firm with connections to other firms which are in turn more connected has potentially more channels of

$$Eigenvector\ Centrality_i = \frac{1}{\lambda} \sum_{k=1}^1 A_{ik} C_E(i) \tag{5}$$

communication. Mathematically, eigenvector centrality is described by Eq. (5).

where  $\lambda$  is a constant,  $A_{ik}$  represents the adjacent vertices between firm  $i$  and its  $k$  neighbors, and  $C_E(i)$  measures the sum of all adjacent vertices' eigenvector centrality scores. In Figure 1, firm D has the highest eigenvector centrality since it is connected to several other firms that are

in turn relatively well connected.

To calculate degree centrality, closeness centrality, and brokerage position, we use Pajek – a software program that uses methods in social network analysis – and techniques illustrated in Nooy, Mrvar, and Batagelj (2018). To calculate eigenvector centrality, we use Gephi which is an open-source software used for the calculation and visualization of networks. Similar to Larcker et al. (2013), we create quintile ranks for each of these four network measures every year to mitigate the effects of outliers and make regression results easier to interpret. Larcker et al. (2013) also argue that the first principal component obtained from a principal component analysis of the four network measures that they use captures nearly 70 percent of the variation in the four measures. Since the loadings are similar for all four measures, they create an equal-weighted average quintile rank for each of the four centrality measures. We conduct a similar principal component analysis using our four centrality measures and find that the first principal component explains 78.2 percent of the variation. We also find that the loadings on the four measures are similar across all four measures of centrality. We, therefore, create a fifth measure, *Network Centrality*, that is based on the quintile rank of the first principal component score of the four network measures. For brevity, we use *Network Centrality* in our robustness checks and cross-sectional tests only.

### 3.3 Firm performance measures

The literature has used several different measures of firm performance. However, data limitations related to private firms present some challenges to using all these measures. For instance, while a market-based measure of performance such as Tobin's Q can be used for public firms, private firms do not have publicly available market values to calculate this measure. Our analysis is therefore limited to the operating performance of the firm. We follow Horton et al. (2012) and Larcker et al. (2013) and use the one-year-ahead changes in the return on assets (denoted as *Return on Assets*) and the return on equity (denoted as *Return on Equity*) as our main proxies for firm performance. Additionally, we follow Campello (2006) and Cooper et al. (2008) and use growth in sales and growth in assets as alternative measures of the performance and growth of firms.

### 3.4 Financial slack and employee productivity measures

To assess the relationship between boardroom centrality and firm efficiency, we use two distinct measures. First, we argue that hoarding large amounts of cash presents an agency problem since such cash could be used for investments. It can also signal that a firm has fewer growth opportunities and is therefore accumulating cash and cash equivalents. Moreover, George (2005) shows that discretionary financial slack (measured through cash and cash equivalents) has important implications for the performance of private firms. We, therefore, measure financial slack as the ratio of cash and cash equivalents to total assets. To measure employee productivity, we follow Cronqvist et al. (2009) and use a variation of sales per employee.

### 3.5 Baseline empirical model

To assess the centrality-performance relationship ( $H1a$ ), we estimate the model in Eq. (6):

$$\begin{aligned}
 &Performance_{t+1} \\
 &= \alpha + \beta_1 Q(Centrality)_t + \beta_2 Firm\ Size_t + \beta_3 Firm\ Age_t + \beta_4 Sales\ Growth_t \\
 &+ \beta_5 Leverage_t + \beta_6 Cash\ Ratio_t + \beta_7 Tangibility\ Ratio_t + \beta_8 Capital\ Expenditure_t \quad (6) \\
 &+ \beta_x Industry\ FE + \beta_y Country\ FE + \beta_z Year\ FE + \varepsilon
 \end{aligned}$$

where *Performance* is the one-year-ahead changes in *Return on Assets* and *Return on Equity*, and the one-year-ahead growth in sales and assets. For *H1b*, we use *Cash Ratio* and  $\Delta$ *Employee Productivity* as our dependent variables. *Q(Centrality)* is the individual quintile rank for *Degree Centrality*, *Closeness Centrality*, *Brokerage Position*, and *Eigenvector Centrality*, respectively. Based on prior research, we add a number of control variables to isolate their effect on firm performance. Specifically, we follow Larcker et al. (2013) and Horton et al. (2012) and add *Firm Size*, *Firm Age*, *Sales Growth*, *Leverage*, *Cash Ratio*, *Tangibility Ratio*, and *Capital Expenditure*.<sup>8</sup> All variables are defined in the Appendix in Table A1. We also add industry, county, and year fixed effects. We define industries based on the Fama and French (1997) 48-industry group by using four-digit standard industry classification codes. Unlike Larcker et al. (2013), we do not add contemporaneous performance metrics to control for momentum in performance. Specifically, there are two potential concerns in adding these metrics to our model. First, as pointed out by Larcker et al. (2013, footnote 21), adding them can introduce survivorship bias to the analyses. In our sample, requiring the presence of these metrics results in sample attrition of 3,423 firm-years. Second, as pointed out by Horton et al. (2012), adding them may result in endogeneity. Therefore, we remove the variable from our model; but our inferences are not affected if we include it. We cluster the standard errors at the firm level and report robust *t*-statistics for all our results.

To test our second hypothesis (*H2*), we estimate the model in Eq. (7):

$$\begin{aligned}
 &Performance_{t+1} \\
 &= \alpha + \beta_1 Private_t + \beta_2 Centrality_t + \beta_3 Private_t \times Centrality_t + \beta_n Controls_t \\
 &+ \beta_x Industry\ FE + \beta_y Country\ FE + \beta_z Year\ FE + \varepsilon \quad (7)
 \end{aligned}$$

where *Performance* is either the one-year-ahead changes in *Return on Assets* or the one-year-ahead growth in sales. *Private* is an indicator variable that equals one when the firm is private with limited liability, and zero when the firm is registered as public with limited liability. *Centrality* is the separate raw values of *Degree Centrality*, *Closeness Centrality*, *Brokerage Position*, and *Eigenvector Centrality*. Given that public firms are large and are significantly more likely to fall in the fifth quintile of centrality, in this specification, we use raw measures to exploit greater variation within the network centrality measures.<sup>9</sup> *Controls* is the same set of firm-level control variables as in Eq. (6). Our main variable of interest is the interaction term between *Private* and *Centrality*. If networks matter more for private firms than public firms, then we predict a posi-

<sup>8</sup> Larcker et al. (2013) add research and development (R&D) intensity as a control variable. Since this variable is almost non-existent for private firms and is largely unavailable for public firms in our sample, we add the capital expenditure ratio instead. Larcker et al. (2013) also do not use cash and tangibility ratios as additional variables. However, as Aktas, Croci, and Petmezas (2015) show that both cash and tangibility ratio can have important implications for firm performance. Therefore, we add them as control variables.

<sup>9</sup> In our sample, nearly half of all firm-year observations from public firms are in the top quintile, making it difficult to compare all public and private firms using quintiles of centrality scores.



tive and statistically significant coefficient on the interaction term. To help reduce the effect of firm size in this specification, we first use propensity score matching with one-to-one matching without replacement to find a size-matched private firm for every public firm.

## 4. Empirical analysis

### 4.1 Descriptive statistics

After estimating the raw network measures for each firm, we merge them with financial data from Orbis.<sup>10</sup> Panel A of Table 1 provides the summary statistics for our sample composition by year. Every year, we have between 18,692–20,455 firms. However, since we use the one-year-ahead values of the dependent variable in all our specifications, we lose one year of data. The final sample size is 97,562 firm-year observations after removing all public and private firms with missing accounting variables. For the sample on employee productivity, the information on employees is not available for all firms which reduces our sample size to 75,781 firm years. On average, there are 2.53 ( $246,807 \div 97,562 \approx 2.53$ ) directors per firm. The number of directors increases over time. This is consistent with the board's tasks becoming more complex and thus requiring more board expertise and members (Linck, Netter, and Yang, 2008).<sup>11</sup> Panel A also provides information on the number and percentage of isolated firms. We find that around 69 percent of our final sample are isolated firms.<sup>12</sup> Connected firms, on average, are connected to at least two other firms, as indicated by the average *Degree Centrality* score. The averages for *Closeness Centrality*, *Brokerage Position*, and *Eigenvector Centrality* of the connected firms are 0.130, 0.137, and 0.269, respectively.

Panel B of Table 1 provides the pooled descriptive statistics for our final sample.<sup>13</sup> *Firm Size* is a firm's total assets while *Total Sales* is a firm's total operating revenue and both are in millions of euros.<sup>14</sup> Our sample has a range of mostly small and medium-sized firms with a few large firms. The average (median) total assets for sample firms is €15.789 (€3.134) million.<sup>15</sup> The average (median) firm age is 23.814 (20.00) years. The average firm has 65 employees which is determined at the fiscal year-end. The average firm also has approximately 27.9 percent in non-current liabilities compared to total assets. The average (median) cash ratio is 0.124 (0.063) which indicates greater variation in the level of cash hoarding. Around 36.9 percent of a firm's total assets are tangible, and the average firm invests about 4 percent of its assets in capital expenditure. The average (median) firm has 8.5 (1.9) percent sales growth, 5.6 (3.9) percent return on assets, 11.4 (10.6) percent return on equity, 5.2 (1.4) percent growth in assets, and 5.2 (0.5) percent change in employee productivity.

<sup>10</sup> Orbis also provides delisting status, and delisting and initial public offering dates, which we use to classify firms as private or public when they are delisted or go public, respectively. We also exclude all subsidiaries from our sample since their decision-making as well as flow of information and capital is potentially affected by their parent companies.

<sup>11</sup> One potential issue with Orbis' director level data is the non-availability of director termination date for the majority of the directors. In cases where the termination date is not available, we assume the directorship to be active. In robustness checks, we also test whether our results hold if we limit our analyses to network size computed in the last year of the sample. This enables us to reduce the effect of non-availability of archival data in potentially driving our results because Orbis' current data is the most accurate. All our inferences remain unchanged if we use this methodology. Our main results are also valid if we limit our sample to only 2016.

<sup>12</sup> Given this large number, in robustness checks, we estimate our baseline results excluding the isolated firms. We obtain qualitatively similar results.

<sup>13</sup> We winsorize all continuous variables at the 1<sup>st</sup> and 99<sup>th</sup> percentile to reduce the effect of outliers.

<sup>14</sup> We choose euros as our currency when obtaining data from Orbis. To convert the currencies, Orbis allows to choose the fiscal year end date conversion rate. Hence, all our variables for the Swedish sample are converted to euros as of fiscal year end for the firms.

<sup>15</sup> To limit the number of micro firms, we place a limit of €1 million in total assets for all sample years. Our results are also robust to strictly following the definition of small and medium-sized enterprises (SMEs) provided by the European Commission and available at [https://ec.europa.eu/growth/smes/sme-definition\\_en..](https://ec.europa.eu/growth/smes/sme-definition_en..) However, we include some micro and large firms in our final sample.

**Table 1**

Sample statistics.

Panel A provides a description of the sample and average (median) centrality scores for connected firms across the sample years. Isolated firms are those that are not connected to any other firms. Descriptions of *Closeness Centrality*, *Brokerage Position*, *Degree Centrality*, and *Eigenvector Centrality* are detailed in subsection 3.2. Panel B provides the pooled descriptive statistics. *Firm Size* is a firm's total assets while *Total Sales* is a firm's total operating revenue in millions of euros. *Number of Employees* is the total number of employees as of the end of the fiscal year. *Firm Age* is in years and is calculated as the difference between the fiscal year and the incorporation year of the firm. *Sales Growth* equals a firm's change in total operating revenue multiplied by 100. *Leverage* is the firm's non-current liabilities scaled by total assets. *Cash Ratio* is the firm's cash and cash equivalents divided by total assets. *Tangibility Ratio* equals the ratio of firm's tangible assets scaled by total assets. *Capital Expenditure* is the ratio of the firm's capital expenditure scaled by total assets. *Return on Assets* is the firm's net income scaled by total assets multiplied by 100. *Return on Equity* is the firm's net income scaled by total shareholder funds multiplied by 100. *Assets Growth* equals a firm's change in total assets multiplied by 100. *ΔEmployee Productivity* is the change in a firm's total operating revenue divided by the number of employees multiplied by 100. Panel C contains pooled sample averages (medians) by firm size quintiles, and panel D presents variable averages by industry. We winsorize all continuous variables at the 1<sup>st</sup> and 99<sup>th</sup> percentile to reduce the effect of outliers.

PANEL A: SAMPLE AVERAGES BY YEAR						
	2012	2013	2014	2015	2016	Total / Sample Mean
Number of firms	18,692	19,008	19,504	19,903	20,455	97,562
Number of directors	41,775	44,684	48,208	53,568	58,572	246,807
Isolated firms	13,594	13,466	13,554	13,376	13,375	67,365
Percent isolated firms	0.727	0.708	0.695	0.672	0.654	0.690
<i>Degree Centrality</i>	2.070	2.148	2.249	2.319	2.436	2.259
	(1.000)	(1.000)	(1.000)	(1.000)	(2.000)	(1.000)
<i>Closeness Centrality</i>	0.047	0.068	0.104	0.148	0.245	0.130
	(0.007)	(0.008)	(0.010)	(0.009)	(0.009)	(0.009)
<i>Brokerage Position</i>	0.109	0.122	0.132	0.147	0.163	0.137
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
<i>Eigenvector Centrality</i>	0.232	0.251	0.291	0.274	0.287	0.269
	(0.065)	(0.081)	(0.095)	(0.105)	(0.109)	(0.093)

PANEL B: POOLED DESCRIPTIVE STATISTICS						
	Observations	Mean	Std. Dev.	P25	Median	P75
<i>Degree Centrality</i>	97,562	0.699	1.533	0.000	0.000	1.000
<i>Closeness Centrality</i>	97,562	0.040	0.172	0.000	0.000	0.006
<i>Brokerage Position</i>	97,562	0.042	0.148	0.000	0.000	0.000
<i>Eigenvector Centrality</i>	97,562	0.083	0.284	0.000	0.000	0.054
<i>Firm Size</i> (in millions of €)	97,562	15.789	53.309	1.828	3.134	7.665
<i>Total Sales</i> (in millions of €)	97,562	13.823	42.782	0.797	3.049	8.688
<i>Number of Employees</i>	86,419	65.230	520.833	3.000	13.000	35.000
<i>Firm Age</i>	97,562	23.814	17.000	12.000	20.000	29.000
<i>Sales Growth</i>	97,562	8.473	45.968	-6.747	1.852	12.641
<i>Leverage</i>	97,562	0.279	0.279	0.028	0.192	0.460
<i>Cash Ratio</i>	97,562	0.124	0.154	0.014	0.063	0.176
<i>Tangibility Ratio</i>	97,562	0.369	0.336	0.040	0.283	0.666
<i>Capital Expenditure</i>	97,562	0.040	0.086	0.000	0.012	0.055
<i>Return on Assets</i>	97,562	5.615	9.411	0.510	3.880	9.420
<i>Return on Equity</i>	97,562	11.352	35.191	1.650	10.590	23.200
<i>Assets Growth</i>	97,562	5.229	20.429	-5.200	1.392	11.001
<i>ΔEmployee Productivity</i>	76,107	5.166	36.070	-8.942	0.481	11.111

PANEL C: SAMPLE AVERAGES (MEDIAN) BY FIRM SIZE QUINTILES					
	1 (Small)	2	3	4	5 (Large)
<i>Degree Centrality</i>	0.307	0.403	0.586	0.829	1.392
	(0.000)	(0.000)	(0.000)	(0.000)	(1.000)
<i>Closeness Centrality</i>	0.015	0.019	0.027	0.045	0.098
	(0.000)	(0.000)	(0.000)	(0.000)	(0.006)
<i>Brokerage Position</i>	0.014	0.019	0.029	0.049	0.103
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
<i>Eigenvector Centrality</i>	0.031	0.043	0.064	0.097	0.184
	(0.000)	(0.000)	(0.000)	(0.000)	(0.049)
<i>ln(Firm Size)</i>	1.379	2.039	3.212	6.556	67.585
	(1.383)	(2.017)	(3.147)	(6.115)	(25.852)
<i>ln(Firm Age)</i>	21.945	22.018	22.567	24.228	28.460
	(20.000)	(20.000)	(20.000)	(21.000)	(22.000)
<i>Return on Assets</i>	5.453	6.259	6.248	5.713	4.361
	(4.070)	(4.645)	(4.380)	(3.860)	(2.760)
<i>Sales Growth</i>	5.056	8.013	9.600	9.885	9.831
	(0.109)	(1.689)	(2.584)	(2.422)	(2.249)
<i>Observations</i>	19,616	19,464	19,725	19,811	18,946

PANEL D: SAMPLE AVERAGES BY INDUSTRY								
	Obs.	<i>Degree Centrality</i>	<i>Closeness Centrality</i>	<i>Brokerage Position</i>	<i>Eigenvector Centrality</i>	<i>Firm Size</i>	<i>Firm Age</i>	<i>Return on Assets</i>
Consumer non-durables	5,547	0.494	0.035	0.031	0.053	8.882	25.371	4.792
Consumer durables	926	0.581	0.036	0.029	0.066	17.276	32.462	5.376
Manufacturing	7,847	0.555	0.028	0.030	0.063	13.111	28.519	6.411
Oil and gas	78	0.282	0.021	0.011	0.020	3.738	22.218	4.949
Business equipment	2,585	0.551	0.038	0.034	0.056	12.934	20.281	7.158
Telephone and television	283	1.293	0.154	0.126	0.136	61.489	30.343	3.804
Wholesale and retail	19,218	0.417	0.021	0.019	0.040	10.270	26.279	6.793
Healthcare and medical equip.	1,063	0.478	0.045	0.043	0.057	18.030	19.467	8.584
Utilities	1,870	1.464	0.100	0.126	0.156	49.209	27.182	1.569
All other industries	58,145	0.817	0.047	0.051	0.103	17.415	22.177	5.218

Panel C contains the pooled sample averages (medians) by firm size quintiles. The network measures are highly correlated with firm size. Therefore, to mitigate concerns of multi-collinearity, we follow Larcker et al. (2013) and calculate quintile ranks of network measures based on the quintile ranks of firm size measured as the natural logarithm of total assets. The difference between the fifth and fourth quintile average total assets indicates that there are fewer large firms in the sample. The averages across all variables are similar which indicates uniformity in the sample by size quintiles. It appears that large firms introduce skewness in the sample; however, their exclusion does not influence our results. Panel D provides mean values for selected variables across different industries. Based on firm size and degree centrality scores, firms in the utilities, telephone, and television industries are the largest and have the highest number of direct connections.

#### 4.2 Boardroom centrality and firm performance: Tests of H1a

Table 2 presents our main results from regressing the firm-specific, one-year-ahead changes in *Return on Assets* and *Return on Equity* on the quintile ranks of four measures of boardroom centrality based on the regression specification in Eq. (6). In the first four columns, when we use one-year-ahead changes in *Return on Assets* as the dependent variable, the coefficients for our four measures of network centrality are positive and statistically significant at the 1 percent level. In the next four columns, when we use the one-year-ahead changes in *Return on Equity* as the dependent variable, we once again find that our four measures of boardroom centrality are positively associated with firm performance. This is in line with our predictions in the first hypothesis (*H1a*) that private firms with more central boards outperform those with less central boards. The results are also economically meaningful. For instance, from the coefficients for *Eigenvector Centrality* in columns (4) and (8), we can infer that firms in the highest (fifth) quintile experience on average an increase in *Return on Assets* and *Return on Equity* per year that is 0.236 percent  $[(5 - 1) \times 0.059]$  and 0.920 percent  $[(5 - 1) \times 0.230]$  more than firms in the lowest (first) quintile, respectively.

The coefficients for *Firm Size* are negative and statistically significant which indicates that larger firms have relatively lower performance than smaller firms. The coefficients for *Firm Age* are positive potentially because private firms are more likely to perform better as they grow older. The coefficients for *Leverage* are positive and statistically significant in all the models. This is consistent with Larcker (2013) and the concept that levered firms have performance metrics to meet and have better growth. Profitability is also negatively correlated with cash holdings (*Cash Ratio*) and tangible assets (*Tangibility Ratio*). In contrast, greater levels of capital expenditure are positively associated with firm performance. This is indicated by the positive and statistically significant coefficients for *Capital Expenditure*.

**Table 2**

Boardroom centrality and firm performance.

This table contains results from regressing firm-specific one-year-ahead changes in *Return on Assets* and *Return on Equity* on the quintile ranks of four measures of boardroom centrality. *Return on Assets* is the firm's net income scaled by total assets multiplied by 100. *Return on Equity* is the firm's net income scaled by stockholder's equity multiplied by 100.  $\Delta$  indicates the one-year-ahead minus current year percentage change in the variable. Descriptions of *Degree Centrality*, *Closeness Centrality*, *Brokerage Position*, and *Eigenvector Centrality* are detailed in subsection 3.2. Quintile ranks are formed using the centrality measures from director information every year, where higher (lower) values are assigned a rank 5 (1). *Firm Size* equals the natural logarithm of total assets. *Firm Age* equals the natural logarithm of the firm's age. *Sales Growth* equals the firm's change in total operating revenue multiplied by 100. *Leverage* is the firm's non-current liabilities scaled by total assets. *Cash Ratio* is the firm's cash and cash equivalents divided by total assets. *Tangibility Ratio* equals the ratio of the firm's tangible assets scaled by total assets. *Capital Expenditure* is the ratio of the firm's capital expenditure scaled by total assets. Industry, country, and year fixed effects are included throughout. The *t*-statistics based on firm clustered robust standard errors are shown in parentheses. Levels of significance are indicated by \*, \*\*, and \*\*\* for 10%, 5%, and 1%, respectively.

DEPENDENT VARIABLE:	ONE-YEAR-AHEAD $\Delta$ RETURN ON ASSETS				ONE-YEAR-AHEAD $\Delta$ RETURN ON EQUITY			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Q( <i>Degree Centrality</i> )	0.058*** (4.12)				0.223*** (3.36)			
Q( <i>Closeness Centrality</i> )		0.059*** (4.23)				0.234*** (3.60)		
Q( <i>Brokerage Position</i> )			0.056*** (2.96)				0.296*** (3.20)	
Q( <i>Eigenvector Centrality</i> )				0.059*** (4.28)				0.230*** (3.58)
Firm Size	-0.303*** (-17.55)	-0.304*** (-17.59)	-0.303*** (-17.33)	-0.304*** (-17.60)	-0.784*** (-10.19)	-0.789*** (-10.22)	-0.802*** (-10.33)	-0.789*** (-10.23)
Firm Age	0.124*** (4.04)	0.124*** (4.04)	0.121*** (3.93)	0.125*** (4.04)	0.784*** (5.27)	0.785*** (5.27)	0.782*** (5.26)	0.785*** (5.28)
Sales Growth	-0.017*** (-16.96)	-0.017*** (-16.96)	-0.017*** (-16.95)	-0.017*** (-16.96)	-0.053*** (-15.07)	-0.053*** (-15.07)	-0.053*** (-15.06)	-0.053*** (-15.07)
Leverage	1.968*** (15.99)	1.968*** (15.99)	1.971*** (16.02)	1.968*** (15.99)	3.348*** (5.10)	3.348*** (5.09)	3.356*** (5.11)	3.348*** (5.10)
Cash Ratio	-4.463*** (-21.09)	-4.462*** (-21.09)	-4.478*** (-21.17)	-4.461*** (-21.08)	-9.026*** (-13.56)	-9.022*** (-13.56)	-9.074*** (-13.64)	-9.020*** (-13.55)
Tangibility Ratio	-0.774*** (-7.88)	-0.773*** (-7.88)	-0.781*** (-7.96)	-0.773*** (-7.88)	-0.278 (-0.59)	-0.275 (-0.59)	-0.298 (-0.63)	-0.275 (-0.58)
Capital Expenditure	2.140*** (5.83)	2.140*** (5.83)	2.123*** (5.78)	2.141*** (5.83)	4.835*** (2.93)	4.840*** (2.93)	4.804*** (2.91)	4.842*** (2.94)
Intercept	1.760*** (8.97)	1.763*** (8.99)	1.808*** (9.22)	1.765*** (9.00)	0.520 (0.59)	0.527 (0.59)	0.710 (0.80)	0.536 (0.60)
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.018	0.018	0.018	0.018	0.008	0.008	0.008	0.008
Observatio	97,536	97,536	97,536	97,536	97,536	97,536	97,536	97,536

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Table 3 presents the alternative test results for hypothesis (H1a) by replacing changes in Return on Assets and Return on Equity with growth in sales and assets as the dependent variables. The coefficients for the network measures remain positive and statistically significant in all these specifications. These regression results demonstrate that better networking firms outperform worse networking firms in terms of growth in sales and assets and are consistent with the concept that extended boardroom networks, *ceteris paribus*, provide a net gain to firms. The findings are also in line with our predictions in hypothesis H1b and the findings of Horton et al. (2012) and Larcker et al. (2013) who show that the connectedness and boardroom centrality positively influence the future performance and growth of the UK and US public firms, respectively.

#### 4.3 Boardroom centrality and firm performance: Test of H1b

In the second part of our first hypothesis, *H1b*, we argue that private firms with more central boards hoard less cash and have greater employee productivity. To test this argument, we estimate the regression model in Eq. (6) and use the one-year-ahead cash ratio (*Cash Ratio*) and the one-year-ahead changes in sales per employee ( $\Delta$ *Employee Productivity*) as the dependent variables. The results in Table 4 indicate that private firms with more central boards hoard less cash and cash equivalents, as indicated by the negative and statistically significant coefficients for all four measures of boardroom centrality. In columns (5)-(8), we find that well-connected private firms also have better employee productivity. These sets of results further support our predictions in *H1b* and show that greater network centrality provides private firms with more channels of information and resource exchange that can lead to more growth opportunities by decreasing the need to hoard cash and by improving employee productivity.

#### 4.4 Boardroom centrality and firm performance in private and public firms: Test of H2

We next test *H2*. Specifically, we estimate the regression model in Eq. (7) and apply propensity score matching to control for the variation in sizes across public and private firms. To implement propensity score matching, we require a one-to-one match, without replacement, and a caliper of 0.05 to obtain a size-matched private firm for each public firm. This process results in a matched sample of 4,846 firm-year observations (2,423 public and 2,423 private firm-years). The reasoning behind matching on firm size is to allow for the correct estimation of the effect of network size on performance. Including all private firms in our model leads to an incorrect comparison of the small, medium, and large private firms pooled together against primarily large public firms.

Table 5 provides the results of this test. We use the one-year-ahead changes in *Return on Assets* and the one-year-ahead *Sales Growth* as proxies for the performance and growth of firms, respectively.<sup>16</sup> Our main variable of interest is the interaction term (*Private* × *Centrality*). We find that when we use the one-year-ahead changes in *Return on Assets* as our dependent variable and *Degree Centrality*, *Closeness Centrality*, and *Brokerage Position* as our main measures of network centrality in the first three columns, the interaction terms are negative and statistically insignificant. In column (4), when we use *Eigenvector Centrality*, the interaction term turns positive and is statistically significant at the 10 percent level. This significance indicates that while other forms of network centrality do not contribute to greater performance in private firms compared to public ones, having more influential connections (as captured by eigenvector centrality) is positively associated with better performance in private than in public firms. The

<sup>16</sup> The results are similar if we use *Return on Equity* and *Assets Growth*; therefore, for brevity, we only report the results based on *Return on Assets* and *Sales Growth*.

**Table 3**

Boardroom centrality and firm performance: Alternative measures of firm performance and growth.

This table contains results from regressing firm-specific one-year-ahead percentage *Sales Growth* and *Assets Growth* on the quintile ranks of four measures of boardroom centrality. *Sales Growth* equals the firm's change in total operating revenue multiplied by 100. *Assets Growth* equals the firm's change in total assets multiplied by 100. Descriptions of *Degree Centrality*, *Closeness Centrality*, *Brokerage Position*, and *Eigenvector Centrality* are detailed in subsection 3.2. Quintile ranks are formed using the centrality measures from director information every year, where higher (lower) values are assigned a rank 5 (1). *Firm Size* equals the natural logarithm of total assets. *Firm Age* equals the natural logarithm of the firm's age. *Leverage* is the firm's non-current liabilities scaled by total assets. *Cash Ratio* is the firm's cash and cash equivalents divided by total assets. *Tangibility Ratio* equals the ratio of the firm's tangible assets scaled by total assets. *Capital Expenditure* is the ratio of the firm's capital expenditure scaled by total assets. Industry, country, and year fixed effects are included throughout. The *t*-statistics based on firm cluster robust standard errors are shown in parentheses. Levels of significance are indicated by \*, \*\*, and \*\*\* for 10%, 5%, and 1%, respectively.

DEPENDENT VARIABLE:	ONE-YEAR-AHEAD SALES GROWTH				ONE-YEAR-AHEAD ASSETS GROWTH			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Q( <i>Degree Centrality</i> )	0.345*** (3.64)				0.175*** (3.87)			
Q( <i>Closeness Centrality</i> )		0.351*** (3.75)				0.171*** (3.87)		
Q( <i>Brokerage Position</i> )			0.366*** (2.86)				0.166*** (2.76)	
Q( <i>Eigenvector Centrality</i> )				0.356*** (3.83)				0.168*** (3.80)
Firm Size	-0.399*** (-3.28)	-0.404*** (-3.32)	-0.407*** (-3.32)	-0.407*** (-3.35)	-0.475*** (-8.10)	-0.476*** (-8.11)	-0.475*** (-8.04)	-0.476*** (-8.11)
Firm Age	-2.827*** (-12.82)	-2.827*** (-12.83)	-2.842*** (-12.89)	-2.825*** (-12.81)	-1.503*** (-13.85)	-1.504*** (-13.86)	-1.513*** (-13.94)	-1.504*** (-13.86)
Sales Growth	-0.103*** (-17.14)	-0.103*** (-17.14)	-0.103*** (-17.12)	-0.103*** (-17.14)	0.006*** (3.40)	0.006*** (3.40)	0.006*** (3.42)	0.006*** (3.40)
Leverage	2.943*** (3.29)	2.942*** (3.29)	2.958*** (3.31)	2.942*** (3.29)	-4.602*** (-12.95)	-4.602*** (-12.95)	-4.594*** (-12.92)	-4.601*** (-12.94)
Cash Ratio	-11.534*** (-10.28)	-11.532*** (-10.28)	-11.621*** (-10.37)	-11.525*** (-10.27)	-1.611*** (-3.03)	-1.613*** (-3.04)	-1.658*** (-3.13)	-1.612*** (-3.03)
Tangibility Ratio	-10.351*** (-13.66)	-10.348*** (-13.65)	-10.389*** (-13.73)	-10.346*** (-13.65)	-2.029*** (-6.75)	-2.029*** (-6.75)	-2.050*** (-6.83)	-2.029*** (-6.75)
Capital Expenditure	40.836*** (20.70)	40.837*** (20.71)	40.752*** (20.68)	40.847*** (20.71)	15.907*** (18.06)	15.903*** (18.06)	15.856*** (18.01)	15.903*** (18.06)
Intercept	17.975*** (13.45)	17.994*** (13.46)	18.263*** (13.66)	18.000*** (13.47)	12.363*** (19.20)	12.377*** (19.22)	12.507*** (19.46)	12.384*** (19.24)
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.027	0.027	0.027	0.027	0.023	0.023	0.023	0.023
Observations	97,536	97,536	97,536	97,536	97,536	97,536	97,536	97,536

**Table 4**

Boardroom centrality, financial slack, and employee productivity.

This table contains results from regressing firm-specific one-year-ahead *Cash Ratio* and change in *Employee Productivity* on the quintile ranks of four measures of boardroom centrality. *Cash Ratio* is the firm's cash and cash equivalents divided by total assets.  $\Delta$ *Employee Productivity* is the change in the firm's total operating revenue divided by the number of employees multiplied by 100.  $\Delta$  indicates the one-year-ahead minus current year percentage change in the variable. Descriptions of *Closeness Centrality*, *Brokerage Position*, *Degree Centrality*, and *Eigenvector Centrality* are detailed in subsection 3.2. Quintile ranks are formed using the centrality measures from director information every year, where higher (lower) values are assigned a rank 5 (1). *Firm Size* equals the natural logarithm of total assets. *Firm Age* equals the natural logarithm of the firm's age. *Sales Growth* equals the firm's change in total operating revenue multiplied by 100. *Leverage* is the firm's non-current liabilities scaled by total assets. *Cash Ratio* is the firm's cash and cash equivalents divided by total assets. *Tangibility Ratio* equals the ratio of the firm's tangible assets scaled by total assets. *Capital Expenditure* is the ratio of the firm's capital expenditure scaled by total assets. Industry, country, and year fixed effects are included throughout. The *t*-statistics based on firm clustered robust standard errors are shown in parentheses. Levels of significance are indicated by \*, \*\*, and \*\*\* for 10%, 5%, and 1%, respectively.

DEPENDENT VARIABLE:	ONE-YEAR-AHEAD CASH RATIO				ONE-YEAR-AHEAD $\Delta$ EMPLOYEE PRODUCTIVITY			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Q( <i>Degree Centrality</i> )	-0.001*** (-3.08)				0.255*** (2.87)			
Q( <i>Closeness Centrality</i> )		-0.001*** (-3.08)				0.248*** (2.85)		
Q( <i>Brokerage Position</i> )			-0.001*** (-2.88)				0.299** (2.46)	
Q( <i>Eigenvector Centrality</i> )				-0.000*** (-3.01)				0.242*** (2.80)
Firm Size	-0.003*** (-16.06)	-0.003*** (-16.04)	-0.003*** (-15.81)	-0.003*** (-16.03)	-0.685*** (-6.30)	-0.686*** (-6.31)	-0.689*** (-6.35)	-0.686*** (-6.30)
Firm Age	-0.000 (-0.89)	-0.000 (-0.88)	-0.000 (-0.84)	-0.000 (-0.88)	-1.035*** (-5.09)	-1.036*** (-5.10)	-1.037*** (-5.09)	-1.037*** (-5.10)
Sales Growth	-0.000** (-2.43)	-0.000** (-2.43)	-0.000** (-2.44)	-0.000** (-2.43)	-0.125*** (-20.24)	-0.125*** (-20.24)	-0.125*** (-20.24)	-0.125*** (-20.24)
Leverage	-0.027*** (-19.89)	-0.027*** (-19.90)	-0.027*** (-19.91)	-0.027*** (-19.90)	4.055*** (4.70)	4.056*** (4.70)	4.058*** (4.70)	4.056*** (4.70)
Cash Ratio	0.800*** (226.36)	0.800*** (226.36)	0.800*** (226.52)	0.800*** (226.35)	-7.763*** (-8.09)	-7.765*** (-8.10)	-7.830*** (-8.17)	-7.764*** (-8.10)
Tangibility Ratio	-0.006*** (-5.30)	-0.006*** (-5.30)	-0.006*** (-5.25)	-0.006*** (-5.30)	-6.761*** (-9.17)	-6.763*** (-9.18)	-6.814*** (-9.28)	-6.765*** (-9.18)
Capital Expenditure	0.004 (1.44)	0.004 (1.44)	0.004 (1.47)	0.004 (1.44)	12.468*** (6.89)	12.464*** (6.89)	12.434*** (6.87)	12.465*** (6.89)
Intercept	0.054*** (21.61)	0.054*** (21.60)	0.053*** (21.47)	0.054*** (21.59)	15.889*** (12.52)	15.911*** (12.54)	16.042*** (12.65)	15.917*** (12.54)
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.688	0.688	0.688	0.688	0.029	0.029	0.029	0.029
Observations	97,536	97,536	97,536	97,536	75,781	75,781	75,781	75,781

**Table 5**  
 Boardroom centrality and firm performance in private versus public firms.  
 This table contains results from regressing firm-specific one-year-ahead changes in *Return on Assets* and one-year-ahead *Sales Growth* on the four measures of boardroom centrality using a sample of both private and public firms. *Return on Assets* is the firm's net income scaled by total assets multiplied by 100. *Sales Growth* equals the firm's change in total operating revenue multiplied by 100.  $\Delta$  indicates the one-year-ahead minus current year percentage change in the variable. *Private* equals one if the firm is private with limited liability, and zero if the firm is public with limited liability. *Centrality* is one of the four measures of boardroom centrality. Descriptions of *Degree Centrality*, *Closeness Centrality*, *Brokerage Position*, and *Eigenvector Centrality* are detailed in subsection 3.2. *Firm Size* equals the natural logarithm of total assets. *Firm Age* equals the natural logarithm of the firm's age. *Leverage* is the firm's non-current liabilities scaled by total assets. *Cash Ratio* is the firm's cash and cash equivalents divided by total assets. *Tangibility Ratio* equals the ratio of the firm's tangible assets scaled by total assets. *Capital Expenditure* is the ratio of the firm's capital expenditure scaled by total assets. Industry, country, and year fixed effects are included throughout. The t-statistics based on firm clustered robust standard errors are shown in parentheses. Levels of significance are indicated by \*, \*\*, and \*\*\* for 10%, 5%, and 1%, respectively.

DEPENDENT VARIABLE: CENTRALITY MEASURE:	ONE-YEAR-AHEAD $\Delta$ RETURN ON ASSETS				ONE-YEAR-AHEAD SALES GROWTH			
	DEGREE CENTRALITY	CLOSENESS CENTRALITY	BROKERAGE POSITION	EIGENVECTOR CENTRALITY	DEGREE CENTRALITY	CLOSENESS CENTRALITY	BROKERAGE POSITION	EIGENVECTOR CENTRALITY
	(3)	(1)	(2)	(4)	(5)	(6)	(7)	(8)
Private	-0.176 (-0.43)	-0.311 (-0.78)	-0.080 (-0.18)	-0.390 (-1.65)	-3.236 (-1.18)	-2.766 (-1.06)	-2.775 (-1.07)	-2.694 (-1.23)
Centrality	0.089 (1.53)	0.145 (0.26)	1.083 <sup>*</sup> (1.76)	0.040 (0.97)	-0.269 (-0.72)	-2.779 (-0.93)	-0.311 (-0.09)	0.067 (0.36)
<i>Private</i> × <i>Centrality</i>	-0.022 (-0.26)	-0.084 (-0.10)	-0.409 (-0.49)	0.137 <sup>*</sup> (1.75)	0.475 (0.71)	0.082 (0.02)	5.037 (0.86)	2.146 <sup>**</sup> (2.37)
Firm Size	-0.378 <sup>***</sup> (-3.76)	-0.333 <sup>***</sup> (-3.19)	-0.394 <sup>***</sup> (-4.12)	-0.334 <sup>***</sup> (-3.47)	-1.261 (-1.67)	-1.141 (-1.62)	-1.433 <sup>**</sup> (-2.07)	-1.454 <sup>**</sup> (-2.12)
Firm Age	0.142 (1.28)	0.140 (1.24)	0.138 (1.24)	0.157 (1.39)	-4.440 <sup>***</sup> (-3.82)	-4.496 <sup>***</sup> (-3.96)	-4.437 <sup>***</sup> (-3.95)	-4.276 <sup>***</sup> (-3.93)
Sales Growth	-0.013 <sup>***</sup> (-2.71)	-0.013 <sup>***</sup> (-2.71)	-0.013 <sup>***</sup> (-2.71)	-0.013 <sup>***</sup> (-2.67)	-0.021 (-0.84)	-0.021 (-0.85)	-0.020 (-0.83)	-0.019 (-0.74)
Leverage	2.267 <sup>***</sup> (4.73)	2.282 <sup>***</sup> (4.87)	2.271 <sup>***</sup> (4.82)	2.275 <sup>***</sup> (4.68)	5.358 (1.52)	5.295 (1.50)	5.347 (1.49)	5.290 (1.42)
Cash Ratio	-5.861 <sup>***</sup> (-3.56)	-5.872 <sup>***</sup> (-3.60)	-5.881 <sup>***</sup> (-3.58)	-5.909 <sup>***</sup> (-3.57)	3.568 (0.38)	3.698 (0.39)	3.556 (0.38)	3.718 (0.40)
Tangibility Ratio	-1.208 <sup>*</sup> (-1.68)	-1.291 <sup>*</sup> (-1.77)	-1.192 (-1.67)	-1.309 <sup>*</sup> (-1.86)	-15.528 <sup>***</sup> (-4.73)	-15.726 <sup>***</sup> (-5.08)	-15.229 <sup>***</sup> (-4.85)	-15.406 <sup>***</sup> (-5.14)
Capital Expenditure	15.222 <sup>***</sup> (4.43)	15.189 <sup>***</sup> (4.41)	15.237 <sup>***</sup> (4.42)	15.202 <sup>***</sup> (4.47)	60.656 <sup>***</sup> (4.44)	60.817 <sup>***</sup> (4.45)	60.661 <sup>***</sup> (4.44)	60.749 <sup>***</sup> (4.25)
Intercept	-1.537 (-1.32)	-1.912 (-1.50)	-1.400 (-1.26)	-1.845 (-1.56)	19.148 <sup>***</sup> (2.89)	17.087 <sup>***</sup> (2.34)	20.821 <sup>***</sup> (3.26)	20.802 <sup>***</sup> (3.15)
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.024	0.024	0.025	0.025	0.034	0.034	0.034	0.038
Observations	4,846	4,846	4,846	4,846	4,846	4,846	4,846	4,846



results in columns (5)-(8) present a similar case in which the coefficients for the interaction terms in the first three columns are positive but statistically insignificant while the eigenvector centrality for the interaction term between *Private* and *Centrality* is positive and statistically significant at the 5 percent level. We, therefore, find some support for *H2* that networks are of more significance for the performance and growth of private than public firms.

#### 4.5 Robustness checks

In this subsection, we examine the robustness of our results given different specifications. We first repeat our analysis for firms across different age groups and different mixes of capital structures. Firms strive towards optimizing their capital structure. In doing so, they can face different challenges. For instance, firms with lower debt can encounter constraints in acquiring external financing (Beck and Demircuc-Kunt, 2006). Extremely low levels of debt may also be associated with lower investment opportunities. In contrast, highly leveraged firms face agency problems (Fama and French, 1998) and bankruptcy costs (Baxter, 1967; Kim, 1978).

To tackle these challenges, the boardroom networks can play a vital role. Larcker et al. (2013) provide evidence that networks are more important for certain types of firms. Specifically, they show that younger firms and firms in financial distress benefit the most from boardroom networks and have stronger performance-centrality relationships. We provide consistent evidence in Table 6. The table presents the results of regressing the one-year-ahead changes in *Return on Assets* on boardroom centrality measures in samples of young (old) and low (high) leverage firms. The first two columns indicate that younger firms benefit more from the networks. Table 6 also shows that the performance-centrality relationship is stronger when firms have lower leverage.<sup>17</sup> This result is not consistent with Larcker et al. (2013) and can be attributed to the riskiness of private firms with larger debts. In untabulated results, we also find that central firms with negative growth in *Return on Assets* in the current year have better future performance. These results support the concept that firms in need of resources benefit more from boardroom networks.

Despite adding country-level fixed effects throughout, we also test whether our results are driven by country-level omitted explanatory variables by estimating profitability regressions separately for the Finnish and Swedish firms. The results in Table 6 show that our findings are robust at the country level. The effect seems to be slightly more positive for Finnish firms despite the smaller sample size.

Table 7 presents results from additional robustness tests. The first two columns present results with extended windows of performance. The two results indicate that firms with larger networks also outperform firms with fewer networks in the long run.<sup>18</sup> Column (3) presents results with industry-adjusted performance metrics. The coefficient for the quintile rank of our aggregate measure is positive and statistically significant at the 1 percent level which suggests that our results are robust to using alternative industry-adjusted measures of firm performance. In column (4), we apply two-way, firm, and year-clustered standard errors. The two-way clustering accounts for both cross-sectional and time-series dependence in the standard errors (Petersen, 2009). When we correct for both cross-sectional and time-series dependence in the standard errors, our *t*-statistics are lower but statistically significant at the 5 percent level.

<sup>17</sup> To test the statistical significance of these differences in coefficients of  $Q(\text{Network Centrality})$ , we conduct an F-test. The associated chi-square value indicates that the difference in columns (1) and (2) is statistically significant at the 10 percent level while the difference in column (3) and (4) is statistically significant at the 5 percent level.

<sup>18</sup> In untabulated results, we also run year-by-year regressions and find that our results are statistically significant in three out of five years of our sample.

**Table 6**  
 Boardroom centrality and firm performance: Cross-sectional tests  
 This table contains cross-sectional tests for the centrality-performance relationship shown in Table 2. The dependent variable is one-year-ahead changes in *Return on Assets*. *Return on Assets* is the firm's net income scaled by total assets multiplied by 100.  $\Delta$  indicates the one-year-ahead minus current year percentage change in the variable. *Network Centrality* is the first principal component formed through a principal component analysis of the four centrality measures described in subsection 3.2. Quintile ranks are formed using the first principal component every year, where higher (lower) values are assigned a rank 5 (1). Young (old) firms are defined as those falling in the bottom (top) terciles of firm age in a given year. Low (high) leverage firms are defined as those falling in the bottom (top) terciles of leverage in a given year. *Firm Size* equals the natural logarithm of total assets. *Firm Age* equals the natural logarithm of the firm's age. *Sales Growth* equals the firm's change in total operating revenue multiplied by 100. *Leverage* is the firm's non-current liabilities scaled by total assets. *Cash Ratio* is the firm's cash and cash equivalents divided by total assets. *Tangibility Ratio* equals the ratio of the firm's tangible assets scaled by total assets. *Capital Expenditure* is the ratio of the firm's capital expenditure scaled by total assets. Industry, country, and year fixed effects are included throughout. The *t*-statistics based on firm clustered robust standard errors are shown in parentheses. Levels of significance are indicated by \*, \*\*, and \*\*\* for 10%, 5%, and 1%, respectively.

DEPENDENT VARIABLE:	ONE-YEAR-AHEAD $\Delta$ RETURN ON ASSETS					
	YOUNG (1)	OLD (2)	LOW LEVERAGE (3)	HIGH LEVERAGE (4)	FINLAND (5)	SWEDEN (6)
Q( <i>Network Centrality</i> )	0.066*** (2.73)	0.047** (2.00)	0.098*** (2.81)	0.031 (1.57)	0.060** (2.46)	0.055*** (3.28)
Firm Size	-0.312*** (-9.21)	-0.274*** (-10.37)	-0.349*** (-7.41)	-0.221*** (-8.80)	-0.197*** (-7.06)	-0.349*** (-16.25)
Firm Age	0.022 (0.20)	0.309*** (3.11)	0.083 (1.01)	0.156*** (3.46)	0.112** (2.08)	0.128*** (3.44)
Sales Growth	-0.013*** (-8.61)	-0.021*** (-10.60)	-0.018*** (-9.69)	-0.011*** (-7.69)	-0.019*** (-10.57)	-0.016*** (-13.72)
Leverage	1.907*** (9.02)	1.967*** (9.26)	-3.652 (-0.87)	2.064*** (8.35)	1.704*** (8.94)	2.125*** (13.76)
Cash Ratio	-5.002*** (-12.37)	-3.969*** (-11.69)	-3.873*** (-12.22)	-5.389*** (-8.36)	-3.977*** (-10.00)	-4.634*** (-18.68)
Tangibility Ratio	-1.026*** (-5.88)	-0.647*** (-3.80)	0.144 (0.50)	-1.082*** (-6.90)	-0.491*** (-3.22)	-0.952*** (-7.57)
Capital Expenditure	2.927*** (4.59)	1.766*** (2.73)	2.553* (1.76)	1.527*** (3.36)	3.030*** (4.34)	1.901*** (4.41)
Intercept	2.357*** (5.66)	0.757 (1.72)	1.523*** (2.64)	1.450*** (4.79)	0.528 (1.41)	2.581*** (11.11)
Industry Fixed Effects	Yes	Yes	Yes	Yes	No	No
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.017	0.017	0.014	0.013	0.023	0.018
Observations	32,615	31,545	27,842	34,901	24,242	73,294

**Table 7**

Boardroom centrality and firm performance: Robustness checks

This table contains robustness checks for our baseline model in Table 2. In columns (1) and (2) the dependent variable is two and three years of cumulative change in *Return on Assets*, respectively. In column (3), the dependent variable is industry-adjusted *Return on Assets*. In all other columns, the dependent variable is the one-year-ahead changes in *Return on Assets*, where *Return on Assets* is the firm's net income scaled by total assets multiplied by 100. *Network Centrality* is the first principal component formed through principal component analysis of the four centrality measures described in subsection 3.2. Quintile ranks are formed using the first principal component every year, where higher (lower) values are assigned a rank 5 (1). *Firm Size* equals the natural logarithm of total assets. *Firm Age* equals the natural logarithm of the firm's age. *Sales Growth* equals the firm's change in total operating revenue multiplied by 100. *Leverage* is the firm's non-current liabilities scaled by total assets. *Cash Ratio* is the firm's cash and cash equivalents divided by total assets. *Tangibility Ratio* equals the ratio of the firm's tangible assets scaled by total assets. *Capital Expenditure* is the ratio of the firm's capital expenditure scaled by total assets. Industry, country, and year fixed effects are included throughout. In column (3), the clustering is based on both firm and year to account for both cross-sectional and time-series dependence. In all other columns, the *t*-statistics based on firm clustered robust standard errors are shown in parentheses. Levels of significance are indicated by \*, \*\*, and \*\*\* for 10%, 5%, and 1%, respectively.

DEPENDENT VARIABLE:	CUMULATIVE ΔRETURN ON ASSETS	CUMULATIVE ΔRETURN ON ASSETS	ONE-YEAR-AHEAD ΔRETURN ON ASSETS	ONE-YEAR- AHEAD ΔRETURN ON ASSETS	ONE-YEAR-AHEAD ΔRETURN ON ASSETS	ONE-YEAR-AHEAD ΔRETURN ON ASSETS	ONE-YEAR- AHEAD ΔRETURN ON ASSETS
	LONGER WINDOW (TWO YEARS)	LONGER WINDOW (THREE YEARS)	INDUSTRY ADJUSTED PERFORMANCE	TWO-WAY CLUSTERS	WITHOUT SIZE ADJUSTMENT	EXCLUDING ISOLATED FIRMS	FIRMS WITH NO CHANGE IN CENTRALITY
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
<i>Q(Network Centrality)</i>	0.047** (2.03)	0.076** (2.54)	0.058*** (4.22)	0.058** (2.09)	0.057*** (4.23)	0.164*** (2.82)	0.037** (2.08)
Firm Size	-0.336*** (-11.66)	-0.275*** (-7.41)	-0.303*** (-17.55)	-0.304*** (-9.61)	-0.311*** (-17.58)	-0.199** (-6.80)	-0.312*** (-13.48)
Firm Age	0.165*** (3.11)	0.230*** (3.40)	0.124*** (4.03)	0.124*** (2.86)	0.124*** (4.02)	0.034 (0.64)	0.181*** (4.46)
Sales Growth	-0.017*** (-14.72)	-0.018*** (-11.89)	-0.017*** (-16.98)	-0.017*** (-8.78)	-0.017*** (-16.96)	-0.013*** (-7.60)	-0.021*** (-15.32)
Leverage	2.660*** (14.03)	3.206*** (13.22)	1.960*** (15.95)	1.968*** (19.76)	1.968*** (15.99)	1.581*** (7.61)	1.908*** (12.44)
Cash Ratio	-5.657*** (-17.78)	-6.915*** (-16.68)	-4.445*** (-21.05)	-4.462*** (-15.64)	-4.462*** (-21.09)	-4.809*** (-10.53)	-4.649*** (-17.35)
Tangibility Ratio	-1.162*** (-7.19)	-1.671*** (-7.90)	-0.769*** (-7.84)	-0.773*** (-5.48)	-0.773*** (-7.87)	-0.790*** (-4.61)	-0.771*** (-6.28)
Capital Expenditure	2.119*** (4.50)	1.880*** (3.30)	2.126*** (5.80)	2.140*** (2.67)	2.138*** (5.82)	4.258*** (6.17)	2.165*** (4.91)
Intercept	1.803*** (5.34)	1.367*** (3.23)	1.708*** (8.72)	1.765*** (3.80)	1.825*** (9.30)	0.602 (1.15)	2.040*** (8.18)
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.022	0.026	0.017	0.018	0.018	0.015	0.021
Observations	70,493	48,537	97,536	97,536	97,536	30,176	63,575

Since the correlation between our network measures and firm size are not as high as those reported by Larcker et al. (2013), we repeat our analysis without the size adjustment. The results in column (5) indicate that our findings are robust to the size adjustment. Similarly, the percentage of isolated firms (firms with no connections) is considerably higher in our sample. We test our results after excluding the isolated firms. The results provided in column (6) of Table 7 are consistent with those in Table 2. The coefficient is positive and statistically significant at the 1 percent level. These robustness tests show that our results are in line with the concept that networks help in generating growth and improving profitability.

## 5. Alternative explanations and additional analyses

We acknowledge that there could be several alternative causal explanations for our results. For instance, profitable firms arguably may attract highly networked individuals (Masulis and Mobbs, 2014). This attraction can in turn increase a firm's overall centrality. Therefore, a case for reverse causality could be made. Larcker et al. (2013) address this issue and provide some causal evidence for boardroom centrality and future firm performance. In line with their work, we also use certain specifications that can mitigate the endogeneity concerns and show why a case for reverse causality is weak. First, we look at the centrality-performance relationship by regressing the one-year-ahead changes in profitability measures on current year quintiles of centrality measures. Second, we rerun our models on a subsample of firms for which there are no changes in a firm's degree centrality from the previous year. The results of these specifications are reported in column (7) of Table 7. Our main findings remain unchanged and signify that the future performance of connected firms is higher even in the sample of firms that have no changes in board connections from the previous year. This result mitigates the concern that board prestige can attract directors since the centrality of boards remains unchanged in our specification. Therefore, improvements in future performance can be attributed to the current connectedness of the firm. Finally, in tabulated results, we assess the determinants of board networks, and we find no evidence that past performance influences future changes in boardroom networks. This result means that the case for reverse causality is weak.

To further demonstrate the importance of board networks as well as their practical implications, we conduct additional analyses on newly interlocked boards. Specifically, we study a unique sample of firms that have no board interlocks in the previous year but establish one in the current year. We compare these firms against a group of firms that never establish an interlock during the entire sample period. The pooled results shown in Table 8 indicate that changes in first-degree linkages positively influence future firm performance. Our results are consistent with the notion that initiating directorship interlocks are associated with immediate economic benefits. However, our results do not mean that non-interlocking firms should initiate an interlock to achieve better performance. As Larcker et al. (2013) point out, firms in reality face financial and nonfinancial constraints in initiating an interlock, and the process may not be easy. Furthermore, our network measures are calculated relative to other firms and since firms almost never have any discretion on how connected other firms are, we cannot estimate the exact economic benefits a firm gets when increasing its board network.

**Table 8**

Boardroom centrality and firm performance of newly interlocked firms.

This table contains results from regressing firm-specific one-year-ahead changes in *Return on Assets* and *Return on Equity*, and *Sales Growth* and *Assets Growth* on a sample of newly interlocked and isolated firms. *Return on Assets* is the firm's net income scaled by total assets multiplied by 100. *Return on Equity* is the firm's net income scaled by stockholder's equity multiplied by 100.  $\Delta$  indicates the one-year-ahead minus current year percentage change in the variable. *Sales Growth* equals the firm's change in total operating revenue multiplied by 100. *Assets Growth* equals the firm's change in total assets multiplied by 100. *Interlocking* equals one if the firm has any change in its first-degree network links after being previously isolated, and zero if the firm remains isolated for the entire sample period. First-degree links are defined as two firms sharing at least one board director. *Firm Size* equals the natural logarithm of total assets. *Firm Age* equals the natural logarithm of the firm's age. *Leverage* is the firm's non-current liabilities scaled by total assets. *Cash Ratio* is the firm's cash and cash equivalents divided by total assets. *Tangibility Ratio* equals the ratio of the firm's tangible assets scaled by total assets. *Capital Expenditure* is the ratio of the firm's capital expenditure scaled by total assets. Industry, country, and year fixed effects are included throughout. The *t*-statistics based on firm clustered robust standard errors are shown in parentheses. Levels of significance are indicated by \*, \*\*, and \*\*\* for 10%, 5%, and 1%, respectively.

	ONE-YEAR-AHEAD $\Delta$ RETURN ON ASSETS (1)	ONE-YEAR-AHEAD $\Delta$ RETURN ON EQUITY (2)	ONE-YEAR-AHEAD SALES GROWTH (3)	ONE-YEAR-AHEAD ASSETS GROWTH (4)
Interlocking	0.438** (2.03)	1.400 (1.48)	2.145*** (4.29)	2.472** (2.51)
Firm Size	-0.372*** (-15.00)	-1.024*** (-9.99)	-0.295*** (-3.50)	-0.290* (-1.82)
Firm Age	0.205*** (4.75)	0.943*** (4.79)	-1.584*** (-10.36)	-2.154*** (-7.33)
Sales Growth	-0.024*** (-14.79)	-0.066*** (-13.01)	0.009*** (3.47)	-0.129*** (-14.83)
Leverage	2.145*** (12.31)	5.649*** (6.31)	-5.093*** (-10.36)	3.037** (2.40)
Cash Ratio	-4.551*** (-15.92)	-9.401*** (-10.50)	-2.478*** (-3.58)	-13.738*** (-9.65)
Tangibility Ratio	-0.742*** (-5.47)	-1.545*** (-2.61)	-1.578*** (-3.86)	-9.183*** (-8.64)
Capital Expenditure	2.072** (4.23)	4.119** (2.10)	13.494*** (11.96)	34.274*** (14.63)
Intercept	2.394*** (8.92)	3.543*** (3.21)	10.233*** (11.71)	11.987*** (7.42)
Industry Fixed Effects	Yes	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Adjusted R-squared	0.024	0.011	0.024	0.030
Observations	51,229	51,229	51,229	51,229

## 6. Limitations and conclusion

We acknowledge that there are limitations to our results. To begin with, our centrality measures are subject to several theoretical assumptions on the flow of information. First, we assume that formal boardroom networks represent the only channels of information exchange while in reality, social networks go beyond formal interlocks. Second, the measures are simple and may not necessarily reflect the complex settings in practice. For instance, information exchange might occur through indirect routes as opposed to the shortest path. The second limitation concerns the interpretation of the results and their practical implications. Except for sudden director deaths, board changes are rarely exogenous. Instead, the number of directors will typically change to a new optimum following a shock (Harris and Raviv, 2008). The effects of such shocks may vary by managerial ownership which has a nonlinear relationship with firm performance (Barnhart and Rosenstein, 1998; Morck, Yeung, and Yu, 2000). Hence, the unavailability of the managerial ownership data poses a potential limitation to our results. Nevertheless, our methodology is consistent with the dominant literature that does not control for ownership (e.g. Larcker, So, and Wang, 2013). Further, a firm's centrality measures are relative to the connections of other firms over which it may not have any control. Under these circumstances, the economic benefits that network extension can provide are conditional on the quality of available directors and the costs related to acquiring them. Therefore, our results do not indicate that initiating or increasing board interlocks always results in economic rents. Further, we cannot eliminate the endogeneity concerns even though we provide several specifications to mitigate them.

Boardroom centrality constitutes a nascent stream of literature in corporate finance. Studies linking boardroom centrality and firm performance have previously concentrated on public firms in the common law countries. We contribute to this strand of literature by constructing a boardroom network for private firms – a setting never explored before. We use data from Finland and Sweden to study the influence of network centrality on the future performance and efficiency of firms. We show that private firms, *ceteris paribus*, earn a net benefit from having an extended boardroom network. Specifically, we show that our network measures are positively correlated with the one-year-ahead growth in return on assets and other performance measures. We also find that firms with central boards have better performance efficiency. These results are robust to a range of sensitivity tests. We also show that private firms with greater eigenvector centrality outperform size-matched public firms. Further analyses also show that private firms benefit from networks when they need informational resources the most. Collectively, our results contribute to the social networks literature and provide a promising avenue for deepening our understanding of corporate finance and governance in private firms.

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## Appendix A

**Table A1**

Variable definitions

DEPENDENT VARIABLES	
$\Delta$ Return on Assets	One-year-ahead change in return on assets (i.e., FY1 minus current year <i>Return on Assets</i> ) when <i>Return on Assets</i> is the firm's net income scaled by total assets multiplied by 100.
$\Delta$ Return on Equity	One-year-ahead change in return on equity (i.e., FY1 minus current year <i>Return on Equity</i> ) when <i>Return on Equity</i> is the firm's net income scaled by total stockholder's equity multiplied by 100.
Sales Growth	One-year-ahead change in total operating revenue multiplied by 100.
Assets Growth	One-year-ahead change in total assets multiplied by 100.
Cash Ratio	One-year-ahead cash and cash equivalents divided by total assets
$\Delta$ Employee Productivity	One-year-ahead change in the firm's total operating revenue divided by the number of employees multiplied by 100.
Cumulative $\Delta$ Return on Assets	Cumulative change in <i>Return on Assets</i> over the next two or three years, depending on the model.
Industry-Adjusted $\Delta$ Return on Assets	One-year-ahead change in industry-adjusted return on assets (i.e., FY1 minus current year industry-adjusted <i>Return on Assets</i> ) when industry adjustment is based on the annual average <i>Return on Assets</i> in the Fama and French (1997) 48-industry groupings.
CENTRALITY MEASURES	
Degree Centrality	A measure of network centrality that captures the total direct connections of a firm. For a more detailed description and an example, please see subsection 3.2 and Figure 1.
Closeness Centrality	A measure of network centrality that captures the average distance of all firms from the focal firm in a network. For a more detailed description and an example, please see subsection 3.2 and Figure 1.
Brokerage Position	A measure of network centrality based on Horton et al. (2012) that captures the ability of a firm to connect with loosely connected or unconnected networks. For a more detailed description and an example, please see subsection 3.2 and Figure 1.
Eigenvector Centrality	A measure of network centrality that captures the strength of both direct and indirect connections of a firm. For a more detailed description and an example, please see subsection 3.2 and Figure 1.
Network Centrality	First principal component formed through principal component analysis of the four centrality measures described in subsection 3.2.
OTHER INDEPENDENT VARIABLES	
Firm Size	Natural logarithm of total assets in thousands of euros.
Firm Age	Natural logarithm of the firm's age in years that is calculated as the difference between the fiscal year and incorporation year of the firm.
Sales Growth	Current year-over-year change in total operating revenue multiplied by 100.
Leverage	Non-current liabilities scaled by total assets.
Cash Ratio	Cash and cash equivalents divided by total assets.
Tangibility Ratio	Tangible assets scaled by total assets.
Capital Expenditure	Capital expenditure scaled by total assets, where capital expenditure is estimated as fixed assets in the current year minus fixed assets in the previous year plus depreciation and amortization in the current year.
Private	Equals one if the firm is private with limited liability, and zero if the firm is public with limited liability.
Centrality	A variable denoting one of the four measures of boardroom centrality described in subsection 3.2.
Interlocking	Equals one if the firm has any change in its first-degree network links after being previously isolated, and zero if the firm remains isolated for the entire sample period. First-degree links are defined as two firms sharing at least one board director.

# Short-Term Crisis Management of Solo Entrepreneurs during the COVID-19 Pandemic

Anna-Mari Simunaniemi, Martti Saarela, Matti Muhos, Santeri Halonen, Eeva Leinonen, Heli Kurikkala and Markus Rytinki

## Abstract

This multiple case study investigates short-term crisis management among solo entrepreneurs during the COVID-19 crisis. The study focuses on the immediate business impacts and entrepreneurs' strategic management responses within a short-term period at the beginning of the global pandemic. The data consist of repeated thematic interviews with nine Finnish solo entrepreneurs. A model of strategic responses to the crisis was used to analyze the retrenchment, perseverance, and innovation actions. This study introduces a novel, adjusted version of the model with a focus on solo entrepreneurs' short-term managerial responses to crises. Cutting down costs and temporary closure of businesses were typically adopted as immediate retrenchment actions. Persevering actions involved the use of personal savings, applying for grants, and manufacturing products for future needs. As for innovation actions, entrepreneurs focused on the renewal of marketing strategies and business models.

## Keywords:

crisis management, solo entrepreneurs, entrepreneurship, managership, COVID-19 pandemic, retrenchment, perseverance, innovation actions

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Anna-Mari Simunaniemi (Ph.D. in Food, nutrition and dietetics) is a Research Director of the Micro-entrepreneurship Center of Excellence MicroENTRE at the Kerttu Saalasti Institute, University of Oulu, Finland.

Martti Saarela (Ph.D. in Industrial Engineering) is a Development Manager of the Micro-entrepreneurship Center of Excellence MicroENTRE at the Kerttu Saalasti Institute, University of Oulu, Finland.

Matti Muhos (Dr.Sc. Tech., Industrial Engineering and Management) is a Professor and the Director of the Kerttu Saalasti Institute at the University of Oulu, Finland. He holds a title of Docent in Technology Management at the Faculty of Information Technology at the University of Jyväskylä."

Santeri Halonen is a Project Researcher at the Micro-entrepreneurship Center of Excellence MicroENTRE at the Kerttu Saalasti Institute, University of Oulu, Finland.

Eeva Leinonen is a Project Researcher at the Micro-entrepreneurship Center of Excellence MicroENTRE at the Kerttu Saalasti Institute, University of Oulu, Finland.

Heli Kurikkala is a Doctoral Researcher in the Doctoral Programme in Education and Society at Tampere University, Finland.

Markus Rytinki (Ph.D. in Information Science) is a Project Researcher at the Micro-entrepreneurship Center of Excellence MicroENTRE at the Kerttu Saalasti Institute, University of Oulu, Finland.

## **1 Introduction**

In crisis periods, entrepreneurs take important roles in improving products and services and evolving new technologies (Ratten, 2021). A crisis is an umbrella term referring to any kind of disasters, business interruptions, catastrophes, emergencies, or contingencies (Herbane, 2010). One of the most used definitions is Pearson and Clair's (1998) who defined a crisis as "a low-probability, high-impact situation that is perceived by critical stakeholders to threaten the viability of the organization" (p.66). In this paper, the concept of crisis management refers to how entrepreneurs act to diminish the consequences of a crisis (Spillan and Hough, 2003). Entrepreneurial individuals' ability to have a flexible response to external changes guarantees the survival of business (Frangieh & Rusu, 2021).

The scale of business is likely a major factor affecting the proportions of losses, as bigger companies are more probable to have added resources and a more resistant business structure, whereas the smaller the company, the smaller its resources are, making it sensitive to any kinds of disturbances (Farlie, 2020, p.738). Crises in general create resource availability and liquidity problems for small- and medium-sized enterprises (SMEs), as customers cut down on purchases and financiers become more cautious (Eggers, 2020). Lack of finance is one of the most obvious consequences of crises for SMEs, whereas opportunity-based management, entrepreneurial orientation, and entrepreneurial expertise are factors promoting business survival (Eggers, 2020). Doern, Williams, and Voreley (2019) conducted a literature review on entrepreneurship and crises showing that whether and how entrepreneurs respond to a crisis may be contingent on various reasons, including experience, stage of business development, the type or stage of the crisis impacting on the business, and resources, both in terms of how resources are utilized as well as the suitability of resources. All in all, this study attempts to respond to a need to examine in depth the factors behind managerial responses to the situational circumstances of a crisis (Wenzel, Stanzke & Lieberman, 2020). By analysing the case data of nine solo entrepreneurs' business impacts and managerial actions during the first months of the COVID-19 crisis, we provide new empirical insights on the practices of crisis management and provide an adjusted framework on short-term crisis managerial actions building on the literature overview by Wenzel, Stanzke, and Lieberman (2020, p.8) and empirical analyses among European family businesses by Kraus, Clauss, Breier, Gast, Zardini and Tiberius (2020). As little is known about the temporal dynamics involved in strategic responses to crises, we focus in this study on the crisis management phase following the actual crisis incident, which can also be called a reactive or responsive crisis management strategy (Alonso-Almeida et al. 2015).

### **1.1 The COVID-19 pandemic and businesses**

On March 11, 2020, the World Health Organization (WHO) declared COVID-19 a pandemic, and authorities globally followed by setting national shutdowns. The Finnish Government declared The Emergency Power Act, granting additional powers to authorities on March 16, 2020. The act was exercised until June 15, 2020 which also sets the timeframe for the present study.

The crisis hit unexpectedly with massive disruptions to business markets, and it pushed all kinds of businesses to adapt their operations in resilient ways (Verma & Gustafsson, 2020). Investigation of a company's ability to act in response to a crisis is significantly pertinent in the COVID pandemic (Margherita & Heikkilä, 2021). Only a few small companies had created a crisis plan beforehand, and far from all of them found their existing crisis plans to be useful in dealing with the COVID-19 situation (Fasth, Elliot, & Styhre, 2021). The crisis necessitated the renewal of business management strategies to keep businesses agile and productive. Even in the

world's leading business corporations, the COVID-19 emergency urged new ways to face supply chain interruptions, shifts in customer demands, and risks to workforce health (Margherita & Heikkilä, 2021).

There already is a rapidly growing body of published studies on the overall influence of COVID-19 on businesses (Verma & Gustafsson, 2020), as well as on the challenges and opportunities the crisis provided for SMEs (see Eggers, 2020). Analyses of the impacts of COVID-19 revealed that companies and their supply chains may lack flexibility, diversity, and slack, which are essential to resilience against crises (Zhu et al., 2020). During the present crisis, businesses tried to sustain their cash flows by cutting non-essential costs and modifying their business models to maintain or grow revenue (Ratten, 2021). Generally, the most pressing concern for businesses enduring the COVID-19 crisis was surviving an event that had a scale of a structural break and that challenged all traditional business models (Kahveci, 2021). Small businesses are a fundamental instrument for economic growth and, it is, therefore, useful to focus on how small businesses dealt with the crisis (Ratten, 2021; Kahveci, 2021).

There is also a rapidly expanding body of literature analyzing the impacts of the COVID-19 pandemic on solo entrepreneurs. This is not surprising, as the pandemic hit hard to self-employed (Graeber, Kritikos & Seebauer, 2021; Kalenkoski & Wulff, 2021). They seem to have suffered more strongly than other parts of the working population (Block et al., 2020). Blundell and Machin (2020) revealed that approximately 75 percent of the self-employed reported a reduction of work in April 2020. Beland, Fakorede & Mikola (2020) reported an unambiguous, over 10 percent, decrease in self-employed businesses in Canada during the first months of the pandemic, with the largest decrease in the business sector of art, culture, and recreation. Yue and Cowling (2021) noticed that the large reductions in income clearly caused a worsening of self-reported well-being among self-employed compared to waged employees during the pandemic. Moreover, some studies have pointed out that among the self-employed, women were more likely to experience income losses, as they tend to work in service industries that were more severely affected by the COVID-19 pandemic (Kalenkoski & Wulff, 2021; Graeber et al., 2021).

## 1.2 Solo entrepreneurs and crisis management

Microenterprises with less than ten employees comprise most of all businesses globally. The specific focus on solo entrepreneurs is reasoned by the increasing role of self-employment and entrepreneurship in modern economies (Graeber, Kritikos & Seebauer, 2021). More and more individuals employ themselves through businesses of their own; in Finland, the number of solo entrepreneurs increased by 50% during the 2000s. In a dictionary, self-employment is defined as “the situation of working for yourself and not being employed by a company” (Oxford Learner’s Dictionaries, 2020). Self-employment is something referred to as “the simplest kind of entrepreneurship” (Blanchflower & Oswald, 1998), and they are sometimes accused of low productivity (Acs, 2006). However, solo entrepreneurs contribute greatly to modern national economies as they enable client firms and network partners to operate in a more agile and cost-effective manner, while also introducing innovations to their clients (Burke, 2011; Burke & Cowling, 2015). As stated in topical academic discussion, micro-enterprises without immediate growth intentions are strongly underrepresented in the small business management literature (Rasthollo-Horrillo, 2021) although they need management strategies and practices equally to any other company (Lieberman-Yaconi, Hooper & Hutchings, 2010). The focus of this paper is on solo entrepreneurs, who represent a large proportion of businesses, albeit with the smallest

amount of available resources, but who, on the other hand, can be flexible and quick to adapt their operations in times of change. The term solo entrepreneur is used to refer to individuals who are business owners without employees (e.g., Wennekers & Thurik, 1999).

Small businesses might be distinctly exposed to crises due to size-related characteristics (Battisti & Deakins, 2017; Vargo & Seville, 2011), although small businesses on the other hand have a strategic advantage in their flexibility and adaptability, which grants them the ability to react swiftly to changing environments (Vargo & Seville, 2011). Given the economic significance and vulnerability of small businesses, we need to gain an understanding of how their owners think and act in relation to crisis management efforts in business disturbances (Herbane, 2010). Only a few studies have examined crises among small enterprises (Doern, Williams & Vorley, 2019; Herbane, 2010; Kahveci, 2021), and hardly any of them have focused on businesses run by solo entrepreneurs. Moreover, a review by Korber and McNaughton (2017) revealed that research on this topic tends to focus on the pre-crisis stage and the capabilities or resources possessed by entrepreneurs to help in withstanding crisis events.

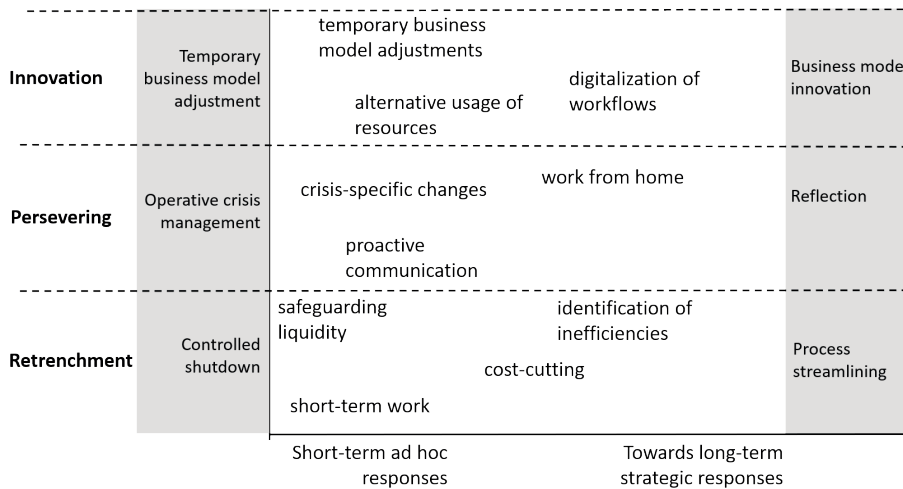
It is important to describe the strategic actions of crisis management and to consider how business managers deal with crises in practice to complement the interpretation of the impact of the COVID-19 crisis, and to comprehend the managerial measures taken shortly after the crisis began (Fasth, Elliot, & Styhre, 2021). All companies aim toward survival, but each of them proceeds from their individual starting points, and the processes to accomplish this goal are unique to each company (Kahveci, 2021). The novelty of this paper is that it details the moment-to-moment experiences of solo entrepreneurs and their crisis management strategies during the global and unexpected COVID-19 crisis. This study aims to stimulate more nuanced insights into how solo entrepreneurs can adapt their management strategies to external crises. The data are based on follow-up interviews to reveal the impacts of the COVID-19 crisis on solo entrepreneurs' businesses, and what managerial strategies the entrepreneurs applied to overcome the crisis. By integrating the on-time experiences of solo entrepreneurs during the first months of the pandemic, we pursue to foster a richer understanding of crisis management strategies.

The present study contributes to the existing research knowledge in three ways. Firstly, it brings to focus crisis management in a common yet vaguely studied group of small business owners – solo entrepreneurs. Secondly, it adds to the current literature more insights on the short-term business impacts of the unexpected global pandemic through nine real-life cases through a follow-up study design. Thirdly, it adjusts the framework by Wenzel, Stanske, and Lieberman (2020) on crisis management strategies in a new empirical setting.

### **1.3 Framework for strategic responses to crisis**

In their literature review, Wenzel, Stanske, and Lieberman (2020, p.8) found four main types of strategic responses to crisis: 1) retrenchment, 2) persevering, 3) innovating, and 4) exit. Wenzel et al. (2020, p.13) pointed out that retrenchment may help firms endure crises in the short run, whereas persevering can be an applicable strategic option in the medium-time perspective. Innovating, on the other hand, is seen as “an important, if not unavoidable” strategy in the long run. Finally, exit is not necessarily considered to be a failure or last resort, but it can free up resources for other (for example crisis-induced) business opportunities at any time. In the present study, exit as a crisis management strategy is not covered, as the empirical data consist of solo entrepreneurs who continued their businesses over the first months of the COVID-19 crisis.

Further, Kraus et al. (2020) tested and applied the model of strategic responses to the COVID-19 crisis in the context of family-owned businesses. The updated model combines response strategies with temporal perspectives. The model consists of specific managerial measures to three response strategies – retrenchment, persevering, and innovation – either as short-term ad hoc or long-term strategic interventions. In the context of the present study, only the short-term perspective is relevant and adopted as our analysis framework (see Figure 1). In the present study, the framework was used as a standing point for the qualitative content analysis to categorize managerial responses into retrenchment, persevering, and innovating actions. Descriptions of these three response categories are introduced below.



**FIGURE 1.** Analysis framework for strategic responses to a crisis. Adapted based on the models by Wenzel et al., 2020 and Kraus et al., 2020.

### 1.3.1 Retrenchment

Retrenchment implies reductions in costs, assets, products, and business operations restricting the range of a firm’s business activities (Wenzel et al., 2020). Generally, retrenchment or cost-cutting is often the main strategy that entrepreneurs choose in crises (Bruton, Ahlstrom, & Wan, 2003; Köksal & Özgül, 2007). Besides downsizing, there are many other strategies to lower costs, including government subsidies, bank and debt financial restructuring, organizational restructuring, mergers and acquisitions, alliances, or business process restructuring (Kahveci, 2021). Retrenchment promotes long-term strategic renewal, as it soothes performance declines (Pearce & Robbins, 1994; Robbins & Pearce, 1992) and sets attention on existing activities (Benner & Zenger, 2016). In the current analysis framework, a major retrenchment strategy is the controlled shutdown referred to as cost-cutting, and safe-guarding liquidity through, for example, shortened work hours (Kraus et al., 2020). The identification of inefficiencies can be launched rather early in the crisis as the first step towards process streamlining, which continues further as a long-term strategy.

### 1.3.2 Persevering

Persevering means actions targeted at maintaining existing business activities in response to crises. The strategy aims to preserve the status quo and moderate negative impacts (Wenzel et



al. 2020; Wenzel, 2015) particularly through leveraging firm-specific core competencies (De Carolis et al., 2009). In the current framework, the most significant persevering strategy is operative crisis management, whereby the short-term measures taken are proactive communication and crisis-specific changes, but also adjustments to practical ways of working, such as working from home. Working from home was particularly relevant during the COVID-19 pandemic, as distance work was rapidly adopted and even obligated through authorities. As a long-term strategy, companies can use reflection (Kraus et al., 2020).

### *1.3.3 Innovating*

Crises can also provide a chance for strategic renewal, and innovation in this perspective refers to the realization of strategic renewal as a reaction to a crisis (Wenzel *et al.*, 2020). In the framework, the short-term innovation strategy refers to temporary business model adjustments when entrepreneurs recognize opportunities based on the altered setting a crisis has created; they thus alter or adapt their business model for some time to take advantage of these prospects (Kraus et al., 2020). As practical actions, short-term innovation refers to alternative usage of resources and temporary business model modifications. In the COVID-19 crisis, the digitalization of workflows became a predominant strategy for many businesses.

## **2 Aims and research questions**

The purpose of this study is to investigate how solo entrepreneurs respond to an acute external crisis using a short-term temporal perspective. The temporal context includes the first three months of the COVID-19 crisis (March to June, 2020), and the more specific research questions are:

RQ1: What were the immediate and short-term impacts of the COVID-19 crisis on solo entrepreneurs' businesses?

RQ2: How did solo entrepreneurs respond to the COVID-19 pandemic with regards to retrenchment, persevering, and innovation?

## **3 Research process**

### **3.1 Longitudinal data collection**

The timeline in Figure 2 illustrates the monthly progression of critical events, including the most significant political decisions and legislative changes which evolved in Finland during the spring of 2020. The emergency act was officially activated on March 16<sup>th</sup>, and it lasted until June 16<sup>th</sup>, 2020. On March 31<sup>st</sup>, the operations of restaurants throughout the country were restricted, and all restaurants were mandated to be closed starting from April 4<sup>th</sup>. In addition, the act initiated various funding opportunities for solo entrepreneurs as represented in Figure 2.

### COVID-19 TIMELINE IN FINLAND



FIGURE 2. COVID-19 timeline in Finland.

This study design is a longitudinal multiple case study. Case studies are suitable for portraying the temporal, emerging nature of crises (Doern, Williams, & Vorley, 2019). The informants are solo entrepreneurs who were willing to attend follow-up interviews and contact. Case selection was based on purposive sampling (Guest et al., 2006; Morse et al., 2002); entrepreneurs from a variety of industries were included to get a varied overall description of the impact and actions related to the COVID-19 crisis. The represented branches include video production, event production, graphic design, music production, jewelry, manufacturing, digital services, food retail, and second-hand sales.

The data consist of repeated thematic follow-up interviews with entrepreneurs repeated weekly or every two weeks. The same theme set was used as the basis for all entrepreneurs including a) business impacts of COVID-19, b) managerial actions, c) current business prospects and economic buffers, d) application of business support and development funding, e) access to business counseling, and f) personal mood and well-being. The communication channel was chosen based on the preference and convenience of each informant: WhatsApp messages, written diary memos, phone discussions, Facebook Messenger, e-mail, and face-to-face discussions. The data collection was carried out from mid-March until mid-June 2020. The start and end date of data collection as well as the total number of contacts with each informant are shown in Table 1.

**Table 1.** Data collection.

CASE	COMMUNICATION CHANNELS	FOLLOW-UP PERIOD	NUMBER OF CONTACTS
A	Facebook Messenger, telephone	March 20 <sup>th</sup> to May 14 <sup>th</sup>	14
B	written diary, telephone	March 23 <sup>rd</sup> to June 21 <sup>st</sup>	6
C	email	March 30 <sup>th</sup> to June 30 <sup>th</sup>	6
D	email	March 25 <sup>th</sup> to June 30 <sup>th</sup>	9
E	telephone	March 27 <sup>th</sup> to June 18 <sup>th</sup>	6
F	telephone	March 27 <sup>th</sup> to June 18 <sup>th</sup>	6
G	telephone	March 31 <sup>st</sup> to June 15 <sup>th</sup>	8
H	telephone, Facebook Messenger	March 31 <sup>st</sup> to June 8 <sup>th</sup>	5
I	telephone, face-to-face, Whatsapp	March 26 <sup>th</sup> to June 5 <sup>th</sup>	5

### 3.2 Qualitative content analysis

Qualitative content analysis (Neergaard & Ulhøi, 2007) is presented herein on the managerial actions and managerial actions of entrepreneurs to survive and overcome the crisis. We adopted the strategic response framework based on the works by Wenzel et al. (2020) and Kraus et al. (2020) as a theoretical lens through which we explored the interview data. The interview transcripts were analyzed using NVivo 12 software as an analysis tool and codified into two primary categories: a) the immediate impact of the COVID-19 crisis on business and b) managerial actions and implications the entrepreneurs took to survive and overcome the crisis. As the interviews were conducted repeatedly over the follow-up time, the entrepreneurs always reported their current situation. In the analysis phase, the authors categorized these business impacts as immediate (approximately 1–3 weeks) and short-term (appr. 1–3 months). Likewise, the managerial responses to these impacts were placed on a continuum as immediate, short-term, or long-term responses depending on when the entrepreneurs reported these actions to occur. Finally, the managerial responses were categorized as retrenchment, innovation, or persevering actions inspired by Kraus et al. (2020) and Wenzel et al. (2020).

## 4 Findings

### 4.1 COVID-19 impact on business

Each entrepreneur described the current situation in follow-up interviews. The summaries of case-by-case stories are presented below.

#### 4.1.1 Case A: Increased demand for online streaming

Case A produces online event streaming services. As an immediate impact of the crisis, most of the pre-bookings were cancelled because live meetings were not allowed. In a few weeks, new orders re-filled the schedule as novel demand for online streaming services, such as webinars, occurred particularly among public sector officials and authorities who had an urgent need for providing crisis-related information and other services online. In March, travel restrictions and the closing of the borders to the capital region caused trouble, as the entrepreneur would have needed to attend events physically to stream them. In early April, the entrepreneur applied for economic support from the municipality and requested a temporary pause for rental payments. The bank offered a one-year break on loan payments, but the entrepreneur believed in a quick recovery and did not take advantage of it. Finally, April month exceeded the sales

of the same month in the previous year. New websites attracted new customers, but still, in early May, the entrepreneur had worries about whether any physical events could be organized in the summer. Moreover, the recruiting of the entrepreneur's first employee was postponed because of uncertainty.

#### *4.1.2 Case B: Transferring matchmaking events online*

Case B organizes business matchmaking events. Immediately after the crisis started, most pre-booked events were cancelled with a short warning. Spring being the peak season was planned to serve as an economic buffer prior to a quiet summer. The entrepreneur quickly offered new online lectures and webinars, which led to new orders within a few weeks. In early April, schools were closed, and the entrepreneur worked at home with two young children who needed constant care. A few weeks later, the entrepreneur received two development funding grants for a new technical solution. An external technical consultant was hired, and three other entrepreneurs tested the new product. In May, the focus was on marketing the new product, which led to the first orders. By the end of June, the situation seemed reasonably satisfying and there were bookings for the upcoming fall with online and hybrid events.

#### *4.1.3 Case C: Shutdown for performing artist*

Case C is a music producer whose main business is performing musical gigs and selling related promotional material. The crisis cancelled all music shows and practically shut down the business. Moreover, the entrepreneurs' children stayed at home because schools were closed, which made working almost impossible. In April, the entrepreneur started musical pedagogical coaching online, and she considered offering services to international customers through a new online course – but the plans were not implemented in the follow-up period. During the crisis, the entrepreneur was inspired to apply for musical theatre studies, which kept her occupied from developing new online-based services such as online coaching until later in June.

#### *4.1.4 Case D: Minor impact on graphic design business*

Case D is graphic designer for whom the COVID-19 crisis did not cause cancellations of pre-booked orders, but it halted new orders for several weeks. The entrepreneur had an economic buffer for about two months, and the prolonged crisis would thus disturb business later in the fall. The local public business advisory service provided information through WhatsApp: the Association of Visual Communication Designers in Finland created grants open for application, but after a few weeks of waiting her application was rejected. Moreover, her business did not fulfill the criteria for solo entrepreneurs' COVID-19 funding, as she could not demonstrate the immediate effects of the pandemic on sales. In May, the entrepreneur did not want to apply for a one-time grant from the municipality because she interpreted it as a loan. Instead, she considered applying for investment funding from the local LEADER program later, although she was unfamiliar with the application process. A minor positive signal for business upturn was an opportunity to organize an online course later after the summer. Finally, in late June, the entrepreneur concluded that the overall impact of COVID-19 remained minor for her business.

#### *4.1.5 Case E: Shortened opening hours as a reaction to customer drop*

Case E is a jewelry street-level shop with retail sales and product manufacturing, while also offering jeweler services, including repair and engraving. In March, customer flows in the

shop dropped dramatically. People cancelled and postponed all family celebrations, which dramatically decreased the need for gift items. The immediate solution was to cut down all non-necessary running costs and purchases. The entrepreneur's economic buffer was set to last a maximum of a couple of months. New products were manufactured while the shop remained closed. In April, customer flows were lower still, and the shop was closed on Saturdays. In early May, sales dropped again – yet not enough to apply for solo entrepreneur funding with the pre-requisite of a sales drop of 30 percent or more. The entrepreneur's personal economic situation remained bearable. In mid-May, Saturday openings were introduced again, and the national Mother's Day cheered up the sales temporarily. By mid-June, the summer season turned out to be significantly lower than expected.

#### *4.1.6 Case F: Material supply problems and capital bound to product stocks*

*Case F* is a manufacturing company processing side-stream material for the wood industry. In March, the first decision was to negotiate with the bank to postpone regular loan payments. The immediate business impact was minimal, but the entrepreneur was worried about the possible impact on upcoming seasons. In April, changes in consumer behavior and leisure time activities led to decreased sales. The entrepreneur was worried about whether the situation would cause problems in material logistics, and he took the opportunity to fill up on product stocks, although large stocks meant more bound capital. In May, the manufacturing hall property owner halved the monthly rent for three months. The entrepreneur applied for development funding through the Centre for Economic Development, Transport and the Environment. In June, risks for domestic material shortage were real. The running costs were covered only by using existing financial capital.

#### *4.1.7 Case G: Through temporary liquidity problems to record-high sales*

*Case G* is a mobile application developer. During the first month, the crisis did not cause a notable impact on business, and the order backlog was set to last over the summer. During the first month, the entrepreneur had already received public funding for changing the business model. The existing orders were been cancelled, but one client did not give a pre-payment. Running costs were cut down due to the business loan as well, as well as an on-hold personal house loan. Additionally, the entrepreneur's property owner agreed on a rental discount. By the end of April, minor liquidity problems caused one or two invoices to pass the due date. The general growing interest in software services and mobile applications along with the global digitalization boom, however, hoisted up the business in May. Potential customers were other companies who paid for software development with their own R&D funding grants, but long handling times and strict criteria for applicants postponed the first real deals until the end of May. The entrepreneur received one-time funding for solo entrepreneurs from the municipality, and by the end of June, the order backlog stretched to late fall and exceeded the situation of the year before.

#### *4.1.8 Case H: Rapid shutdown and re-thinking personal goals*

*Case H* is a part-time entrepreneur operating in a secondhand store that was closed already in mid-March. In April, the entrepreneur went through personal consideration to consider whether there is still a personal boost for entrepreneurship. In mid-May, general travel and social distancing restrictions were relieved, and the entrepreneur found a new eagerness to re-adjust the business towards something new. In May, the entrepreneur received COVID sup-

port vouchers from the municipality to hire two young people for the summer. Overall, the crisis made the entrepreneur to stop and re-think their own personal values, and how those values could be integrated into a more socially responsible business model.

#### *4.1.9 Case I: Unprepared for total business shutdown*

*Case I* is a retail company focused on importing selected Italian food products to restaurants. The COVID-19 crisis interrupted business immediately as restaurants were shut down. At the pandemic's most acute phase, the bank was the only alternative for providing funding. In April, the entrepreneur was worried about a sustained shutdown. In May, some restaurants were re-opened, but the situation for the case company did not seem any better. It was also probable that the prices of imported food products would need to be lowered to get them sold. The entrepreneur was offered a job as a hired salesperson in another company, but he preferred keeping up with his own business. He had made a pre-payment for a truck load of food products, which could not be transported to Finland. Some of the food products in the stock were about to expire soon if the restaurant business would not be opened soon. In early June, the entrepreneur applied for a temporary unemployment benefit uniquely offered for entrepreneurs, but he looked forward to continuing business as soon as the sales and product transportations would be running again.

Table 2 shows the case descriptions as well as the immediate (1-3 weeks) and short-term (1-3 months) impacts of the COVID-19 on their businesses, respectively.

**Table 2.** Case descriptions and business impact.

CASE	CORE BUSINESS	COMPANY AGE (YEARS)	IMMEDIATE IMPACT (1-3 WEEKS)	SHORT-TERM IMPACT (1-3 MONTHS)
A	Streaming live videos online; video production	7	cancellation of all pre-booked events; travel restrictions prevented business trips	increased demand for online streaming services; total sales exceeded the year before; hiring an employee postponed
B	Producing online and hybrid matchmaking events	6	cancellation of pre-booked events	development funding for a new technical solution; new online service was well received by customers
C	Composer, lyricist, producer	12	all music shows cancelled and business was shut down	offering new musical pedagogical coaching online; development of service portfolio and re-thinking customer segment strategy
D	Graphic design; illustrations	10	no immediate impact on pre-booked orders but new sales were stopped	no success in grant funding; in total, only minor impact on business
E	Jewelry shop	30	a dramatic drop in in-store customer flow and demand for present items	limited opening hours; still few in-store customers; generally negative impact on business and motivation
F	Wood product manufacturing	9	changes in customers' leisure time activities decreased sales	building product stocks for future demand bound financial capital and increased economic risks; problems in domestic material supply; personal capital used to survive
G	Digital applications; mobile applications	8	no immediate impact: company survived with a development funding grant received before the crisis	one client did not make a pre-payment; minor cash liquidity problems in April; new orders in May and the June result exceeded the year before
H	Sales of secondhand products	22	the shop closed immediately, scaling down the stock and increasing online sales	focus on re-adjusting the business model and re-thinking personal motivations for entrepreneurship
I	Wholesale of food products	5	sales stopped when restaurants were shut down; buying trips and transportation of products postponed	application for unemployment benefits until the business could be re-launched

### 4.2 Short-term managerial actions in the COVID-19 crisis

Managerial actions were categorized into three strategic responses: retrenchment, persevering, and innovation. The cases with different responses are presented in Table 3, and actions on each response strategy are described below.

**Table 3.** Short-term strategic managerial responses to COVID-19 crisis.

STRATEGIC RESPONSE	CASES	MANAGERIAL ACTIONS
Innovation	BDG	Re-design and development of marketing (e.g., website)
	BGH	Re-thinking business model, cost structure or pricing
	ABG	Developing entrepreneurial competence and skills
	CD	Development of new products or services
	H	Increasing online-based services and online sales
	B	Using entrepreneurial networks for new business opportunities
	FG	Looking for an employee
Persevering	BDFG	Applying for development and investment funding
	ADI	Applying for COVID support grants or unemployment benefit
	CF	Building material / product stocks
	DF	Use of personal economic capital ("slack resources")
	HI	Selling out stock products
	E	Manufacturing products for the future need
	A	Work from home ("digitalization leap")
Retrenchment	AFGH	Rental payment arrangement with the property owner
	EHI	Shortening opening hours or temporarily pausing the business
	FG	Loan arrangements with banks
	DE	Focusing on personal recovery and family time
	DE	Cutting down personal expenses
	EH	Postpone investments and purchases
	G	Rearranging invoice payment terms or paying invoices past the due date

#### 4.2.1 Retrenchment actions

Managerial actions with regard to retrenchment were applied by all except one case (B). The most common short-term retrenchment actions were negotiating lower rental costs for a temporary period (cases A, F, G, and H), as well as shortening opening hours or even pausing the business (C, E, H, I). From the financial perspective, entrepreneurs reported also making loan arrangements with banks (C, D, E), cutting down on personal expenses (D, E), and postponing investments or purchases (E, H). One entrepreneur reported actual cash liquidity problems which led to the late-paying of invoices (G). The COVID-19 crisis necessitated general social distancing and other restrictions, which gave entrepreneurs time to focus on personal recovery and family time (C, D, E). The forced pause from day-to-day business activities was not experienced as merely negative, but many entrepreneurs described it as a welcome break that allowed time for making plans for other strategic responses; i.e., persevering and innovation.

#### 4.2.2 Persevering actions

Managerial actions with regard to persevering were identified in the interviews of eight entrepreneurs. The most common persevering actions were applying for development and investment funding (cases B, D, F, and G), or for more specific COVID support grants or unemployment benefits that were uniquely available for entrepreneurs with certain criteria for a set period (A, D, I). Unfamiliarity with funding applications and a lack of information on suitable funding instruments proved a barrier to applying for external funding (C, E). Moreover, some entrepre-



neurs had to use personal savings (i.e., “slack resources”) or their spouse’s income to survive (C, D, F). When business operations were shut down temporarily, entrepreneurs were able to use the time for preparing new products or other materials for future needs (C, F), although there were troubles in material supply chains. Some tried to sell out their stock products to get some turnover (H). One entrepreneur in the food business had trouble with pre-paid products that were stuck abroad and could not be transported because of travel restrictions (I). Case E did not report persevering actions.

#### *4.2.3 Innovation actions*

We identified managerial actions with regard to innovation among seven case companies. Entrepreneurs re-designed and developed their marketing, mainly through updating their websites or making updated analyses on their current customer segments (B, D). One entrepreneur was lucky to win a free radio campaign and a business coaching session to strengthen entrepreneurial competencies (G). Re-thinking business models, cost structure, or pricing could mean, for instance, introducing a servitization-based business model with monthly fees from customers (G), or a plan to start a new company with another online-based business model better fitting the personal goals of the entrepreneur (H). Also, the development of new products or services (C, D) was reported in more than one company. Three entrepreneurs told they used the crisis time to develop their personal entrepreneurial competencies and skills (A, B, G). Two entrepreneurs were even looking for or even hiring a new employee for the summer (F, G). Two cases (E, I) did not report any innovative actions, and Case I expressed having been totally unprepared for the situation and disappointed in the state for precluding private business making.

## **5 Discussion**

This study contributes to the academic literature on crisis management and entrepreneurship by identifying the immediate and short-term impacts of the COVID-19 crisis on solo entrepreneurs’ businesses (RQ1) and integrating the strategic responses into a reference framework based on a robust literature review by Wenzel *et al.* (2020) and an empirical study among family businesses by Krause *et al.* (2020) (RQ2).

### *5.1 Business impacts*

Most of the case businesses were hit dramatically by the crisis. A couple of them survived with minor damage, and some of them even reached record-high sales exceeding the previous year towards the end of the follow-up period. Those who increased their sales were able to offer online-based services or software design quickly. Crises in general create resource availability and liquidity problems, mainly because customers cut down on purchases and financiers become more cautious (Eggers, 2020). During the COVID-19 crisis, shutting down restaurants, cancelling live meetings, and prohibiting live performances of artists led to a drop in business for some entrepreneurs, whereas this led to increasing demand for online streaming services, online matchmaking, or new software development. Particularly the latter case received new orders from companies that had received COVID-recovery funding to promote their digitalization. An earlier study on the COVID-19 business impact showed that supply chains often lack essential flexibility and diversity (Zhu *et al.*, 2020). One of the case businesses suffered from delivery problems of domestic material to manufacture new products, and another entrepreneur had a pre-paid truckload stuck abroad because of travel restrictions. None of the cases were

permanently shut down, but the crisis also forced entrepreneurs to take some time for themselves. Additional leisure time was sometimes warmly welcome and provided a well-deserved chance for re-thinking the business model or even personal goals as entrepreneurs.

### 5.2 Managerial responses to the crisis

Based on the analysis, we adjusted the existing models in the context of solo entrepreneurs (Figure 3).

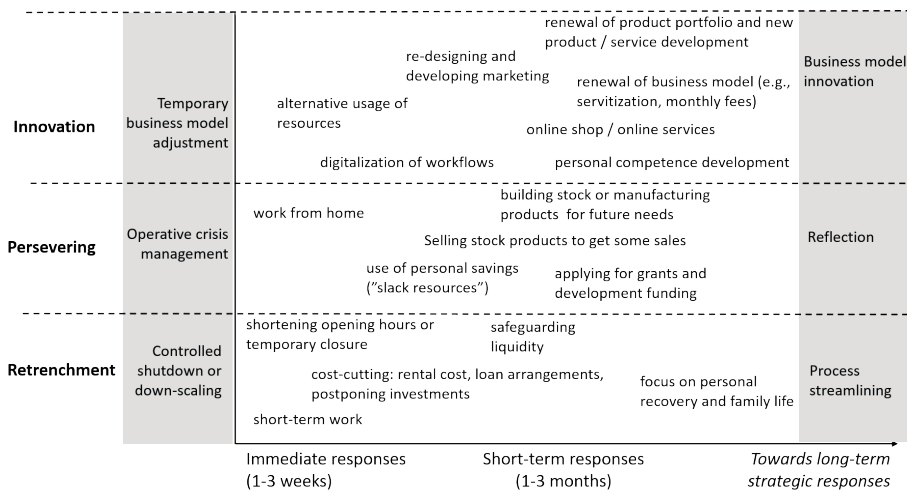


FIGURE 3. Adjusted framework for solo entrepreneurs' responses to the COVID-19 crisis

Wenzel *et al.* (2020) used the term retrenchment to refer mainly to cost-cutting, which is known to be the most common managerial response to crises. Besides downsizing, there are many strategies to lower costs, including the use of public administration subventions, financial or organization restructuring, or business process restructuring, among others (Kahveci, 2021). During the COVID-19 crisis, businesses cut down on non-essential expenses and modified existing business models to sustain revenue (Ratten, 2021). In the present study, retrenchment actions included cost-cutting mainly through temporary arrangements for rental and loan payments and the temporary closure of business.

Entrepreneurs in the present study reported persevering actions related to distance work completed from home, the use of personal savings to survive, and the manufacturing of new products or large stock purchases for future needs. Further, many financial instruments were introduced to help companies overcome the crisis. Within a few weeks or months, solo entrepreneurs looked for potential funding grants, although many of them felt confused and unsure as to where and how they could apply, or whether their businesses met the application criteria. In the short run, retrenchment can be a vital or inescapable ad-hoc response, but in a prolonged crisis, attention should be drawn to alternative strategic responses to ensure firm recovery (Wenzel *et al.*, 2020). Trouble in choosing a persevering strategy is that this response is fundamentally bound to the accessibility to slack resources, and in small businesses, economic buffers are typically low. For instance, in a 2020 study in the UK, only four SMEs in ten

had saved money for a possible crisis, and 1 one in 12 had no cash holdings whatsoever facing COVID-19 (Cowling, Brown, & Rocha, 2020, p.8); in a similar study, a typical small business in the USA was shown to have less than one month's worth of buffer in hand (Bartik et al., 2020). The business prospects of case companies in this study varied, particularly in the ambiguous situation where firms were faced with altered conditions on a day-to-day basis. In such a situation, persevering firms may surpass rivals that conduct strategic renewal (Wenzel et al., 2020). However, because of the need for slack resources, persevering will be a difficult, if not impossible, response in a prolonged crisis.

As seen in the present study, many solo entrepreneurs chose to start the development of new products or services. Like in large companies, solo entrepreneurs were also struck by rapidly declining sales, and they were forced to adapt their business models to meet the switching customer needs and demands. An external crisis often prompts temporary business model innovations also in small companies (Clauss, Breier, Kraus, Durst & Mahto, 2021). A characteristic of the COVID-19 pandemic was the dramatically increased demand for online shopping and services, which offered rapid business recovery opportunities for solo entrepreneurs who had the agility to renew their sales and marketing channels, or even business models with new forms of online-based services. Some other strategies applied by global businesses may not be directly converted to solo entrepreneurs' businesses. For instance, large companies have financial and technical assets to ensure operations during a crisis state. Moreover, it is necessary for large organizations to adopt effective business analytics methods to support data-driven leadership, whereas among solo entrepreneurs the intra-organizational information flow is very straightforward. Innovating is essential to sustain firm survival if the crisis is long-lasting and requires the exploration of complementary sources of income (Wenzel et al., 2020). The time frame for strategic renewal may be over if the entrepreneur holds back too long and use up the slack resources through persevering or retrenchment actions. While the temporary business model adjustment is essentially only new to firms and not to the industry, long-term business model innovation can be more complex (Foss & Saebi, 2017). Margherita and Heikkilä (2021) have investigated company responses to COVID-19 among the world-leading corporations. They drew recommendations for managers considering developing their response strategies for the future. Among these recommendations, they highlight a need for agile business processes, recommending the redesigning and adapting of existing business activities. In the adjusted model, there are actions both on the company and individual levels, as in solo entrepreneur businesses both levels are closely intertwined.

In his investigation on crisis management among small business owners, Herbane (2010) found that there is typically very little pre-crisis planning, and there is thus more focus on the trans- and post-crisis phases. Our follow-up period lasted for three months, and so long-term strategic responses cannot be reported here. However, identified actions related to persevering and, more importantly, innovation show preparedness for long-term responses such as process streamlining, reflection, and business model innovation. Relatively rapid actions on the renewal of marketing strategies, the introduction of online-based services and sales channels, as well as plans for the servitization of business models indicate that more permanent changes in solo entrepreneurs' businesses have been initiated by the unforeseen COVID-19 crisis.

## **6 Conclusions and implications**

We contributed to the literature with an analysis of actual on-time responses by solo entrepreneurs to face the COVID-19 pandemic. The main outcome of this analysis is an adjusted model

for solo entrepreneurs' short-term crisis management. In addition, the identified responses are placed into the framework on a chronological continuum from immediate responses to short-term responses. Compared to the original framework from the literature review of Wenzel et al. (2020) and the family business context by Kraus et al. (2020), we added focus on personal recovery and family time as a retrenchment response, working from home was applied immediately in accordance with the crisis start, and solo entrepreneurs applied more diverse persevering responses compared to other contexts (e.g. use of personal savings, applying for grants and development funding, selling stock products to get some sales, and manufacturing products for future sales). Regarding innovation responses, solo entrepreneurs were quick to adopt digitalization of workflows, whereas renewal of business models and renewal of portfolio typically occurred only after the immediate shock was over. Focus on personal competence development is also one addition to the framework compared to the previous versions. The main contribution of this study to the crisis management literature is that it provides a more nuanced understanding of the temporal process of strategic managerial actions that solo entrepreneurs apply in an acute external crisis. The retrenchment actions tend to be applied very soon when the crisis occurs, whereas over the first months the actions focused on persevering and increasingly on innovation become more relevant. These findings confirm the framework based on the works by Kraus et al. (2020) and Wenzel et al. (2020) but also provide with more elaborated description of the strategic crisis management process in the context of solo entrepreneurs.

Previous studies have shown that companies introducing any kind of innovation had a higher likelihood of surviving the crisis than non-innovators (Cefis et al., 2020). As the study by Herbane (2010) showed, small business owners characterize crises by a lack of control or cash and compressed time to respond. In the COVID-19 crisis, the situation itself was surprising, and barely anyone foresaw the extent of its impact on society. The crisis management of SMEs during the COVID-19 crisis can generally be described as reactive and informal; it thus is necessary to move towards improved systematization to balance structure and flexibility (Fasth, Elliot, & Styhre, 2021). However, it has also been recognized that micro-sized enterprises, including solo entrepreneurs, tend to be more customer-oriented and they adapt easily to changes thanks to their agile organization and flexible business models as well as their capacity to learn quickly (Rastrollo-Horrillo et al., 2021). Solo entrepreneurs' responses to the COVID-19 crisis showed, that solo entrepreneurs could quickly innovate novel online-based services and adaptations to their business models. These advantages can at least partly compensate for their less developed strategic preparation for crises, as strategic flexibility in business model innovation during COVID-19 may lead to better potential to tackle future crises (Clauss et al., 2021). Thus, the managerial implication of this study is that companies of any size, also solo entrepreneurs, should seek long-term strategic innovation actions proactively before the crisis hits. Those entrepreneurs that have alternative means to provide their services, particularly through digital platforms, have an advantageous position in pandemic situations when physical contact with customers are restricted. Also, entrepreneurs' personal competence development is a strategic investment that boosts the capability to successfully meet external crises.

The strategic choice for the data collection of this study was a rapid implementation when the wide-scale pandemic restrictions were implemented in Finland. While the quick response and on-time follow-up of the case companies is a strength of this study setting, a larger number of participating companies might have revealed other strategic responses and made the adjusted framework more comprehensive. The data collection was based on thematic, open-

ended interviews that allowed each participant to focus on those issues they felt most relevant at the present time point. Following a more systematic interview protocol might have allowed a more comprehensive analysis of each interview theme, while it could have added more stress on the participants and increased risks for dropouts at a time that was highly stressful for the target group.

A crisis can be examined from the perspective of the crisis event sequence (Turner, 1976), starting from pre-crisis planning through several phases all the way to the implementation of crisis inquiry recommendations (Doern, Williams, & Vorley, 2019). As a suggestion for future research, our understanding of crisis management among solo entrepreneurs would be boosted by observing the whole crisis sequence as a process through longitudinal research designs and an emphasis on the periods prior to, during, and after the crisis (Buchanan & Denyer, 2013; Doern, Williams, & Vorley, 2019).

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**Lahjoittaminen on tulevaisuuden sijoittamista – Liikesivistysrahasto tukee apurahoin liikkeenjohtoa palvelevaa tutkimusta, koulutusta ja julkaisutoimintaa.**

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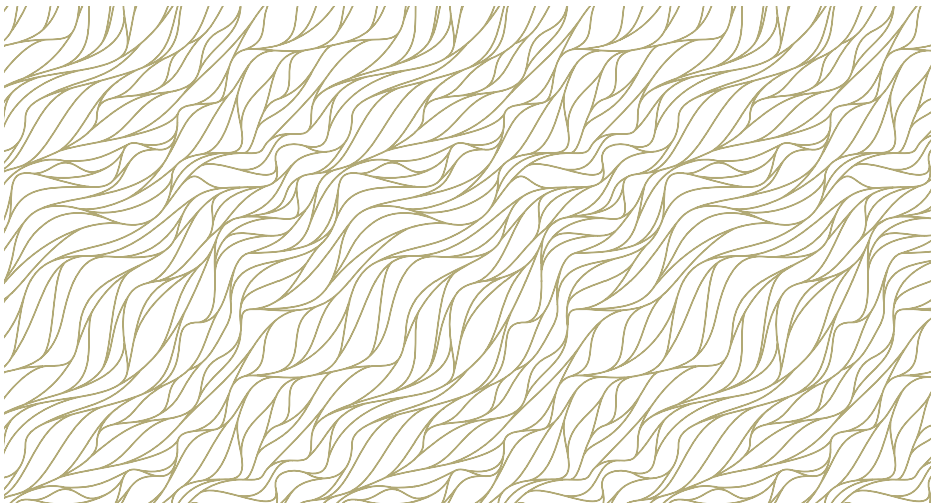
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**Editorial correspondence:** The Association of Business Schools Finland, Mr. Juuso Leivonen, Pohjoinen Makasiinikatu 7 A 2 00130 Helsinki, Finland.

**E-mail:** [editor@njb.fi](mailto:editor@njb.fi)  
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