

‘Bringing Materiality Back In’: The strength of bonds and stocks as ties in interfirm networks

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Abstract

Research into financial institutions and their organizational ties continues to draw attention from scholars across business and organization studies. However, there is a gap in the extant research in measuring the strength of the interdependent material interest in interfirm networks. This paper proposes a framework to measure that material strength of ties in organizational networks and models the social networks of decision-makers as an overlay to corporate interlocks, integrating network concepts and financial data analysis. Based on holdings and ownership data collected in 2019, the paper illustrates this by utilizing co-investor networks with 148 nodes connected in the 40 stocks of the German DAX index and 232 nodes through common ties in 35 stocks constituting the Spanish IBEX index and to measure the strength of ties. The paper offers a method to study both micro and macro phenomena in corporate interlocks of financial markets and develops three areas of possible hypothesis development relevant to international business studies: 1) Organizational and industry structures, 2) mimetic network behavior, 3) home bias and capital market liability of foreignness.

Keywords

Interfirm networks, embeddedness, investor networks, capital market liability of foreignness, home bias, organizational fields

Introduction

‘Blood is thicker than water’: the 12th century German proverb states that familial ties supersede other areas of life, such as those bonds invoked by baptismal water. But what about money and the financial bonds it forms between people and organizations, how may one approach the study of monetary ties and the materiality of such ties?

Financial markets are important playing fields for both corporate executives and financial investors alike. As much of executives' net worth is tied to their shareholdings, the rise of shareholder capitalism (Davis & Kim, 2015; Lazonick & O'Sullivan, 2000) has led executives to increasingly align corporate decisions with investor preferences. This interface of investors and corporate executives has inspired a range of organization studies and international business (IB) literatures, highlighting the networks between institutional investors, executives and publicly listed corporations (Cohen et al., 2008, 2012; Fracassi, 2016; Le & Kroll, 2017; Mintz & Schwartz, 1981, 1985; Mizuchi, 1982; Useem, 1980, 1996; Zuckerman, 2000; Zukin & DiMaggio, 1990). Shareholders influence corporate strategy directly through stewardship and proxy voting (Huang et al., 2018; Krause et al., 2013; Wasserman, 2006) and fulfill monitoring roles, such as pertaining to dividend payouts (Chang et al., 2016). Recent IB studies have also shown that the ownership structures of a company influences the degree of innovation (Shui et al., 2022) and that types of ownership structures are a variable to the overall business performance (Chen et al., 2022). This underlines the importance of studying institutional investors and the networks they inhabit.

Networks form an essential part of the investment decision-making process through information exchanges between investors and investment banks (J. A. C. Baum, Rowley, et al., 2016; Bowers et al., 2013; Cohen et al., 2010; Giorgi & Weber, 2015; Useem, 1996), and among actors in the venture capital industry, where networks are used to scan for new opportunities and enable collaboration (Batjargal, 2007; Podolny, 2001; Sorenson & Stuart, 2001, 2008; J. Zhang & Pezeshkan, 2016). Despite widespread growth in financial data availability and computational power, there has been a lack of understanding on how individual agents, with their specific attributes, shape and how material interest binds nodes in organizational networks.

This paper seeks to address this shortcoming by proposing an alternative method for the determination of organizational centrality through portfolio holdings. Holdings network analysis yields corporate interlocking networks based on securities which bind co-investors. This has the following advantages over existing price correlation studies. First, the technique of measurement is relatively simple with ordinal level strength of relationships. Second, the problem of measuring short-term relationships in price-related and high-frequency studies can be overcome. Third, researchers are able to draw inferences based on collected node attributes, such as specific geographies, useful for capital market liability of foreignness (CMLOF) or home bias studies.

Theoretically, this paper introduces an extension to the literature on corporate interlocks by refining and applying network concepts to portfolio holdings in co-investor networks. Specifically, it proposes a systematic framework to study the material strength of the social networks which exist as an overlay to corporate interlocks. It thereby answers research calls for further incorporation of network thinking and methods into IB studies (Cuypers et al., 2020), and elaborates the idea of network agency through the use of empirical data in financial markets, bridging micro and macro aspects of network behavior. This paper draws from extant IB and organization studies to illustrate how the method can contribute to theory building and hypothesis testing in three distinct IB research areas.

Theoretical Framework

Longer-term interdependent interest vs short term transactions

Network approaches have seen growing application across organization (Borgatti & Foster, 2003; Kilduff & Brass, 2010) and, to a slightly lesser extent, business studies (Cuypers et al., 2020). Network research into financial institutions has traditionally focused on ties between

corporations, investment banks and investment firms (J. A. C. Baum, Rowley, et al., 2016; Cohen et al., 2008, 2012; Fracassi, 2016), and financial securities' price correlations and contagion by financial economists (Allen et al., 2010; Allen & Babus, 2008; Brida et al., 2016; Elliott et al., 2014; Gale & Kariv, 2007). Very little attention has been paid to the intersection of the two areas of research by looking at organizational ties in co-investor networks of financial securities, such as shares and bonds. This is surprising as securities define the material interest of financial market participants across institutional investors, retail investors and corporate executives.

The growing availability of data and software programs enables novel approaches to the analysis of organizational networks. Early network studies of financial markets were developed by Baker (1984), who examined a stock option exchange in Chicago. At the time, trading activity was still very much physically linked to the exchange and the study was conducted before the advent of electronic trading. For Baker, "each location is thus the observable marketplace for specific options" (Baker, 1984, p. 776). However, financial markets lie in the securities which bind issuers, brokers and investors. There are two separate network relationships: A short term relation between buyer and seller at the point of transaction and a more medium to longer term relationship between co-holders of securities. The holdings-based network assumes that the material interest of co-owners of an asset is more strongly tied and aligned than with a buyer and seller of an asset. By definition, the material interest of the two market participants changes in an inverse direction in short term transactions, by one party selling and one party buying a certain asset. These longer-term ties are similar to what Baker (1990, pp. 594–597) referred to as the 'relationship interface', while the transactions between buyers and sellers resemble the 'transaction interface'.

Recent research has started to explore the high-frequency ties of such a transaction interface, between buyers and sellers quantitatively (Bianchi & Lomi, 2022; Lomi & Bianchi, 2021). However, longer-term changes in the financial market and material interest between corporations, cannot be captured by such high frequency exchanges. The social context of investing of the largest asset management companies is more longer-term and entails meeting corporates (Barker et al., 2012; Taffler et al., 2017; Wu, 2022) and investment analysts (Bowers et al., 2013; Giorgi & Weber, 2015) and communicating asset allocation decisions to stakeholders.

Materiality in co-investor networks

Previous sociological research found that financial capital is socially embedded (Uzzi, 1999) and that stock ownership and the institutional investor have been identified as important variables in the ruling capital classes (Mintz & Schwartz, 1981, 1985; Useem, 1980, 1984, 1996; Uzzi, 1997), depicting yet another way how stock ownership influences corporate outcomes (Useem, 1984), through co-optation on boards (Burt, 1983), but also through impact on prices (Zuckerman, 1999, 2000). Uzzi (1997) found that the multiplexity of ties in the garment industry, incorporating both producers and suppliers, lead to more common investments. Elsewhere, Mizruchi (1996, p. 289) shows that ownership concentration also impacts board decisions. In other words, the social networks of decision-makers including investors and corporate executives impact corporate investment decision-making.

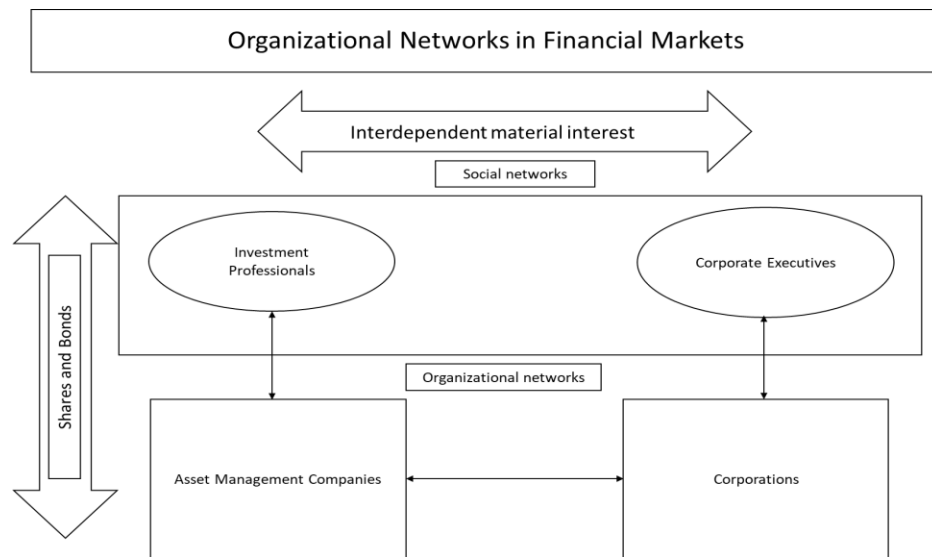
Traditionally, much of the IB literature focuses on the firm level of behavior in inter-organizational networks (Pedersen et al., 2019). However, network research has highlighted the importance of bringing the individual back in and to analyze the micro-behavior in organizational networks (Cuypers et al., 2020; Kilduff & Buengeler, 2019; Kilduff & Krackhardt, 1994).

Kilduff and Krackhardt (1994) paved the way for thinking about networks not only as a social structure, but also as constructs in individuals' minds and the way one adapts to one's perception of it through self-monitoring (Kilduff & Buengeler, 2019; Mehra et al., 2001). Such agency requires reading and interpreting the network and one's place in it. This elementary tenet of such network cognition (Brands et al., 2019) is implicit in business and management studies, for instance by studying school ties between fund managers and CEOs (Cohen et al., 2008, 2012; Fracassi, 2016) or CEO influence on post listing returns, using signaling and social capital theory (Ko & McKelvie, 2018; Le & Kroll, 2017).

As illustrated in Figure 1, this paper offers a multilevel model (Peterson et al., 2012) to analyze individual agency in the organizational networks of financial markets, as corporate interlocks are created based on individual agency; investment purchases by portfolio managers and investors. As a result this paper systematically addresses the social networks which exist as an overlay to the corporate interlocks.

The focus on ownership ties through the analysis of the corporate interlocking networks of portfolio holdings, forms a novel approach to refine and re-apply previous network research to current financial markets. Shared ownership automatically binds individuals together as their material interest is interdependent. This shared and common economic situation requires market participants to be aware of other people's actions. Co-owners of assets are likely to have more influence on each other's behavior given their shared economic position.

Figure 1. Social networks overlay the material connections of stock or bond holdings



Areas of theory and hypothesis development

Organizational fields and industry structures

Firms act and compete in organizational fields (DiMaggio & Powell, 1983; Owen-Smith & Powell, 2004; Ricciardi et al., 2018), in which competitors pay attention to their position and interests in relation to others, interacting and collaborating (Powell et al., 2005; Reagans & Zuckerman, 2001; L. Zhang & Guler, 2020; Zhelyazkov, 2018). Establishing central actors of such an organizational field is essential to assess one's position in the network as well as to explain actors' influences on the network itself (Podolny, 1993, 1994) and relationships over longer periods of time (Powell, 1990). Organizational researchers may be interested in the political economy of the organizational field (DiMaggio & Powell, 2000; Fligstein, 2001), while needing some quantitative assessment of the actors and a measure of the strength of relationships in such a field.

IB literature has also highlighted the importance of industry structures (Gulati et al., 2000), global value chains (Kano, 2018), international technology supply chains (Pham et al., 2016) and the effect signaling theory can have on share price performance (Ko & McKelvie, 2018). Like corporate executives, institutional investors apply network thinking to invest in the supply chains of IT and technology hardware firms by analyzing data points in the ‘eco system’ (Cabral & Ankit Prasad, 2017), also applied by hedge funds (Kolhatkar, 2017). From a practitioners’ perspective, this is especially relevant in the technology hardware and semiconductor industry in which the supply chain consists of listed companies across different geographies. For instance, there are semiconductor foundries in Taiwan (TSMC, UMC), including substrate suppliers, semiconductor capital equipment in Japan (Tokyo Electron) and Europe (ASML, ST Microelectronics), Integrated Circuit (IC) design houses (Marvell, Qualcomm) in the Americas and those who distribute the finished product globally (Avnet, Arrow). This holds true across other industries, such as sports shoes, where supplier companies are listed in Hong Kong and Taiwan (YueYen, Eclat Textile), operate in Vietnam, and supply to OEMs in the Americas (Nike, Under Armor). Hence, investment holdings offer an explanation into the centrality and material resources which such ties constitute. The analysis and visualization offers a useful starting point to infer interdependent interests and the positions of significant actors.

Given the often-significant amount of data in qualitative research projects, the holdings-based network analysis can be used to guide data reduction (Miles & Huberman, 1994) and can thereby serve as a key input to theoretical sampling, common in qualitative case study approaches (Eisenhardt, 1989; Welch et al., 2022; Yin, 2017). For instance in the below example, case studies or qualitative interviews could be planned at central nodes in the networks and triangulate findings at a handful of peripheral nodes.

Analyzing this interdependent material interest is one way to theorize and hypothesize about a given organizational field. Figure 2 illustrates such a visualization and associated descriptive statistics.

Insert Figure 2

Mimetic behavior and herding

IB literature has worked with the concept of boundary spanners predominantly in intra-organizational networks as individuals who mediate between senior management and the work force or headquarters and subsidiaries in multinational companies. In that body of literature, the boundary spanner fills structural holes (Burt, 1992) and is able to diffuse information effectively, aiding management practice transfer (Dong et al., 2017; Kostova & Roth, 2003; Mäkelä et al., 2019), but also innovate (Burt, 2004) and enhance entrepreneurial behavior (Nikiforou et al., 2020).

Organizational research has also found that heterogenous executive teams may function less well when coercive and mimetic pressures are high (Mehrabi et al., 2021). This has also been observed in inter-organizational networks where competitors look at each other and imitate behavior in times of uncertainty (Powell et al., 2005; White, 1981). Thus both from a micro (individual) and macro (organizational) perspective, a firm's position in a network has implications on decision-making and performance outcomes (Ahuja et al., 2012; Cuypers et al., 2020; Kilduff & Brass, 2010).

As opposed to buying and selling minority stakes in corporations, an interesting topic of investigation has been the analysis of outright acquisitions (Zhao et al., 2021). In this area of corporate strategy, awareness of network ties is pivotal to avoid premium valuations (J. A. C. Baum, Li, et al., 2016; Haunschild, 1994). 'Mutual forbearance' (Bowers et al., 2013) is another

way in which actors in a network influence another and the multiplexity of ties between individuals at the helm of corporate interlocks can lead to mimetic behavior in investment decision making (Clement & Tse, 2005; Uzzi, 1996; Wu, 2022). Increasing bridges between ties are not necessarily conducive to increased innovation in the network (Tortoriello & Krackhardt, 2010). Hernandez and Shaver (2019) show how a direct acquisition of other corporates can increase influence and the strategic position of the acquirer in a given interorganizational network. Likewise, different configurations of inter- and intrafirm network structures influence knowledge acquisition from partners of multinational companies and may hinder the effective diffusion of such knowledge across business units (Walter et al., 2007).

Taking this rationale, one can theorize that increased ties lead to increased common investment. One way to test network density is the strength of ties. Strong ties produce a close-knit network, in which ‘your friend is also my friend’. Using Borgatti and Feld’s (1994) operationalization of the strength of ties hypothesis, the two-mode network of the Dax and IBEX are taken to infer network density and mimetic behavior. The extent and strength of the relationship can be measured by the k-level of holding percentages.

The more connected the node is the more likely it is to learn from others, thereby replicating investment strategies and, in turn, causing mimetic behavior, akin to the process of network and social learning (Tortoriello et al., 2011). The micro decision of security purchases re-aligns the actor within the network. The idea behind this is the ‘Matthew Effect’ (Merton, 1968) in that the more numerous weak ties a node has, the more easily it grows further ties. Therefore the connectedness of the whole network grows and the whole-network starts to increasingly mirror the ego-network of the central node. Building on this, one could hypothesize that strong ties encourage imitation, rather than innovation, in a dense network.

Home bias and liability of foreignness

Following on from the previous section, IB research sees imitation and mimetic behavior as a way foreign firms overcome the cost of doing business overseas (Wu & Salomon, 2016, 2017).

Homophily is the tendency to form connections with people who are familiar (McPherson et al., 2001). Home bias is homophily based on geography propinquity, in other words, the tendency to do business with people that are close (Coval & Moskowitz, 1999). Research on home bias (Coval & Moskowitz, 1999; Ke et al., 2010; Lin & Viswanathan, 2016; Varas & Walker, 2011) suggests that investors have a preference to invest into the familiar or the geographically proximate. Recent research has also shown that performance of overseas assets improves where fund managers invest in overseas geographies which are culturally similar (Fedenia et al., 2022) and that European bond investors tend to invest in culturally similar markets of the Eurozone (Wu, 2022). Likewise, recent IB studies show that improvements in domestic network positions influence investment and divestment decisions overseas (Iurkov & Benito, 2020).

The flipside of home bias pertains to the idea that there is a cost associated with doing business with someone unfamiliar. IB theories of foreign liability analyze such cost of multinational companies doing business abroad, particularly the liability of issuing shares on a foreign stock exchange (Zaheer, 1994), hereby referred to as Capital Market Liability of Foreignness (CMLOF) (Bell et al., 2012; Tupper et al., 2018; Wu & Salomon, 2017).

The homophily and home bias in a given network offers valuable input into the analysis of the degree of foreignness. The IB literature on CMLOF found that post-IPO performance of foreign listings can be moderated by the nationality of the CEO. For instance, a foreign listing does relatively better if the CEO of the company has international experience (Le & Kroll, 2017). A lot

of what this literature is trying to ascertain are the independent variables or moderating influences on foreign performance. The recent CMLOF literature has also paid more attention to share price and stock holdings by measuring organizational performance through stock price performance relative to a given benchmark (Tupper et al., 2018).

Following this rationale, one area of hypothesis development can focus on the geographic node attributes of a given co-investor network. We can infer from the data, whether a given market is relatively heterophilous. In turn, the capital market foreign liability may be higher in homophilous markets. In the example below we look at the European stock market as measured through networks of leading stock indices and compare this in polar geographies based on cultural and social dimensions in the Hofstede model.

Method

Management theory suggests that novel findings can be generated through practical rationality (Sandberg & Tsoukas, 2011) and the framework in this study makes use of practitioner experience. Equity sales staff often consult holding/ownership lists on Bloomberg to see who would be interested in equity placements or which investor has exposure in a given sector. Likewise, investors themselves are aware of co-holders through holdings lists and other administrative activities pertaining to proxy voting and earnings calls. Hence, the developed framework encapsulates much of what practitioners work with (Wu, 2022). Additionally, business scholars have taken to collect ownership data on corporates before (Abdelbadie & Salama, 2019; Chen et al., 2022). The interlocking corporate ties are causally established by individuals through micro-decisions in security purchases and network membership is defined by a nominalist boundary (Laumann et al., 1992).

In a holdings-based model, the financial market is defined through its constituent securities $s(1,2,\dots,n)$. Each security $s(n)$ incorporates a n -list of holders with varying percentage ownership levels. Hence the nodes are the investors holding the securities that form the financial market. To keep data manageable, nodes of only up to the 20th holder are included as the level of influence is deemed too small beyond this level. So $N_g=s(n)1,2,\dots, 20$. This results in $N(\max)=s(n)\times 20$ and $N(\min)=s(n)$. This threshold ensures that the maximum 20 number of holders for a given $s(n)$ will only have a maximum level of ownership for the 20th largest holder of 5%.

Let there be four ordinal k -core levels of ownership with $k_1 > 0\%$, $k_2 \geq 2\%$, $k_3 \geq 5\%$ and $k_4 \geq 10\%$. As discussed in previous sociological accounts (Mintz & Schwartz, 1985, pp. 98–99; Useem, 1980, p. 42), institutional investors are able to exert significant influence through their portfolio holdings. This both impacts prices of securities when trading is conducted, but also proxy voting. Consistent with these accounts, the assumption taken here is that with greater ownership levels comes greater influence and the different ownership thresholds $K_1^1 - K_4$ yield multiple graphs g_{kn} at k -levels of concentration. These thresholds were chosen as 5% forms a significant threshold for issuing 13d forms to the Securities and Exchange Commission and over 10% equals a principal shareholder status.

The resultant network g is an undirected network, 2-mode network, as investors shareholdings which define the network boundary. Only nodes that are holders of a security are included in the network, so network (g) consists of vertices $g_{ij}=g_{ji}$ and $g_{ij} \neq 0$. The number of degrees of a node i is simply N_{ig} and the maximum degrees a node (N_i) can have is thus $i(N-1)$.

Research context

Out of the five largest equity markets in continental Europe, Germany is traditionally seen as the most international and open financial market as overseas investors have a large allocation to German Bunds (government Bonds) and leading firms in the DAX equity index are export leaders. On the other hand, Spain has struggled to attract overseas investors, especially in government bonds over the past decade. These two geographies are chosen for purposes of contrasting the network results below. While both geographies are in Europe, they have contrasting cultural and linguistic characteristics as measured by Hofstede's cultural dimension data.² Hence, two networks were constructed based on the index constituents of the DAX and IBEX index.

Data collection

Drawing data from Bloomberg the 20 top holders of the constituents of the Spanish IBEX index and the German DAX index between March 2018 and March 2019. Further holder attributes drawn from the financial data provider were number of holdings, % of outstanding, investor type, country and city of domicile. Each fund listed as holding a given security also has a named individual fund manager included.

The independent variables lie in the node attributes. For instance we will work with investor domicile for the home bias analysis. Taking the investor type of specific nodes, 'pension funds' act on specific parameters agreed on by plan fiduciaries, with the legal framework adding a significant input to security selection. Likewise, taking geographical origin, institutional investors may have a certain mandate to invest domestically, which shows some

² [The dimension scores in the Hofstede model of national culture can be downloaded here \(geerthofstede.com\)](http://geerthofstede.com)

country bias in the selection process of the investor type. Information cascades could be beneficial to certain actors, geographically close to a central node, who may be able to extract a profit quicker than those further away in the network through front-running expected investment behavior, such as if located in the same city. Indeed, Coval and Moskowitz (2001) found geographical proximity to have an outsized effect on investment returns. Any subgraph (g') will display clusters by node attributes such as Country or Investor Type. Figure 1 details the data collection and handling process. Ownership data for each index constituent is downloaded and arranged into adjacency matrix. Likewise node attributes for each holder are downloaded and reformatted. The data is then uploaded into UCINET for the data analysis (Borgatti et al., 2002).

Figure 3 Master sheet, Adjacency Matrix, Node Attribute Table

	1	2	3	4	5	6	7	8	9	10	11
1	PLATTNER HASSO	n/a	EXCH	79975628	6.51	0	43200	Unclassified	n/a	Unclassified	SAP GY Equity
2	BLACKROCK	n/a	13G	72906042	5.93	0	43100	Investment / United State	New York Cit	SAP GY Equity	
3	HOPP DIETMAR	n/a	Research	67864344	5.52	0	43233	Unclassified	n/a	Unclassified	SAP GY Equity
4	TSCHIRA KLAUS	n/a	Research	36360955	2.96	0	43154	Unclassified	n/a	Unclassified	SAP GY Equity
5	VANGUARD GROUP	n/a	ULT-AGG	30255980	2.46	-251777	43343	Investment / United State	Philadelphia	SAP GY Equity	
6	SAP AG	n/a	Annual Re	29880390	2.43	0	42735	Corporation	Germany	Frankfurt	SAP GY Equity
7	DEUTSCHE BANK AG	n/a	ULT-AGG	28943440	2.36	394420	43368	Investment / Germany	Frankfurt	SAP GY Equity	
8	NORGES BANK	Multiple Por	MF-AGG	21909025	1.78	0	43100	Sovereign W/ Norway	Oslo	SAP GY Equity	
9	FMR LLC	n/a	ULT-AGG	17336155	1.41	39415	43312	Investment / United State	Boston	SAP GY Equity	
10	ALLIANZ SE	n/a	ULT-AGG	16462139	1.34	-83341	43367	Investment / Germany	Munich	SAP GY Equity	
11	FIL LIMITED	n/a	ULT-AGG	11529903	0.94	-143657	43367	Investment / Bermuda	Unclassified	SAP GY Equity	
12	UNION INVESTMENT	n/a	ULT-AGG	9875897	0.8	-334022	43343	Bank	Germany	Unclassified	SAP GY Equity
13	GOVMT PENSION INVST	Multiple Por	MF-AGG	9767258	0.8	0	43190	Government	Japan	Tokyo	SAP GY Equity
14	OPPENHEIMER FUNDS IN	Multiple Por	MF-AGG	8548433	0.7	3613	43343	Investment / United State	New York Cit	SAP GY Equity	
15	DEKABANK DEUTSCHE GI	Multiple Por	MF-AGG	8240878	0.67	-281701	43368	Bank	Germany	Frankfurt	SAP GY Equity
16	BNP PARIBAS	n/a	ULT-AGG	8112008	0.66	264871	43343	Investment / France	Unclassified	SAP GY Equity	
17	SUN LIFE FINANCIAL I	n/a	ULT-AGG	7672780	0.62	9576	43312	Investment / Canada	Toronto	SAP GY Equity	
18	TSCHIRA HARALD	n/a	Research	7026680	0.57	0	42814	Unclassified	n/a	Unclassified	SAP GY Equity
19	CREDIT AGRICOLE GROU	n/a	ULT-AGG	6827894	0.56	383052	43343	Bank	France	Paris	SAP GY Equity
20	TSCHIRA UDO	n/a	Research	6660680	0.54	0	42814	Unclassified	n/a	Unclassified	SAP GY Equity
21	BLACKROCK	n/a	EXCH	49470000	5.82	-340000	43354	Investment / United State	New York Cit	SIE GY Equity	
22	SIEMENS AG	n/a	EXCH	37485000	4.41	85000	43354	Corporation	Germany	Munich	SIE GY Equity
23	QATAR INVESTMENT AUT	n/a	Annual Re	27791784	3.27	0	42643	Sovereign W/ Qatar	Unclassified	SIE GY Equity	
24	DEUTSCHE BANK AG	n/a	ULT-AGG	23004766	2.71	122118	43368	Investment / Germany	Frankfurt	SIE GY Equity	
25	VANGUARD GROUP	n/a	ULT-AGG	21397421	2.52	-2079491	43343	Investment / United State	Philadelphia	SIE GY Equity	
26	NORGES BANK	Multiple Por	MF-AGG	14435993	1.7	0	43100	Sovereign W/ Norway	Oslo	SIE GY Equity	
27	PRIMECAP MANAGEMENT	PRIMECAP N/3F		8550881	1.02	1390881	43281	Investment / United State	Los Angeles	SIE GY Equity	
28	DEKABANK DEUTSCHE GI	Multiple Por	MF-AGG	8060850	0.95	479360	43368	Bank	Germany	Frankfurt	SIE GY Equity
29	CREDIT AGRICOLE GROU	n/a	ULT-AGG	7867350	0.93	775005	43343	Bank	France	Paris	SIE GY Equity
30	UNION INVESTMENT	n/a	ULT-AGG	5837507	0.69	253151	43343	Bank	Germany	Unclassified	SIE GY Equity
31	GOVMT PENSION INVST	Multiple Por	MF-AGG	5751779	0.68	0	43190	Government	Japan	Tokyo	SIE GY Equity
32	FRANKLIN RESOURCES	n/a	ULT-AGG	5689709	0.67	804141	43367	Investment / United State	San Francisco	SIE GY Equity	
33	BNP PARIBAS	n/a	ULT-AGG	5105436	0.6	1634042	43343	Investment / France	Unclassified	SIE GY Equity	
34	INVECO LTD	n/a	ULT-AGG	5025366	0.59	121530	43367	Investment / United State	Atlanta	SIE GY Equity	

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
		ADIDAS AG	ALFRIED KRUPP	ALLIANCE BER	ALLIANZ SE	AMERIPRISE	AQR CAPITAL	AQTON SE	ARTISAN PAR	ASSENAGON	AVIVA GROU	BAILLIE GIFF	BANK OF AM	BANK OF MO	BANK OF NEV	BEIERSDORF	BLACKROCK	BNP PARIBAS
1	ADIDAS AG	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	1	1
2	ALFRIED KRUPP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
3	ALLIANCE BER	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0
4	ALLIANZ SE	1	0	1	0	2	0	0	3	0	1	0	0	0	1	0	13	11
5	AMERIPRISE	1	0	0	2	0	0	0	1	0	0	0	0	0	0	0	3	3
6	AQR CAPITAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
7	AQTON SE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
8	ARTISAN PAR	1	0	1	3	1	0	0	0	0	1	0	0	0	0	1	7	4
9	ASSENAGON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
10	AVIVA GROU	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1
11	BAILLIE GIFF	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0
12	BANK OF AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2
13	BANK OF MO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
14	BANK OF NEV	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1
15	BEIERSDORF	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0
16	BLACKROCK	1	1	1	13	3	1	1	7	1	1	1	2	1	1	1	0	24
17	BNP PARIBAS	1	1	0	11	3	1	1	4	0	1	0	2	1	1	0	24	0
18	CAIXABANK	0	1	0	1	0	0	0	0	1	0	0	0	0	0	0	3	2
19	CANDRIAM	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0
20	CAPFI DELEN	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	3	1
21	CAPITAL GRO	1	0	0	8	2	0	1	3	0	1	0	0	1	1	0	14	12
22	CAUSEWAY C	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	3	2
23	CERBERUS C	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1
24	CEVIAN CAPI	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
25	CI INVESTME	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
26	CITIGROUP	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1
27	COMMERZB	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1
28	COMMONW	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0
29	CREDIT AGR	1	1	0	8	1	1	1	4	1	0	0	1	1	0	1	20	16
30	DEKABANK	1	1	1	13	3	1	1	6	1	1	0	2	1	1	1	29	24
31	DEUTSCHE B	1	1	1	13	3	1	1	7	1	1	1	2	1	1	1	30	24
32	DEUTSCHE B	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1	0
33	DEUTSCHE P	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	1	1
34	DIDNER & G	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0

	A	B	C	D	E	F	G
1	ID	Investor Type	Country	City	>2%	>5%	>10%
2	ADIDAS AG		11	31 Unclassified	1	1	0
3	ALFRIED KRUPP VON BO		15	31 Unclassified	1	1	1
4	ALLIANCE BERNSTEIN		7	57 New York City/Southern CT/Northern NJ	0	0	0
5	ALLIANZ SE		7	31 Munich	4	1	0
6	AMERIPRISE FIN GRP		6	57 Unclassified	0	0	0
7	AQR CAPITAL MANAGEME		4	57 New York City/Southern CT/Northern NJ	0	0	0
8	AQTON SE		7	31 Frankfurt	1	1	1
9	ARTISAN PARTNERS LTD		7	57 Milwaukee/Madison	5	0	0
10	ASSENAGON ASSET MANA		7	40 Luxembourg	0	0	0
11	AVIVA GROUP		6	57 Des Moines	0	0	0
12	BAILLIE GIFFORD AND		7	56 Edinburgh	1	0	0
13	BANK OF AMERICA CORP		1	57 Charlotte	1	0	0
14	BANK OF MONTREAL		1	25 Toronto	0	0	0
15	BANK OF NEW YORK MEL		7	57 New York City/Southern CT/Northern NJ	0	0	0
16	BEIERSDORF AG		11	31 Hamburg	1	1	0
17	BLACKROCK		7	57 New York City/Southern CT/Northern NJ	29	18	0

UCiNET software was used to visualize network graphs and test hypothesis in the three segments. Measuring how influential a given Actor A is, leads to the measure of centrality, developed and refined by various sociologists (Bonacich, 1987; Freeman, 1978; Marsden, 2002).

The aim is to include in the holdings-based network analysis measures of not only the pure number of connections of a given node (degree centrality), but also aim to measure second and third degree connections. The ability to move markets for a given central node is best captured by closeness centrality. The more securities are shared at high k-level the more intense the

relationships becomes, as performance will be similar and managers will meet more regularly at the same company meetings.

According to Freeman (1978, p. 225), closeness centrality is calculated with the following formula:

$$C_c(i) = \left[\sum_j^N d(i, j) \right]^{-1}$$

This measure will be used in the following empirical expositions.

Results

Discussion

Institutional theory has long embraced the idea of organizational fields in which economic outcomes are by and large shaped by interdependent interests and by organizations acting in relation to another (DiMaggio & Powell, 1983). Many companies face key person risk as decision discretion becomes more concentrated at the top. This does not only affect banks and asset managers (Morgan Stanley), but also other Fortune 500 companies. Part of the reason is the increasing focus on the financialized economy and company valuations being determined by its share price. As seen in recent IB studies around CMLOF, organizational performance is increasingly measured by share price performance (Ko & McKelvie, 2018; Le & Kroll, 2017). By measuring the material strength of ties, the proposed method of holdings-based network analysis of organizations is a feasible avenue to hypothesize and theorize organizational behavior.

Further, this method can analyze potential risks of sustained selling pressure, particularly in ESG investing. ESG investing includes active selection, tilting and outright selling of ‘brown’ companies (Edmans et al., 2022). Tilting entails reducing exposure to brown sectors but holding companies who take corrective actions and thereby reward them for positive behavior. Sustainable market practice requires orderly exits of positions. In a network of strong ties, in which indiscriminate selling begets more selling, risks can easily spread through the co-investor networks, particularly those with a large presence of Exchange Traded Funds (Pagano et al., 2019). Applying systems thinking (Neumeyer & Santos, 2018; Williams et al., 2017) to investor networks will increase awareness of market conduct in particularly dense interfirm networks.

Homophily is a useful concept to analyze literatures on home bias and liability of foreignness as it encapsulates familiarity as the basis for strong ties. Homophily is not only network adjacency, but also relates to geographical propinquity. It therefore becomes particularly useful in CMOFL and home bias studies. Holdings based network analysis introduces another layer and measure of the strength of ties, required in the continuously growing area of CMOFL studies (Lu et al., 2021; Wu & Salomon, 2017). Syndication networks have been studied in IB in the VC sector (J. Zhang & Pezeshkan, 2016), but also in equities (Ke et al., 2010; Moore et al., 2012). Home bias is another form of homophily, based on geographic proximity. Geographic propinquity enables constant information exchange (Owen-Smith & Powell, 2004).

Help with the systems analysis, theoretical sampling and triangulation is given by this method. It can help focus data collection for case studies as well as qualitative research designs.

Policy and managerial implications

Likewise, central banks looking to conduct quantitative easing in a specific market segment could use this network visualization to responsible market conduct (Wu, 2022). This may be particularly apt in the peripheral bond markets of Europe. In the US, the Federal Reserve conducted purchases of Blackrock's corporate bond ETFs as the most efficient way to impact quite a homophilous market marred by fire sales. Even a market as big as the one for US corporate debt suffered significantly from market failure during the first months of the Covid-19 pandemic (Falato et al., 2021). During that time, dealers were unwilling to give quotes and mark down corporate debt books during the Covid-induced selling in March 2020. As Blackrock emerges as a central node in the co-investor network (Greifeld, 2020), redemptions in ETFs can bare risks of significant mark downs during such episodes, also highlighted by regulators in Europe (Pagano, Serrano, and Zechner, 2019). Understanding the co-investor networks better would enable more sustainable policy implementation by central banks.

Responsible investing and Environmental Social and Governance strategies include exclusion, which entails divestment of fossil fuel and 'brown' companies. ESG investing also includes active selection and 'tilting' (Edmans et al., 2022), which entails reducing exposure to brown sectors but holding companies who take corrective actions and thereby reward them for positive behavior. The question of socially responsible divestment is important as outright sales of assets may not bring about improvements in governance of 'brown' companies, while holding brown companies with corrective behaviors may be more beneficial (Bateman, 2022; Edmans et al., 2022). Sustainable market conduct requires orderly exits of positions and assessing the impact of a divestment can be inferred from the density of the network structure of a given securities network, such as when looking to sell equity in the Malaysian crude palm oil sector, Thai oil

refineries or the European steel sector. Awareness of the co-investor network structure would also enable institutional investor to perform better stewardship, either by responsibly reducing exposure, or through better collaboration in engagement activities during proxy season. this method can analyze potential risks of sustained selling pressure, particularly in ESG investing.

Limitations and future research

The limitations to this study lie in the extent of data collection in terms of node attributes and frequency of changes in the data (which is monthly). It would be, for instance, interesting to collect other node attributes such as the manager characteristics and educational ties as in other such studies. Like many network methods, co-investor networks also require manual handling and data processing. However, the aim of this paper is to squarely focus on the methodological merits of the proposed holdings-based model and illustrate areas of potential use for future research in international business and management studies.

Network research has already pointed out the discrepancies between the network in people's minds and the actual social structure it represents (Brands et al., 2019; Kilduff & Lee, 2020). Visualizing networks through software is one way to make inferences about the social world (Back & Puwar, 2012), it is by definition limited to the sets of inputs chosen to construct the network.

Each fund listed as holding a given security also has a named individual fund manager included. A further study involving the social characteristics of given fund managers would be a further study to conduct, however, it would involve a much higher degree of data manipulation and manual handling. However, it would add another layer of analytical depths to co-investor networks.

Another interesting avenue would be to examine MSCI ESG indices and their investor networks. It would be enable an organizational field analysis and offer strategies to influence proxy voting and stewardship from a network perspective.

Conclusion

This paper addresses the underexplored aspects of materiality in the organizational networks of financial markets and elaborates its relevance to a variety of literatures in business and management studies. It does so by integrating concepts from organizational sociology and elements of modern financial data analysis. By elaborating areas of hypothesis and theory development in distinct literatures, the proposed method should be a fruitful avenue to explore the complex interface between people and organizations acting in financial markets.

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