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Broadening the perspective of supply chain ﬁnance: The performance impacts of network power and cohesion

Steven Carnovalea,⁎, Dale S. Rogersb, Sengun Yeniyurtc

a Rochester Institute of Technology, Saunders College of Business, Department of Management, 108 Lomb Memorial Drive, Lowenthol Hall (Bldg. 12), Room 3336, Rochester, NY 14623, United States

b Arizona State University, Department of Supply Chain Management, BA 402, W. P. Carey School of Business, 450 E. Lemon St., Tempe, AZ 85287, United States

c Rutgers University, Department of Supply Chain Management and Marketing Science, Rutgers Business School-Newark and New Brunswick, 100 Rockefeller Rd.-Room

3153, Piscataway, NJ 08854, United States

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A B S T R A C T

Because ﬁrms do not operate in isolation, they are bound by the structure of the networks in which they are embedded. This structure has implications on a ﬁrm's ability to access resources and utilize them to their ad-

vantage. We consider two critical components of this network structure: network power and network cohesion. Both of these network structures can be critical determinants of ﬁrm ﬁnancial success. Yet, to date the extant

research has not yet considered the role of network relations in the context of Supply Chain Finance (SCF). This manuscript attempts to contribute to this gap. Through the use of a dynamic supply chain network structure, we

test the role that network power and cohesion have on a ﬁrm's ﬁnancial performance. The results indicate

network cohesion contributes positively to eﬃciency in ﬁnancial performance, whereas power is a critical factor

in earnings performance. Taken together, the study advances a nuanced perspective of managing the ﬁrm's levels

of network power and cohesion to allow for heightened ﬁnancial performance.

1. Introduction

Traditionally, the research that connects supply chain management with ﬁnance primarily focuses on factoring and reverse factoring of accounts receivables so as to facilitate the ease with which cash ﬂows

(e.g. Buzacott and Zhang, 2004; Tsai, 2008; Tsai, 2011), as well as to optimize the working capital positions of ﬁrms (Wuttke et al., 2013b). Accordingly, most Supply Chain Finance (SCF) deﬁnitions focus on the “planning, managing, and controlling of supply chain cash ﬂows”

(Wuttke et al., 2013b:773). This perspective has been echoed in more

recent research where it has been suggested that the supply chain has a direct and signiﬁcant impact on the ﬁrm's “revenue, cost, balance sheet, customer service, risk management and compliance” initiatives (Foster,

2015). Modern supply chains, however, are increasingly dense and

interconnected (Bernardes and Zsidisin, 2008; Carnovale, Rogers and

Yeniyurt, 2016) with ﬁrms such as General Motors (GM), for example,

having over 2700 suppliers globally (Colias, 2015). Not considering the

implications of such interconnectedness on the implementation of a ﬁrm's SCF initiatives, and ﬁnancial performance overall, can have po- tentially negative ramiﬁcations. Particularly because such expansive

and interconnected supply bases can impact the success (Foerstl et al.,

2013) or failure (Bode, Hübner and Wagner, 2014) of a ﬁrm's ﬁnancial

performance.

One example of this growing interconnectedness is the inclusion of the so called “FinTech” intermediaries leveraging procure-to-pay tech-

nologies that “incorporate both purchasing management and accounts

payable functionality” (Rogers, Leuschner and Choi, 2016:2), typically backed by a large ﬁnancial institution. These systems can often render

savings for the procurement professional, but in turn they necessarily increase the complexity and interconnectedness of the network in

which ﬁrms are embedded. Accordingly, research demonstrates that the

ﬁrm's extended network is the primary means through which ﬁrms gain

access to resources (Dubois and Fredriksson, 2008; Kähkönen and

Virolainen, 2011; Tate, Ellram and Gölgeci, 2013; Finne, Turunen and

Eloranta, 2015). This body of work suggests that the entity (i.e. the ﬁrm) exists in a larger interconnected system, and the ability to manage and navigate this interconnectedness can lead to signiﬁcant value

creation, and access to diverse resources. However, accessing these network (i.e. external) resources requires a certain level of dependence

on the focal ﬁrm's network partners. Thus, argumentation from re-

source dependency theory (RDT) provides for a theoretical connection between accessing resources via the ﬁrm's network connections, and the

⁎ Corresponding author.

E-mail addresses: [scarnovale@saunders.rit.edu](mailto:scarnovale@saunders.rit.edu) (S. Carnovale), [Dale.Rogers@asu.edu](mailto:Dale.Rogers@asu.edu) (D.S. Rogers), [yeniyurt@business.rutgers.edu](mailto:yeniyurt@business.rutgers.edu) (S. Yeniyurt).

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ﬁnancial performance of the ﬁrm. Generally, RDT posits that “inter- corporate relations can be understood as a product of patterns of inter- organizational dependence and constraint" (Pfeﬀer, 1987:40) and is

”premised on the notion that all organizations critically depend on other organizations for the provision of vital resources” (Drees and Heugens, 2013:1667).

RDT as a theoretical lens implicitly leverages the network as a source of access to resources, and necessarily includes the ﬁnancial

resources contained in a supply chain (Hofmann and Kotzab, 2010). Thus, upon juxtaposing the network view with RDT, as it relates to SCF, two prominent themes emerge: (1) levels of interdependence (power)

facilitate resource access, and therefore can signiﬁcantly impact ﬁ-

nancial performance and (2) the structure and cohesion of the network

is the conduit through which such resources are accessed, and therefore can be utilized to increase performance. Thus, the main objective of this research is to elucidate the role that the juxtaposition of network and

resource dependency theories has in explaining the eﬀect(s) that the

structural characteristics of a ﬁrm's network have in enhancing the

ﬁrm's ﬁnancial performance; an area to-date, that has received minimal

attention in the research on SCF and related work.

In order to answer this question, we analyze the eﬀect of network structure on the ﬁnancial performance of ﬁrms contained in an auto-

motive supply chain network, from 1985 to 2003. This network struc- ture is comprised of manufacturing partnerships explicitly focused on

the procurement, production, and distribution of ﬁnished goods and

services and was created using automotive joint venture (JV) formation

information from the Thompson SDC platinum database. This database constitutes an ideal repository from which to re-create the structure of a supply chain network, given the detailed information on the sourcing information between (and among) all parties involved in such trans- actions, and has been used in similar lines of inquiry (Carnovale et al.,

2016, 2017). Furthermore, manufacturing JVs present a unique and worthwhile vantage point for the purchasing and sourcing context. A JV

occurs when two or more ﬁrms combine equity and create a third entity

with a speciﬁc purpose (Kogut, 1988). In the manufacturing context,

these arrangements are focused on the sourcing and production of ﬁnished goods and services. Take, for example, the $3.3 billion Fiat Spa JV with the Russian automotive ﬁrm, Sollers, which was initiated in

order to “to produce up to 500,000 vehicles per year” and will “will be capable of producing up to 500,000 passenger cars and SUVs annually” (Vasilyeva, 2018: 1). Also, it's worth noting that while this focus is

outside the traditional scope of core SCF related research, the related nature of ﬁrm ﬁnancial performance and network characteristics can yield ﬁndings that are also valuable to the body of SCF research, writ

large.

2. Literature review

2.1. What is supply chain ﬁnance?

SCF has been deﬁned as the “optimized planning, managing, and controlling of supply chain cash ﬂows” in order “to facilitate eﬃcient supply chain material ﬂows” (Wuttke et al., 2013b:773). The core of

SCF, then, “…is based on the idea that collaboration among actors in the supply chain is key for better management of ﬁnancial ﬂows”

(Caniato et al., 2016). This research engenders the idea that the level of analysis should be raised from the focal ﬁrm to the supply chain net-

work. In fact, some have suggested that SCF initiatives should be thought of as “using the supply chain to fund the organization, and

using the organization to fund the supply chain” (Huﬀ and Rogers,

2015:5). Eﬀectively, this view advocates for ﬁrms to leverage their

extended networks for heightened ﬁnancial performance and manage-

ment, as well as access to ﬁnancial resources.

SCF is focused on the coordination of cash ﬂows between entities in

the supply chain to achieve increased ﬁnancial performance and eﬃ-

ciency (Wuttke et al., 2013b). The need for such coordination is

apparent, as ﬁnancial coordination between entities can depend “on the terms of payment that may include penalty for late payments and/or discounts for early payments” (Gupta and Dutta, 2011:47). The com-

plexity of managing these terms can increase as the supply bases of

ﬁrms increase in size. Firms that leverage SCF as a tool through which to optimize ﬁnancial management, both the focal ﬁrm and their sup- plier (typically through the use of a ﬁnancial intermediary), can de-

crease (interest rate) costs (Wuttke et al., 2013a) and increase payment speed (Holter et al., 2010). These results are congruent with other SCM theories suggesting that supplier (Germain et al., 2011) and customer

integration, generally, can lead to increases in ﬁnancial and operational

performance (Ralston et al., 2015). To date, however, little SCF re-

search exists (c.f. Carnovale and Yeniyurt, 2015a) that raises the level of SCF to the network, and connects the structural properties of a ﬁrm's network to their ﬁnancial performance.

2.2. Network and resource dependency theories

2.2.1. Network theory

Firms do not operate in isolation and so, their actions are directly dependent upon the networks in which they are embedded. Stated

diﬀerently, “to understand the behavior of an organization you must understand the … the ecology of the organization” (Pfeﬀer and

Salancik, 1978:1). In the context of supply chain management, this ecology is necessarily the supply chain network. Speciﬁcally, a ﬁrm's

supply chain network “consists of ties to its immediate suppliers and customers, and ties between them and their immediate suppliers and

customers” (Kim et al., 2011:194). Thus, the relationships between and among two or more ﬁrms, in aggregate, deﬁne the overarching struc- ture of the network in which a ﬁrm exists. Given this emphasis on

structure and interconnectedness, scholars have suggested that supply chain management research should continue to develop network theory driven research as a means to solve supply chain problems (Galaskiewicz, 2011).

Such calls to action have been answered by recent research. For example, scholars have investigated network based views of strategic procurement and sourcing, and have shown that network based cap-

abilities positively impact the ﬁrm's customer responsiveness

(Bernardes and Zsidisin, 2008). Building on this research, work that

examines the antecedents of network structure, and network develop- ment, has shown that the composition of a ﬁrm's focal network sig- niﬁcantly explains its future network development behavior (Carnovale

and Yeniyurt, 2014). The network perspective has also been utilized to unravel supply network composition and structure in the global auto- motive industry, demonstrating important insights regarding the con-

nection between network structure and how ﬁrms navigate it to their

beneﬁt (Kim, Choi, Yan and Dooley, 2011). In a similar line of inquiry,

research has also investigated the role that the brokerage and reach abilities a ﬁrm has when expanding its network composition inter- nationally, ﬁnding that as these network characteristics increase so too will the ﬁrm's access to information (Carnovale, Rogers and Yeniyurt,

2016). Other such research has examined the role that a ﬁrm's position

in the overall network plays in increasing its power to gain, and

therefore, utilize resources across overlapping supply networks

(Kähkönen and Virolainen, 2011).

2.2.2. Resource dependency theory

Firms with the ability to maintain, navigate, and successfully op- erate within these networks experience signiﬁcant beneﬁts and access to resources (Zaheer et al., 2010). The assumption that ﬁrms operating

within a network can navigate it presupposes a certain degree of de- pendence upon the network structure in which the ﬁrm is embedded

(Choi and Kim, 2008). Principally, this is because “organizations are not autonomous, but rather are constrained by … interdependencies

with other organizations” (Pfeﬀer, 1987:26–27). Such “dependencies in

the global supply chain arise when ﬁrms do not have alternative

outcomes or have a high level of commitment to the outcomes at stake”

(Connelly et al., 2013:229). This idea that [inter]dependencies aﬀect

ﬁrm operations (either positively or negatively) is generally traced back

to resource dependency theory (RDT) (Pfeﬀer and Salancik, 1978).

RDT suggests that “inter-corporate relations can be understood as a product of patterns of inter-organizational dependence and constraint" (Pfeﬀer, 1987:40). That deﬁnition is dual-faceted having the following

fundamental components: (1) interdependence and (2) constraint. First is the degree of interdependence, which is ”premised on the notion that

all organizations critically depend on other organizations for the pro-

vision of vital resources” (Drees and Heugens, 2013:1667). This inter- dependence exists whenever one actor does not entirely control all

conditions necessary for the achievement of an action or obtaining the desired outcome (Pfeﬀer and Salancik, 1978). A ﬁrm's dependence on a

partner is directly proportional to the goals mediated by the partner, and inversely proportional to the availability of these goals outside the partnership (Emerson, 1962). Essentially, this perspective notes that

ﬁrms act as “coalitions in which structures and patterns of behavior are

molded to acquire needed external resources” (Oke, Prajogo and

Jayaram, 2013:45).

The second part of the above deﬁnition deals with constraint, and necessarily follows from the degree of interdependence that a ﬁrm faces. Constraint generally refers to the eﬀect of the interdependence. That is to say, ﬁrms are faced with constraints based on the level of

interdependence with another actor in the network and are bound by such conditions. Essentially in RDT, because the “organizational sur-

vival hinges on the ability to procure critical resources from the ex-

ternal environment…organizations will try to restructure their de- pendencies with a variety of tactics” (Casciaro and Piskorski, 2005:167) and will “attempt to manage these resource dependencies by setting up

diﬀerent forms of interorganizational arrangements” (Pfeﬀer and

Salancik, 2003:xxxiii). That is to say, leveraging the network in ways so

as to increase control while reducing dependence, and thereby im- proving performance. Eﬀectively, the ﬁrm's ability to successfully op-

erate within the network depends on its power to do so (Zhao et al.,

2008; Terpend and Ashenbaum, 2012) and the cohesion of the network structure (Reagans and Mcevily, 2003).

2.3. Network structure, supply chain practices and focal ﬁrm performance

Fundamentally, ﬁrms that can take advantage of their supply chain network structure are in much better resource access positions, which

should lead to ﬁnancial performance. Extant research tangentially supports this notion, suggesting that ﬁrms who have high levels of

supply chain competency (included in which is the ability to manage the supply base) will experience positive ﬁnancial performance

(Ellinger et al., 2011). Yet, such competency essentially echoes a broad body of literature tackling a problem of understanding the so called

‘structure-performance link’ (c.f. Wagner et al., 2012; Salvador and Villena, 2013; Ralston et al., 2015) which, essentially connects the practices of the ﬁrm to its performance (Foerstl et al., 2016). This body of research has revealed several key ﬁndings. An earlier study on the topic examined the eﬀect of congruence between strategy and design, ﬁnding that for performance beneﬁts (ROA in this case) to be attained,

there must be a congruence between strategy, and organizational de- sign (David et al., 2002). In a sourcing context, the organization of

these activities was shown to be a critical determinant of ﬁnancial

performance. Eﬀectively, this study supports the contingency argument

underpinning the structure performance link: in order for performance

to increase there needs to be commensurate (i.e. contingent) structural design.

Furthermore, recent research has examined the direct ﬁnancial

beneﬁts (i.e. cost savings) that are attainable to ﬁrms who integrate key

members of their supply bases early on in the sourcing process. Speciﬁcally, this research (Van Poucke et al., 2016) empirically ﬁnds

that early involvement of purchasing (i.e. increased cohesion of the

network) in sourcing decisions leads to ﬁnancial gain (cost savings). Further, Vos et al. (2016) examine whether or not there are ﬁnancial beneﬁts attainable to ﬁrms that expand their supply bases globally, ﬁnding that there are potential performance beneﬁts to be attained are

through a broader supply base, among other factors.

Thus, as research continues to articulate that ﬁrms are operating

within complex supply chain networks, where access to resources is

critically dependent upon other actors in the network, their level of interdependence necessarily increases. As the level of interdependence

increases between ﬁrms, so too will the impact that these dependencies

have on the ﬁnancial performance of ﬁrms (indirectly the ﬁnancial

ﬂows between them), and by extension, the supply chain network in

which these ﬁrms are embedded. Yet, to date there is minimal research

undertaking such areas of inquiry, speciﬁcally in the domain of SCF.

3. Hypothesis development

There are two fundamental constructs to this study that emerge from the literature reviewed above. The ﬁrst is the idea that inter-

dependence inherently exists and governs the behaviors between (and among) actors of the network. This notion of interdependence is closely

connected to the ﬁrm's power, which is critical to managing depen-

dence in network relations (Carnovale et al., 2017). The next construct is resource access. The research suggests that when ﬁrms can navigate

their network connections competently, they can heighten their access to resources, and thereby can engender performance. The navigation of these network connections implies a certain degree of cohesion (i.e. density) within the network, which is generally how such resources are attained (Burt, 1992a, b). Taken together there is a mutual importance between power (dependence) and cohesion as it relates to resource

access, and therefore, ﬁnancial performance.

Accordingly, the following hypothesis development will serve to

explain the role that network power and network cohesion have on the

ﬁnancial and operational performance of ﬁrms. Speciﬁcally, we utilize

eigenvector centrality to represent network power, and ego network

density to represent network cohesion. On the performance side of the equation, we examine the cash-conversion-cycle (CCC), EBITDA and

Return on Assets (ROA). The use of these three ﬁnancial performance

metrics serves to capture the dynamics of both explicitly ﬁrm-level

(EBITDA and ROA) as well as network related (CCC) ﬁnancial perfor-

mance. Note that while the CCC is traditionally a working capital me- tric, it does necessarily depend on the interactions with a ﬁrm's supply

base. It is for that reason why we interpret it is a network related me- tric.

It is also important to note that with respect to the three dependent variables used in this study the logic is to capture several levels of

‘performance’ as it relates to SCF. Thus, the hypothesized CCC re- lationship will explain the eﬃciency with which the ﬁrm can leverage

its power and cohesion so as to increase the speed that cash is con- verted. Next, the logic around EBITDA is an operational vantage point on performance, and will suggest that the two constructs (power and

cohesion) will improve the ﬁrm's ability to generate earnings. Finally,

the logic around ROA is that as the ﬁrm increases its power and co-

hesion, it can wield this network inﬂuence so as to be able to heighten

the eﬃciency with which it generates returns on deployed assets as well

as leveraging its cohesion to foster better performance. Table 1 re-

presents the operationalization and conceptual framing of each of these variables.

3.1. Network power

The notion of power has long been studied in the purchasing and supply chain management literature (Ramsay, 1995; Pulles et al.,

2014). In the sourcing context, a ﬁrm's power arises “from a combi-

nation of the attractiveness of their own resources and the … freedom

to obtain resources from other organizations” (Ramsay, 1996:129). This

Table 1

Variable operationalization and descriptions.

Variable of interest

Dependent/ independent/ control

Operationalization/comments

Cash Conversion

Cycle (CCC)

Dependent A ﬁrm's CCC is a “a composite metric that … requires adding days of inventory plus days of accounts receivable and subtracting days of accounts payable” so as to bridge “material activities with suppliers, production operations, distribution functions, and outbound sales activities” (Farris et al., 2005:114).

*Inventory*

*Accounts Receivables*

*DOI*: *Days of Inventory* = ⎛⎜ ⎞⎟\*365 *DOR*: *Days of Receivables* = ⎛ ⎞\*365

⎝ *Cost of Goods Sold* ⎠

*Accounts Receivables*

⎝ *Net Sales* ⎠

*DOP*: *Days of Payables* = ⎜⎛ ⎟⎞\*365 *Cash Conversion Cycle* = *DOI* +*DOR* − *DOP*

⎝ *Cost of Goods Sold* ⎠

(Source(s): Farris and Hutchison, 2003:85; Hutchison et al., 2007:42)

EBITDA Dependent Represents earnings before interest, taxation, depreciation and amortization. This measure was taken from COMPUSTAT, and is calculated as net sales minus cost of goods sold (COGS) and selling, general and administrative expenses (WRDS, 2015).

Return on Assets

(ROA)

Dependent For ROA we use the commonly used operationalization:

*ROAft* = *net incomeft* /*total assetsft*

Network Power Independent For the operationalization we use the ﬁrm's eigenvector centrality, which “is deﬁned as the principal eigenvector of the adjacency matrix deﬁning the network” and can be interpreted as “a node that has a high eigenvector score is one that is adjacent to nodes that are themselves high scorers” (Borgatti, 2005: 61). For the operationalization we deﬁne *xj* as the centrality score. The eigenvector

“centrality of a vertex is proportional to the sum of the centralities of the vertices to which it is connected. λ is the largest eigenvalue of A and n is the number of vertices” (Bonacich, 2007:556). Note that A refers to the adjacency matrix in a speciﬁc year (see Methods section for more detail) and the vertices to which the deﬁnition makes mention, are the ﬁrms (nodes) in the network. Mathematically:

*Network Powerf* ,*t* = *λxf* = *n ai*,*j xn i* = 1, ..., *n* ∀ *t*

∑*i*= 1

where *f* = *i*, *j and i* ≠ *j* (i.e. the ﬁrms in the network) and t represents the year under observation.

Network Cohesion Independent To operationalize network cohesion, we use ego network density and follow (Borgatti et al., 2002) and calculate:

*Network Cohesionf* ,*t* = *Actual Ties*/*Maximum Number Pairs*

where actual ties refers to the quantity of connections that exist in the ﬁrm's ego network and maximum number of pairs refers to the

number of possible connections in the ego network (Borgatti et al., 2002). This is bound to [0,1], though for purposes of analysis the

scale of the variable is [0,100].

Network

Independent Finally, to calculate the diminishing returns to network cohesion, we take the quadratic of its linear counterpart:

Cohesion2

*Network Cohesion Squared*

= (*Network Cohesion* )

Focal Firm

Network Size

*f* ,*t f* ,*t* 2

This operationalization tests the so called ‘curvilinear’ eﬀect of the variable (Cohen and Cohen, 1983) and has been used in extant

management research (Powell et al., 1999; Lechner et al., 2010).

Control A focal ﬁrm's (ego) network size refers to the sum of the unique, ﬁrst degree (i.e. direct) connections a ﬁrm has (Wei, 2010) and is

important to control for in the context of the present study. Operationalized as (Carnovale and Yeniyurt, 2014):

*Focal Firm Network Sizef* ,*t* = ∑*n* **ai**,**j** ∀ *t*

*i*= 1

Firm Age Control Operationalized as the number of years the ﬁrm has been in business, relative to the year under observation.

Firm Assets Control Firm Assets=Log(Total Assets)

conceptualization of power necessarily implies that the ﬁrm must de-

sign their sourcing relationships and arrangements under the constraint

of network structure so as to “manage interdependence with either sources of input or purchasers of output” (Pfeﬀer, 1976:39) and

therefore broaden their access to resources. From the perspective of the balance of power between entities (c.f. Emerson, 1962) ﬁrms at-

tempting to foster this network power can “lessen their dependency” on certain connections by “cultivating alternative sources of desired re- sources” (Provan et al., 1980).

Thus, for ﬁrms to truly gain and beneﬁt from network power they

must develop capabilities to manage and navigate the interconnected- ness of their ﬁrst-degree connections (i.e. their 'ego networks', c.f. Burt,

1980; Freeman, 1982; Borgatti and Halgin, 2011), as well as their in- direct network connections. Previous research has deﬁned such net-

work power as “an actor's attempts in a multi-actor network to utilize their current position to allocate and decouple actors, resources and activities according to its own beneﬁt” (Olsen et al., 2014:2580). Ac-

cordingly, we conceptualize, a ﬁrm's network power to extend beyond

just the focal ﬁrm's ﬁrst-degree connections, to its local neighborhood

(i.e. the connection's connections), and the prominence of those con-

nections. Theoretically, the network characteristic that most closely represents this power is a ﬁrm's eigenvector centrality. This network

construct is well suited to understand network power, generally, (Wasserman and Faust, 1994) and speciﬁcally in the context of supply

chain networks (Carnovale et al., 2017). This is the case because this network measure does not weigh each connection a ﬁrm has equally (as

is the case with degree centrality, for example), but rather pro- portionally to its network position (Bonacich, 2007).

Accordingly, we expect a positive relationship between network power and improvements in the ﬁrm's CCC; speciﬁcally because of the

inherent dependence of resource access in such supply chain networks. Firms that increase their network power are in better positions to

manage their supply bases, which can signiﬁcantly increase their ability

to access (and often control) the allocation of resources (Kim and Bettis,

2014). Inherently, a shortening in the CCC implies that there exist fa- vorable payment modalities and terms between members of the net- work (Farris and Hutchison, 2003) thereby decreasing the delays in payment. As network power increases so too can the bargaining power

of the ﬁrm, which can make terms of a transaction more favorable

(Crook and Combs, 2007) further engendering supply bases to comply

and therefore reduce payment delays. Furthermore, network power, and indirectly the capability that the ﬁrm has to manage the supply base through it, ensures that ﬁrms can mitigate supply risk and op- erational disruptions to the ﬁnancial ﬂows in supply chain networks

(Mizgier et al., 2015) thereby engendering a shortened CCC. Such mi- tigation initiatives can reduce the potential loss (i.e. lack of resources)

due to ﬁnancially distressed suppliers (Bode et al., 2014) and positively

aﬀect the ﬁnancial positions of ﬁrms (Buzacott and Zhang, 2004). Thus,

we expect that:

H1a. Network power has a shortening eﬀect (i.e. a decrease) on the cash conversion cycle.

In addition to the beneﬁts to a ﬁrm's CCC, we expect that network power will also have a positive impact on a ﬁrm's earnings and returns performance; speciﬁcally, its EBITDA and ROA. In the context of a ﬁrm's ﬁnancial performance, EBITDA is a worthwhile metric to explore

given its operational nature and exclusion of non-operational expenses in its calculation (Brockman and Russell, 2012:84). In line with RDT,

ﬁrms will seek to reduce uncertainty by increasing their control through

various types of organizational arrangements (Pfeﬀer and Salancik,

2003). Higher levels of network power have been shown to be posi-

tively associated with network design (Kähkönen and Virolainen,

2011), which in turn has been shown to heighten ﬁrm performance

(Wagner, Grosse-Ruyken and Erhun, 2012). Access to resources, and

thus tacitly the means with which to generate earnings, necessarily depends upon the network of ﬁrms and the interconnectedness between them (Ramsay, 1996; Cendon and Jarvenpaa, 2001). Increasing a ﬁrm's

network power can raise their standing in the network (Bonacich and

Lloyd, 2001:192) which can further increase the ﬁrm's access to re-

sources and can heighten their bargaining power (Bloom and Perry,

2001). Taken together, such beneﬁts should therefore increase their ﬁnancial performance in both earnings, and in returns. Furthermore, as it has been shown that the ﬁrm's strategic partnerships with ﬁnancially sound partners can beneﬁt the focal ﬁrm ﬁnancially (Hertzel et al.,

2008) and such partnerships are engendered by heightened levels of network power (Carnovale, Yeniyurt and Rogers, 2017). Hence, as ﬁrms

increase their network power, thereby rendering themselves in a posi- tion to gain access to these resources, we expect that their levels of EBITDA and ROA will also increase. Thus:

H1b. Network power has a positive eﬀect on EBITDA

H1c. Network power has a positive eﬀect on ROA.

3.2. Network cohesion

Though network power is critical in explaining performance, the degree to which cohesion exists within a ﬁrm's network (as eluded to

above in the ‘structure-performance link’ discussion) requires ex- amination as well. In order to represent such cohesion, we examine the density of a ﬁrm's ego network. Density has been studied in various

related contexts such as innovation (Carnovale and Yeniyurt, 2015b) knowledge creation (Mcfadyen et al., 2009), alliance (Soh, 2010) and managerial performance (Rodan, 2010), as well as the structure of competition in networks (Skilton and Bernardes, 2015).

We expect that a ﬁrm's network cohesion will improve the perfor-

mance of their CCC. In order to achieve optimal ﬁnancial performance,

the ﬁrm must “optimize functions and processes across the network of ﬁrms in a collaborative fashion” (Randall and Farris Ii, 2009:684). As the cohesion of the network increases, ﬁrms gain access to a more

varied pool of resources, as well as the ability to generate stronger network connections (Walker et al., 1997); all of which can facilitate reductions in the CCC. Network cohesion is then a critical factor to an improved CCC because for CCC performance to increase there needs to

be a “collaborative eﬀort between a company, immediate customers

and immediate suppliers” (Farris and Hutchison, 2003:88). Such col- laborative initiatives are fundamental to the ﬁnancial performance of

the supply chain (Caniato et al., 2016) and are engendered by tightly connected, cohesive networks (Reagans and Mcevily, 2003). Thus, we expect that:

H2a. Network Cohesion has a shortening eﬀect (i.e. decreases) on the cash conversion cycle.

Next, we expect that increased network cohesion will lead to a positive eﬀect on the ﬁrm's EBITDA and ROA for the following reasons. First, a ﬁrm's network relationships are considered a critical organiza-

tional resource, given their ability to facilitate interactions and ex- changes with other network connections (Burt and Durham, 2000; Burt,

2004, 2007) and can directly result in the ﬁrm generating a competitive

advantage (Gulati, 1999). Furthermore, performance increases are di-

rectly associated with organizational, and by extension network, structure (David et al., 2002). Further, because of the positive eﬀect

between supply chain structure (of which cohesion is necessarily a part)

and supply chain integration (Defee and Stank, 2005), cohesion can be seen as a fundamental underpinning to facilitate strategic ﬁt (c.f.

Wagner et al., 2012) and therefore positively impact performance. By contrast, absence of such network cohesion can lead to diminished re-

source access, which can cause downstream intermediaries to “to delay raw material ordering, squeeze work-in-process inventories, or skimp

on service levels or quality processes” (Hofmann and Kotzab,

2010:305). This can render the ﬁrm in a position of potentially di-

minished earnings, the supply base has a direct eﬀect on performance

(Foerstl et al., 2016), and also on the ﬁrm's ﬁnancial success (Bode

et al., 2014).

Thus, ﬁrms that increase their network cohesion also increase their

access to resources and can potentially reduce its interdependence, which in turn has a direct impact on the ﬁnancial performance of network members (Dai et al., 2012). In addition, ﬁrms that increase

their network cohesion through more diverse network relationships, experience positive relational exchange (Dahlstrom and Ingram, 2003)

which has been shown to improve ﬁnancial performance (Germain

et al., 2011). Taken together, these resources can engender the health of

the supply chain (e.g. access to lower cost suppliers or capital through bridged connections in a more densely connected network), and

thereby ﬁrms are in a much stronger position to increase both their

EBITDA as well as their ROA. Accordingly, we expect:

H2b. Network Cohesion has a positive eﬀect on EBITDA.

H2c. Ego network density has a positive eﬀect on ROA.

3.3. Diminishing returns to network cohesion

There does exist a strong theoretical tension inherent in the devel- opment of network cohesion as a construct. Some have argued that the tighter the network (i.e. more densely connected and cohesive) the

larger the potential beneﬁt (Coleman, 1988) and thus advocate for full

cohesion as a means by which to improve performance. Others argue

that the more sparsely connected the network the larger the potential for the ﬁrms contained in it to beneﬁt (Burt, 1992a) through access to network brokers. While we expect that there will be positive beneﬁts to the ﬁrm's ﬁnancial performance as levels of density increase (i.e. H2 above), given this tension we also expect that this eﬀect will see di-

minishing returns at a certain point, thereby exhibiting a curvilinear relationship (Cohen and Cohen, 1983).

Firms that engage in several network relationships might experience administrative complexities that arise with the management of a large supplier portfolio, which can increase the complexity of coordination, making relationship management more challenging (Yeniyurt et al.,

2009). Similar eﬀects have been seen with respect to organizational

performance and increased levels of network complexity (Powell et al.,

1999; Lechner et al., 2010). Furthermore, increasing the cohesion in the focal ﬁrm's network can lead to overlapping, potentially redundant, resources. In such instances the beneﬁts of access are diminished and ﬁrms need to seek out alternate, new connections. This new sourcing

process can result in increased managerial complexity which has been shown to increase “inventory and cash-ﬂow bullwhip along with lead time” (Tangsucheeva and Prabhu, 2013:431) and can negatively aﬀect a ﬁrm's CCC. In addition, if ﬁrms take on leverage (Kale and Shahrur,

2007) so as to bridge such a potential delay in cash ﬂow, they could be

subject to increased cost and decreased availability of capital (Buzacott and Zhang, 2004) thereby negatively eﬀecting its EBITA and ROA. Maintaining a ﬁrm's accounts receivables can also be negatively af-

fected when network cohesion raises above an optimal level, as heightened complexity can cause challenges with managing cash ﬂows (Gupta and Dutta, 2011), thereby further diminishing a ﬁrms CCC,

EBITDA and ROA. Thus, given the managerial complexity, the poten- tially negative impact to capital availability, as well as the potentially

negative impact to the management of cash ﬂows, we hypothesize the

following regarding the diminishing returns to network cohesion:

H3a. Network cohesion has a diminishing return (i.e. U-shaped1) eﬀect on the cash conversion cycle.

H3b. Network cohesion has a diminishing return (i.e. inverse1 U- shaped) eﬀect on EBITDA.

H3c. Network cohesion has a diminishing return (i.e. inverse1 U- shaped) eﬀect on ROA.

4. Empirical study

4.1. Data sources

The overarching research question guiding this study focuses on the role that network power and network cohesion (i.e. the network

structure) have on the ﬁrm's ﬁnancial performance. In order to rigor-

ously do so, the method requires two data sources: (1) a supply chain network (or a reasonable proxy such as a JV network) and (2) the ﬁ- nancial measures required to calculate each ﬁrm's CCC, EBITDA and

ROA. The process by which the data were gathered is detailed below.

In order to capture the structure of a supply chain network the Thompson SDC platinum database was used, speciﬁcally we use the section that aggregates joint venture (JV) activity for a speciﬁc in- dustry. Next, we note that the SDC database aggregates reports of ﬁrms

that are engaging in partnerships (in various capacities) for activities such as research and development, marketing alliances, mergers and acquisitions, and manufacturing partnerships. It is also worthy to note, that included in the sample are both OEMs and component suppliers, providing a rather robust picture of a supply chain network. Given the necessity to replicate the structure of the supply chain network as

closely as possible (i.e. material and ﬁnancial ﬂows) in such an in-

dustry, we draw from the section of the SDC database that gathers in- formation on JV activity dealing speciﬁcally with manufacturing part- nerships. The database provides detailed information on each ﬁrm

engaging in the respective JV, the purpose of the collaboration and the role each participant played in the venture. As an example of the level of detail available, the purpose of one such JV between a component

supplier and a major OEM was to “manufacture disk brakes, drum brakes and vacuum boosters” for the inclusion into a new model of automobile. Though not a traditional buyer-supplier network, given the

explicit sourcing/production related purpose of the partnership, the frequency and volume of sourcing between entities, and equity involved in these transactions, we believe it to be an acceptable proxy. Furthermore, we choose the automotive industry for its vast production networks and resource intensive manufacturing processes (Choi and Hartley, 1996; Choi and Hong, 2002; Kim et al., 2011).

Next, in order to construct the JV supply chain network for each year using this data, we ﬁrst generate symmetric (i.e. square) binary

matrices for year the years 1985–2003 as follows. Each matrix is comprised of n rows and n columns (i.e. a matrix of size nXn, hence the symmetric label) where each ﬁrm constitutes a distinct row (of size n)

and column of the matrix (of length n). In the original sample there were 1158 ﬁrms (both buyers and suppliers) thereby generating 19

adjacency matrices, one for each year, with dimensions 1158 by 1158.

1 Note that there are two expectations of the functional form of the curvi- linear relationship, both of which are non-monotonic in nature. First, at low

levels of density the eﬀect is shortening and there exists a minimizing eﬀect, yet

when the density increases there is a lengthening of the cash conversion time;

hence the traditional ‘U-Shape’ (i.e. initial decline, bottoming out, then an in- crease). This is in contrast to the next two hypotheses wherein we expect that there will be an initial positive eﬀect on EBITDA & ROA as density increases, we expect that this beneﬁt will exhibit an ‘inverse U-Shape’ (i.e. initial rise, reaching the maximum, then decline thereafter). See: Figs. 1 and 2.

We label these matrices **A***t* , where t represents the year under ob- servation (t = 1,2,…,19). Then, each element, **a ij**, of the matrix (for year t) was assigned a value of either 0 or 1 (thus its binary construc-

tion), where a value of 1 indicates that ﬁrms i and j (in year t), engaged in a JV. This constitutes a tie between ﬁrms i and j. When taken to- gether, all of the values in the matrix deﬁne the structure of the network for that speciﬁc year (e.g. a value of 1 in row 1, column 3 indicates that there was a JV involving ﬁrms 1 and 3). This process is then repeated in

each year for all 19 years under observation (i.e. 19 binary adjacency matrices for each year, all of which having dimensions 1158 × 1158).

Additionally, each matrix was updated annually to cumulatively reﬂect

the dynamics of the network and the composition changes therein.

Thus, we have a dynamic panel dataset of automotive JV supply chain network structure over the course of 19 years. Accordingly, this data- base constitutes a suitable repository from which to re-create the structure of a supply network, given the detailed information on the sourcing information between (and among) all parties involved in such transactions. Furthermore, while extant supply chain research has used similar datasets to construct a supply chain network (c.f. Carnovale and Yeniyurt, 2014, 2015b; Carnovale et al., 2016, 2017), the present data include additional dependent and independent variables, collected

speciﬁcally for the purpose of this study. It is also worth noting that

using JVs to understand supply chain network structure is a useful or-

ganizational collaboration to examine from the perspective of the RDT, given that ﬁrms use these arrangements in order to increase control and access to resources (Pfeﬀer and Nowak, 1976; Pfeﬀer and Salancik,

1978, 2003; Gupta and Dutta, 2011).

Next, to gather performance information, we use the COMPUSTAT2

database, which provides disclosure information on publicly traded companies. Using this dataset, we cross reference it against the ﬁrms in

the JV supply chain network using their ticker symbols, and thus tri- angulate the data. Extant research suggests that such techniques ensure methodological rigor in empirical research (Ancarani and Zsidisin,

2010). Collectively, the above referenced matrices deﬁne the structure

of the JV network and thus all network related independent variables

were calculated, for each year, using these matrices. After calculating all network related variables, removing observations that did not have

complete the ﬁnancial information required, adding in the relevant

controls and lagging the dependent variable by two years, we were left with 387, 411, and 388 observations for the ﬁrm's CCC, EBITDA and

ROA, respectively.

4.2. Operationalization of variables

4.2.1. Dependent variables

For speciﬁc mathematical formulae, refer to Table 1. There are three dependent variables used: CCC, EBITDA and ROA. The ﬁrst dependent variable we examine is the ﬁrm's CCC, which is a “composite metric that … requires adding days of inventory plus days of accounts re- ceivable and subtracting days of accounts payable” (Farris et al.,

2005:114). Next, we examine each ﬁrm's EBITDA, which refers to

earnings before interest, taxation, depreciation and amortization and is

calculated as net sales minus cost of goods sold (COGS) and selling, general and administrative expenses (WRDS, 2015). Finally, we ex-

amine each ﬁrm's Return on Assets (ROA), which is the net income over

total assets.

4.2.2. Independent variables

First, in order to operationalize a ﬁrm's network power we use the

centrality measure eigenvector centrality. This network measure cap-

tures “(1) the number of links to other points; (2) the intensity of the links; and (3) the centrality of those with whom one is linked”

2 Compustat Industrial [Annual Data]. (1985–2003). Available: Standard & Poor's/Compustat. Retrieved from Wharton Research Data Service.

Table 2

Correlations and summary statistics.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Variable (\*p < .05) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 1. Cash Conversion Cycle | – |  |  |  |  |  |  |  |  |  |
| 2. EBITDA | 0.035 | – |  |  |  |  |  |  |  |  |
| 3. Return on Assets | 0.0082 | − 0.0753\* | – |  |  |  |  |  |  |  |
| 4. Network Power | 0.0968\* | 0.2218\* | − 0.0245 | – |  |  |  |  |  |  |
| 5. Network Cohesion | 0.1275\* | 0.0870\* | − 0.1520\* | 0.1591\* | – |  |  |  |  |  |
| 6. Network Cohesion2 | 0.1066\* | 0.1481\* | − 0.1369\* | 0.1334\* | 0.9707\* | – |  |  |  |  |
| 7. Focal Firm Network Size | 0.0548 | 0.1517\* | − 0.1610\* | 0.2796\* | 0.5703\* | 0.4955\* | – |  |  |  |
| 8. Firm Age | − 0.0023 | 0.0803\* | 0.0859\* | 0.0113 | − 0.1771\* | − 0.1375\* | − 0.0194 | – |  |  |
| 9. Firm Assets | 0.003 | 0.6102\* | − 0.1949\* | 0.1684\* | 0.044 | 0.0628 | 0.2514\* | 0.0544 | – |  |
| 10. Firm Size | 0.1417\* | 0.4778\* | − 0.0937\* | 0.1768\* | − 0.0474 | − 0.0184 | 0.2748\* | 0.0368 | 0.7022\* | – |
| Mean | 129.81 | 1717.01 | 0.05 | 0.01 | 0.40 | 4.24 | 0.78 | 74.81 | 8.03 | 4.43 |
| Std. Deviation | 421.58 | 3910.43 | 0.06 | 0.07 | 2.02 | 23.73 | 1.13 | 32.78 | 2.03 | 0.71 |

(Mizruchi and Bunting, 1981:478) and is conceptually explained as “an actor is more central if it is in relation with actors that are themselves central” (Ruhnau, 2000:360). To capture a ﬁrm's network cohesion, we

examine each ﬁrm's ego network density. First, the ego network of a

focal ﬁrm deals with its ﬁrst-degree connections. These ﬁrst-degree

connections are those ﬁrms to whom the ego is directly connected, and

the ties among the ﬁrms to which the ego is connected (Burt, 1980;

Freeman, 1982; Borgatti and Halgin, 2011). Essentially, this variable is a ratio comprised on the number of actual ties in the ﬁrm's ego network (i.e. the connections to which the ego, or focal ﬁrm, is connected) over

the maximum possible number of pairs in that ego network. The co- hesion of the ego network, then, captures the degree to which all ﬁrms contained within an focal ﬁrm's network are connected to each other

(Ahuja, 2000). For the empirical tests of the diminishing returns to network cohesion, we simply take the squared value of the ﬁrms net-

work density, thereby resulting in a quadratic equation where a nega- tive coeﬃcient would represent the presence of diminishing returns (i.e. a curvilinear eﬀect, c.f. Cohen and Cohen (1983)). Please refer to Table 1, above, for the speciﬁc operationalizations noted herein.

4.2.3. Control variables

In order to capture the any unobserved heterogeneity associated with the relationship between the ﬁrm's network structure and their ﬁnancial performance, we also include some key control variables.

First, because extant research has shown that the size of the ego net- work is an important determinant to the eﬃcacy in understanding the

connection between network structure and performance, we include a ﬁrm's ego network size. We also control for any experiential eﬀects by including the ﬁrm's age. Additionally, to control for ﬁrms with higher

levels of liquidity and resources, we include the logarithmic transfor- mation of the ﬁrm's total assets. Note that total assets was chosen to reﬂect all of those resources that are easily convertible to cash (i.e.

property, plant, land & equipment), or those already liquid (i.e. cash). Thus, total assets provides a more robust picture of both liquidity and resource access, particularly germane in light of RDT. Next, we control

for ﬁrm size by including the ﬁrm's total number of employees. Finally,

because the three dependent variables are all ﬁnancial in nature and

implicitly dependent upon time, we expect that there will be signiﬁcant

autocorrelation as well as the potential for endogeneity. Thus, in each

model, two lags (i.e. as independent variables t-1 and t-2) of the de- pendent variables are included. This lagged DV approach to control for auto correlation and endogeneity has been suggested so as to econo- metrically correct for such issues (Patatoukas, 2012; Kim, 2017). Table 2 shows the correlation and summary statistics of all the variables used in this study.

4.3. Econometric method

First, it's important to note that the data used in this study are measured on the same group of ﬁrms over a 19-year period. Therefore,

the resulting sample is a dynamic panel data set. Furthermore, the dependent variables are continuous in their distributions. While long- itudinal data allows researchers to account for dynamic variable re- lationships and one needs to take into account several complexities that arise such as autocorrelation, heteroscedasticity, and endogenous re- gressors. Fortunately, longitudinal econometric methods exist that can take into account such complexities and address additional issues that exist in non-longitudinal designs, such as endogeneity and unobserved heterogeneity. In addition, such longitudinal methods allow for a more robust picture of the dynamics of the network that a traditional panel

would not oﬀer (i.e. variations in network structure over time). In this

study, one such method was chosen speciﬁcally to handle (1) a con-

tinuous dependent variable, and (2) a dynamic panel structure. We thus

chose the Arellano–Bover/Blundell–Bond linear panel data estimator

(Arellano and Bond, 1991; Arellano and Bover, 1995; Blundell and

Bond, 1998). This estimation technique builds upon Arellano and Bond (1991)’s method whereby a ﬁrst diﬀerenced, generalized method of moments (GMM) estimator is used. However, Blundell and Bond (1998)

noted this method can suﬀer from small sample bias due to weak in- struments. Thus, they suggest “a system GMM estimator with ﬁrst-dif- ferenced instruments for the equation in levels” (Bruno, 2005:474). The reason why this method is preferable over other dynamic panel data

models is because “the lagged dependent variables are correlated with the unobserved panel-level eﬀects, making standard estimators incon-

sistent” (Stata, 2015:3). In addition, this method is ideal when there are “few time periods and many individual units…one left hand variable that is dynamic, depending on its own past realizations” and “right- hand variables that are not strictly exogenous” (Baum, 2013:10). Ef- fectively, in the present context this model is ideal given its ability to

cope with “independent variables that are not strictly exogenous, meaning correlated with past and possibly current realizations of the error; with ﬁxed eﬀects; and with heteroskedasticity and autocorrela- tion” (Roodman, 2006:1). Thus, for to test the eﬀects of network power

and network cohesion on the ﬁrm's CCC, EBITDA and ROA we estimate

three such models, one for each dependent variable noted above.

5. Results

Examining each model's Wald χ2, we see that all values are statis- tically signiﬁcant (p < .01) thus indicating that each model ﬁts the

data adequately. Table 3 presents these results.

5.1. Network power

Hypothesis 1 (a–c) dealt speciﬁcally with the impact that the ﬁrm's network power has on the ﬁrm's CCC, EBITDA and ROA. First, the coeﬃcient for the model examining CCC as the dependent variable is positive, and not statistically signiﬁcant (p > .1); thus hypothesis H1a is not supported. Next, the coeﬃcient for the impact of network power on the ﬁrm's EBITDA is 2064.25, which is positive and statistically

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | CCC |  |  | EBITDA |  |  | ROA |  |
| Independent Variable | B | S.E |  | B | S.E |  | B | S.E |
| Network Power | 119.257 | 195.413 |  | 2064.253\*\*\* | 801.216 |  | 0.0118 | 0.035 |
| Network Cohesion | − 1490.450\*\*\* | 505.510 |  | − 327.059 | 630.233 |  | 0.1086\* | 0.061 |
| Network Cohesion2 | 89.841\*\*\* | 30.405 |  | 37.204 | 37.789 |  | − 0.0064\* | 0.004 |
| Focal Firm Network Size | − 129.268\*\*\* | 43.666 |  | − 8.698 | 120.463 |  | 0.0111\* | 0.007 |
| Firm Age | 5.251\* | 2.908 |  | − 14.152 | 13.391 |  | − 0.0001 | 0.000 |
| Firm Assets | − 231.310\*\*\* | 42.899 |  | 301.813\*\*\* | 48.534 |  | − 0.0314\*\*\* | 0.007 |
| Firm Size  +  Dependent Variable t−1 | 1449.630\*\*\*  \*\*\*  0.731 | 118.104  0.040 |  | 307.134  \*\*\*  0.944 | 398.335  0.056 |  | 0.0434\*\*  0.0419 | 0.021  0.054 |
| +  Dependent Variable t−2 | \*\*\*  − .157 | 0.047 |  | − 0.061 | 0.047 |  | − 0.0434 | 0.047 |

+ Note that 'Dependent Variable' refers to each model's dependent variable, and was concentrated for space considerations.

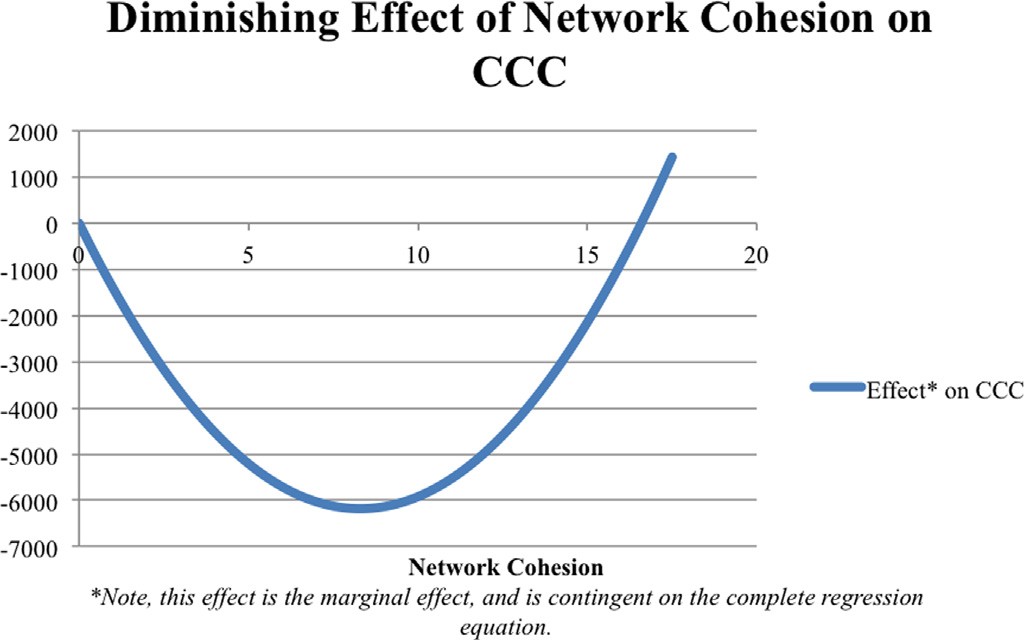
|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | | | |  |  |  |
|  |  |  |
| Intercept  Model ﬁt | − 4611.594\*\*\* | 493.362 | − 2472.000 | 1970.925 | 0.0967 | 0.080 |
| Wald χ2 (DF) | 1435.85\*\*\*(9) |  | 2593.39\*\*\*(9) |  | 39.15\*\*\*(9) |  |
| Observations | 387 |  | 411 |  | 388 |  |

\* p < .1.

\*\* p < .05.

\*\*\* p < .01.

Fig. 1. Diminishing e



ﬀect of network cohesion on CCC.

increases to a ﬁrm's network cohesion has in explaining its CCC,

EBITDA and ROA performances; both linearly, and non-monotonically by way of its diminishing returns. First, we see that the coeﬃcient for the linear impact that network cohesion has on a ﬁrm's CCC is negative and statistically signiﬁcant (p < .01). Hence, H2a is strongly sup- ported. Next, we see that while the coeﬃcient for the impact of network power on a ﬁrm's EBITDA is positive, it is not statistically signiﬁcant

(p > .1). Thus, hypothesis H2b is not supported. Finally, in the linear context we hypothesized that increased levels of cohesion would posi-

tively impact the ﬁrm's ROA. We see that the coeﬃcient is positive and

marginally statistically signiﬁcant (p < .1). Thus, H2c is partially

supported.

We also hypothesized that while cohesion is good, that there would be a diminishing return as levels continue to increase. Thus for H3a we suggested that at a certain level of cohesion, the CCC would actually

lengthen, thereby creating ineﬃciencies with respect to managing cash

ﬂow (the traditional ‘U-Shaped’ eﬀect). Examining this coeﬃcient we see that it is in fact positive, and statistically signiﬁcant (p < .01). In

Fig. 1 we see that the optimal point of cohesion manifests itself at be- tween 8% and 10% of maximum density, immediately thereafter the

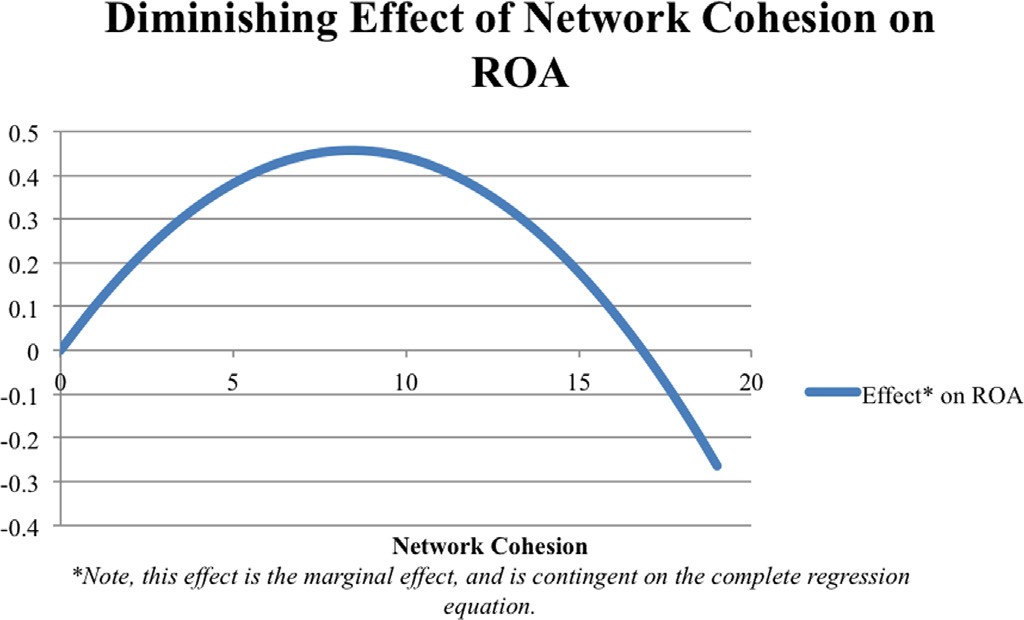
beneﬁt exhibits a rather sharp increase (i.e. lengthening) in the CCC.

Thus, H3a is strongly supported. We also suggested this diminishing return eﬀect would occur between cohesion and EBITDA. While the coeﬃcient for the impact of density on EBITDA is negative, it is not statistically signiﬁcant (p > .1). Thus, H3b is not supported. Finally,

we suggested that at a certain point too much cohesion in a network would detract away from the ﬁrm's ROA performance. Examining the coeﬃcient we see that it is negative and marginally statistically sig- niﬁcant (p < .1). Furthermore, in Fig. 2 we see the same optimal point of cohesion (i.e. 8–10%) whereby thereafter the beneﬁt to ROA sig- niﬁcantly drops oﬀ. Thus H3c is partially supported.

Finally, it's worth highlighting the impact that certain key control variables have on the dependent variables. First, coeﬃcient for ego

Fig. 2. Diminishing eﬀect of network cohesion on ROA.



signiﬁcant (p < .01). Thus, H2b is strongly supported. Finally, we see that while the coeﬃcient for network power's impact on a ﬁrm's ROA is positive, it is not statistically signiﬁcant (p > .1) thus we ﬁnd no

support for H2c.

5.2. Network cohesion

The next set of hypotheses dealt speciﬁcally with the impact that

network size on the CCC model is − 129.27, which is negative and statistically signiﬁcant (p < .01), suggesting that as a ﬁrm's ego net-

work increases its size by one unit, its overall CCC decreases by over

129 units, ceteris paribus. This suggests that there may exist increased complexity with generating working capital as the size of the network

with which the ﬁrm interacts grows in size. Also of note, is the positive

and statistically signiﬁcant (p < .001) impact that the lagged DVs have

on the CCC. This suggests that there may exist experiential eﬀects to

harnessing the beneﬁts of CCC eﬃciencies. Table 4 presents a summary

of these results matched to their respective hypothesis.

|  |  |  |  |
| --- | --- | --- | --- |
| Hypothesis number | Hypothesis | Result | Signiﬁcance |
| H1a | Network power has a shortening eﬀect (i.e. decreases) on the cash conversion cycle. | Not Supported | p > .1 |
| H1b | Network power has a positive eﬀect on EBITDA | Supported | p < .01 |
| H1c | Network power has a positive eﬀect on ROA. | Not Supported | p > .1 |
| H2a | Network cohesion has a shortening eﬀect (i.e. decreases) on the cash conversion cycle. | Supported | p < .01 |
| H2b | Network cohesion has a positive eﬀect on EBITDA. | Not Supported | p > .1 |
| H2c | Network cohesion has a positive eﬀect on ROA. | Marginally Supported | p < .1 |
| H3a | Network cohesion has a diminishing return (i.e. U-shaped) eﬀect on the cash conversion cycle | Supported | p < .01 |
| H3b | Network cohesion has a diminishing return (i.e. inverse U-shaped) eﬀect on EBITDA | Not Supported | p > .1 |
| H3c | Network cohesion has a diminishing return (i.e. inverse U-shaped) eﬀect on ROA | Marginally Supported | p < .1 |

Table 5

Theoretical contributions.

Network construct

Implications for theory

Supply chain ﬁnance Network theory Resource dependence theory

Network

Cohesion

Network cohesion plays the largest role in engendering a ﬁrm's eﬃciency in their ﬁnancial

•

performance.

The results add to the conversation around the contingent beneﬁts of density (i.e. Burt (1992) vs. Coleman, 1988) where by ﬁrms experience

•

The approach herein integrates RDT into the

•

SCF conversation to suggest that ﬁrms consider

both power, and cohesion as critical

• That is, high levels of this construct increase a

positive outcomes, but up to a certain point.

•

determinants of

ﬁnancial success.

Network

Power

ﬁrm's ability to assimilate ﬁnancial reserves from

their network (shorten the time to recover

ﬁnancial resources).

•

This eﬀect is, however, not inﬁnitely positive, and

is only beneﬁcial to a certain point due to

diminishing returns

•

Thus, there is an optimal point of cohesion in the network that ﬁrms should strive to achieve.

•

Network power, in contrast to network cohesion, appears to positively aﬀect earnings performance of the ﬁrm.

•

The ability to leverage network resources and

reduce dependence appears to increase earnings

Findings suggest that loosely connected networks

(Burt, 2004), those with lower levels of cohesion, lead to positive outcomes.

The results extend the context around the importance of eigenvector centrality in networks.

•

Speciﬁcally, its use as an operationalization of

power in network analysis.

From the RDT perspective, the results are two-

fold: (1) cohesive networks engender access to tightly connected local resources, which are more

•

eﬀective for cashﬂow and working capital

performance. Next, (2) Network power can have a dependence reduction eﬀect that can increase

earnings performance.

6. Discussion

The central purpose of this study was to contribute to the existing gap in the supply chain management literature dealing with the inter-

section of the network perspective and ﬁnancial performance. That is,

to date, extant research has not yet considered the role that network

structure has on SCF related performance metrics. Through the use of resource dependence and network theories, we tested the eﬀect of network power and network cohesion on three measures of ﬁnancial

performance (CCC, EBITDA and ROA) thereby broadening out the perspective of SCF and further contributing to the literature on the

‘structure-performance link’ (Foerstl, Franke and Zimmermann, 2016). In the process, two (2) central themes emerged from the results: (1) network cohesion engenders eﬃciency in ﬁnancial performance; and

(2) network power engenders earnings performance. Table 5 provides a summary of the contributions of this study to SCF, RDT and network theory.

6.1. Theme 1: network cohesion engenders eﬃciency in ﬁnancial performance

Network cohesion speaks directly to the local network structure, or the composition a ﬁrm's immediate network. Empirically, this study

shows that it is at this level of network analysis where the largest gains to a ﬁrm's performance are achieved: a shortening of the CCC and an increase to the ﬁrm's ROA. Each of these performance measures relate directly to the ability for the ﬁrm to extract resources and value out of their ﬁnancial processes. In the context of SCF, the importance of col- laboration (Caniato et al., 2016) attention to the ﬁnancial health of the

supply base (Bode et al., 2014) are large antecedents to performance.

Accordingly, the results herein contribute to this discussion by articu- lating the importance of cohesion for engendering eﬃciency (i.e. making better use of ﬁnancial resources). Speciﬁcally, when local net- work structure is optimized ﬁrms are able to leverage resources more eﬃciently and reduce the CCC, thereby increasing their access to cashﬂow. In the context of RDT, this result is also noteworthy. Speci- ﬁcally, the predominant thinking around why ﬁrms seek to engage in

collaborative initiatives is to increase access to resources and decrease dependence to achieve some end. To date, however, the present thinking around SCF is that performance increases are generally only

seen in the context of managing the ﬁrm's ﬁnancial processes through

capital (Mizgieret al., 2015) or procurement initiatives (Wuttke et al.,

2013a). The present study builds on this thinking and suggests that, generally, performance beneﬁts are also seen when ﬁrms manage and

develop their local network structures.

However, it is important to note that there has been a fair bit of theoretical tension surrounding network cohesion (i.e. density), with

some highlighting the beneﬁts gained as it increases, others suggesting

the opposite. The empirical results herein seem to side with the latter. Speciﬁcally, though network cohesion is a positive thing, an optimal

point was shown to exist, beyond which subsequent increases in co- hesion actually reduce the positive eﬀect. In both the case of the re-

lationship between cohesion and CCC as well as cohesion and ROA, the performance beneﬁts gained are at their optimal point between 8% and

10% density, and begin a precipitous decline thereafter. This ﬁnding conﬁrms earlier work (Burt, 2004) that loosely connected networks,

those with lower levels of cohesion, can lead to positive outcomes. In the context of SCF, the results contribute to the work focusing on broadening the scope of SCF to include the extended enterprise (c.f.

Huﬀ and Rogers, 2015) as well as that work which considers the

cluded that ﬁrms seeking to optimize the eﬃciency with which ﬁ-

nancial resources are used, and therefore increase their ROA and de-

crease their CCCs, must be cautious about increasing the connectedness of their networks. This is also substantiated upon examining the ne-

gative eﬀect that focal ﬁrm network size has on both the CCC and ROA.

We did not, however, ﬁnd support for the eﬀect of network power

on neither ROA nor CCC. This merits further exploration. Taken to- gether, the ﬁrms CCC and ROA are, to a certain degree, essentially representing the eﬃciency with which ﬁrms are deploying and mana- ging their ﬁnancial assets locally (i.e. ego network level) in the supply

chain network. One possible explanation for the result is that the ex- ertion of power can lead to opportunistic behavior (Handley, 2012) and, if wielded inappropriately, can lead to negative relational out-

comes. In the context of the ﬁrm's CCC performance, the need to foster

collaborative partnerships (Caniato et al., 2016) is critical and thus, this may explain why there is no signiﬁcant eﬀect present.

6.2. Theme 2: network power facilitates earnings performance

Network power, as deﬁned above, speciﬁcally dealt with how a ﬁrm leverages its network position and connections to its beneﬁt. Thus, as a

construct it is externally driven and from an RDT perspective, funda- mental to reduced dependency and increased access to resources. The

ﬁndings indicate that as ﬁrms increase their network connections to

those ﬁrms with more power in the network, they increase access to

resources and thus generate signiﬁcant improvements to their earnings

performance. In the context of SCF, the ﬁndings suggest that depen-

dence can have a negative eﬀect on performance. This result also ac-

centuates earlier work which advocates managing the ﬁnancial health

of the ﬁrm's supply base to the focal ﬁrm's beneﬁt (Bode et al., 2014),

and extends it by suggesting that power and dependence are also cri- tical to manage in this process. Additionally, the ﬁnding extends pre- vious work suggesting that sound partnerships can beneﬁt the focal ﬁrm ﬁnancially (Hertzel et al., 2008), in this case with respect to the earn- ings performance of the focal ﬁrm.

In this context, however, there were no signiﬁcant ﬁndings with

respect to the eﬀect of network power on the CCC and ROA. Perhaps

one possible interpretation of this is the emphasis that the CCC places on the importance of collaboration so as to facilitate cash ﬂow eﬃ- ciency. Thus, increasing power might have a negative eﬀect on such a

process (i.e. the balance of power might be shifted), whereby powerful

OEMs aren’t compelled to cooperate. Another potential reason for the lack of signiﬁcance in the predicted eﬀect, might be due to the price pressure that ﬁrms who partner with large, powerful ﬁrms often face

(Bloom and Perry, 2001), and thus certain metrics of ﬁnancial perfor- mance could therefore be aﬀected.

6.3. Managerial implications

Our ﬁndings have noteworthy implications for supply chain man- agement practice. Procurement and sourcing professionals need to be aware of the relationship between the structure of their supply chain

networks and the ﬁnancial performance of their ﬁrm for two (2) pri- mary reasons. First, managers should consider the role that their ﬁrst

degree supply base connections, and extended networks overall, have on their ﬁnancial performance. Primarily, a larger network is particu- larly beneﬁcial for cash conversion cycles and return on assets. Thus, to maximize their ﬁnancial performance, managers should strive towards

a relatively robust and diverse supply base (i.e. larger network struc- ture) where their organization has a central role. Additionally, it's quite important for managers to focus on the structure of the connections in

the ﬁrm's supply base, as indirect negative consequences (i.e. dimin-

ishing returns) on ROA can arise when networks are too connected.

That is, when there exist redundancies in the supply base, negative externalities can arise and ameliorate any beneﬁts attained. Second,

that it is these connections have the largest impact on earnings per- formance. We ﬁnd that the prominence of the ﬁrm's extended network connections (i.e. the degree to which the ﬁrm works with key suppliers,

either high volume or those suppliers who have a large number of supply relationships throughout the network), is the characteristic that managers should focus on to increase their earnings performance. This insight becomes particularly important in the supplier selection process. Working with such suppliers, perhaps given their position in the market

and ability to drive value for their customers, allows the ﬁrm to free up

resources and signiﬁcantly increase earnings. Taken together, mana-

ging both the local and extended network connections of the ﬁrm

provides a robust picture, and a nuanced perspective, of how to increase

ﬁnancial performance and manage SCF initiatives.

7. Conclusion, limitations, and future directions

Overall, this research integrates two overarching theoretical per- spectives, resource dependency theory and network theory, in an at- tempt to contribute to SCF research from a non-traditional perspective: the impact that network structure has on resource access, and therefore

the ﬁrm's ﬁnancial performance. Theoretically, the research adds to the

SCF domain by suggesting that network cohesion increases a ﬁrm's

ability to assimilate ﬁnancial reserves from their network (shorten the

time to recover ﬁnancial resources). Also, that network power is a

critical component as ﬁrms seek to engender their earnings perfor-

mance. From the RDT perspective, the contribution is two-fold: (1)

cohesive networks engender access to tightly connected local resources, and therefore increase eﬃciency in performance and capital availability

(i.e. CCC). Next, (2) Network power can have a dependence reduction eﬀect that can increase earnings performance.

While this study has furthered our understanding of the role that network structure and composition has in explaining a ﬁrm's internal

and external supply chain performances, there are several limitations that need to be noted. First, this study uses manufacturing JVs to re- plicate a supply chain network which may not include certain other buyer/supplier relationships (i.e. arms length sourcing arrangements, etc.). Also, while the network herein is dynamic, in future research it would be worth explicitly analyzing the length and the importance of the JV (or other buyer/supplier relationships) as it relates to perfor- mance. Next, we sample from the automotive industry and thus there is

a chance that the external validity of the ﬁndings is not as strong had

we used a cross-industry sample. It's also worth noting that the way in which power was measured is diﬀerent from previous works, as the use

of power is not captured. Clearly, a more contextual understanding of power (rather than the structural one adopted herein) would be bene-

ﬁcial. Additionally, related to the sample, the data are somewhat dated.

While the large number of ﬁrms, and the interconnections between

them, is generally representative of a modern JV network, future re-

search should capture a more updated network structure for this type of analysis. Future research should also perform inter-industry compar- isons in order to extend external validity and theoretical understanding of these concepts. In addition, research should extend to other areas of

general ﬁnance to further broaden the SCF vantage point to include

things like dynamic discounting, FinTech, and other SCF related con-

structs should be studied.

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