Journal of Purchasing and Supply Management xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

Journal of Purchasing and Supply Management

journal homepage: www.elsevier.com/locate/pursup

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

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ARTICLE INFO

Keywords:
Supply chain finance
Supply network structure
Resource dependency
Network theory

ABSTRACT

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 advantage. 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 potentially 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 technologies 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 resource dependency theory (RDT) provides for a theoretical connection between accessing resources via the firm's network connections, and the

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https://doi.org/10.1016/j.pursup.2018.07.007
Received 21 January 2017; Received in revised form 26 July 2018; Accepted 31 July 2018
Available online 07 August 2018
1478-4092/

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 financial 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 automotive supply chain network, from 1985 to 2003. This network structure 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 transactions, 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 network. 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 management, 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 efficiency (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 complexity 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 supplier (typically through the use of a financial intermediary), can decrease (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 research 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 structure 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 capabilities 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 development, has shown that the composition of a firm's focal network significantly 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 automotive industry, demonstrating important insights regarding the connection 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 internationally, 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 operate 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 dependence 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 provision of vital resources" (Drees and Heugens, 2013:1667). This interdependence 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 survival hinges on the ability to procure critical resources from the external environment…organizations will try to restructure their dependencies 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 improving performance. Effectively, the firm's ability to successfully operate 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 design (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 interdependence 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 dependence 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 performance. Note that while the CCC is traditionally a working capital metric, 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 metric.

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 relationship will explain the efficiency with which the firm can leverage its power and cohesion so as to increase the speed that cash is converted. 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 cohesion, 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 represents 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 combination 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). $DOI: Days\ of\ Inventory = \left(\frac{Inventory}{Cost\ of\ Goods\ Sold}\right)*365$ $DOR: Days\ of\ Receivables = \left(\frac{Accounts\ Receivables}{Net\ Sales}\right)*365$ $DOP: Days\ of\ Payables = \left(\frac{Accounts\ Receivables}{Cost\ of\ Goods\ Sold}\right)*365$ $Cash\ Conversion\ Cycle = DOI+DOR - DOP$ (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: $ROA_{ft} = net\ income_{ft}/total\ assets_{ft}$
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 x_j 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: $Network\ \ Power_{f,t} = \lambda x_f = \sum_{i=1}^{n} a_{i,j} x_n \ \ i = 1,\ldots,n\ \forall\ t$ where $f = i, j\ and\ i \neq j$ (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: $Network\ Cohesion_{f,t} = Actual\ Ties/Maximum\ Number\ Pairs$ 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 Cohesion^2	Independent	Finally, to calculate the diminishing returns to network cohesion, we take the quadratic of its linear counterpart: $Network\ Cohesion\ \ Squared_{f,t} = (Network\ Cohesion_{f,t})^2$ 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).
Focal Firm Network Size	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): $Focal\ Firm\ Network\ Size_{f,t} = \sum_{i=1}^{n} \mathbf{a_{i,j}}\ \forall\ t$
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 design 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 attempting to foster this network power can "lessen their dependency" on certain connections by "cultivating alternative sources of desired resources" (Provan et al., 1980).

Thus, for firms to truly gain and benefit from network power they must develop capabilities to manage and navigate the interconnectedness of their first-degree connections (i.e. their 'ego networks', c.f. Burt, 1980; Freeman, 1982; Borgatti and Halgin, 2011), as well as their indirect network connections. Previous research has defined such network 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). Accordingly, 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 connections. 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 proportionally 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 favorable payment modalities and terms between members of the network (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 operational disruptions to the financial flows in supply chain networks (Mizgier et al., 2015) thereby engendering a shortened CCC. Such mitigation 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 positively 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 resources 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 position 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 examination 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 performance 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 collaborative 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 organizational resource, given their ability to facilitate interactions and exchanges 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 directly 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 resource 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 diminished 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 development 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 diminishing 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 affected 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 potentially 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-shaped[1]) effect on the cash conversion cycle.

H3b. Network cohesion has a diminishing return (i.e. inverse[1] U-shaped) effect on EBITDA.

H3c. Network cohesion has a diminishing return (i.e. inverse[1] 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 rigorously 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 financial 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 industry. 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 industry, we draw from the section of the SDC database that gathers information on JV activity dealing specifically with *manufacturing partnerships*. 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. We label these matrices $\mathbf{A}_t$, where t represents the year under observation ($t = 1,2,\ldots,19$). Then, each element, $\mathbf{a}_{ij}$, of the matrix (for year t) was assigned a value of either 0 or 1 (thus its binary construction), 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 together, 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 database 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 organizational 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 COMPUSTAT[2] 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 triangulate 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 receivable 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 examine 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 captures "(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"

[1] Note that there are two expectations of the functional form of the curvilinear 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 increase). 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.

[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 Cohesion^2	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 cohesion 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 network density, thereby resulting in a quadratic equation where a negative 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 network 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 transformation 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 dependent variables are included. This lagged DV approach to control for auto correlation and endogeneity has been suggested so as to econometrically 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 longitudinal data allows researchers to account for dynamic variable relationships and one needs to take into account several complexities that arise such as autocorrelation, heteroscedasticity, and endogenous regressors. 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 continuous 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 instruments. Thus, they suggest “a system GMM estimator with first-differenced 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 inconsistent” (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). Effectively, 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 autocorrelation” (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 χ^2, we see that all values are statistically 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

Table 3
Estimates of network power and network cohesion on CCC, EBITDA, and ROA.

	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 Cohesion^2	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	1449.630***	118.104	307.134	398.335	0.0434**	0.021
Dependent Variable $_{t-1}$ [+]	0.731***	0.040	0.944***	0.056	0.0419	0.054
Dependent Variable $_{t-2}$ [+]	− .157***	0.047	− 0.061	0.047	− 0.0434	0.047
Intercept	− 4611.594***	493.362	− 2472.000	1970.925	0.0967	0.080
Model fit						
Wald χ^2 (DF)	1435.85***(9)		2593.39***(9)		39.15***(9)	
Observations	387		411		388	

[+] Note that 'Dependent Variable' refers to each model's dependent variable, and was concentrated for space considerations.
* p < .1.
** p < .05.
*** p < .01.

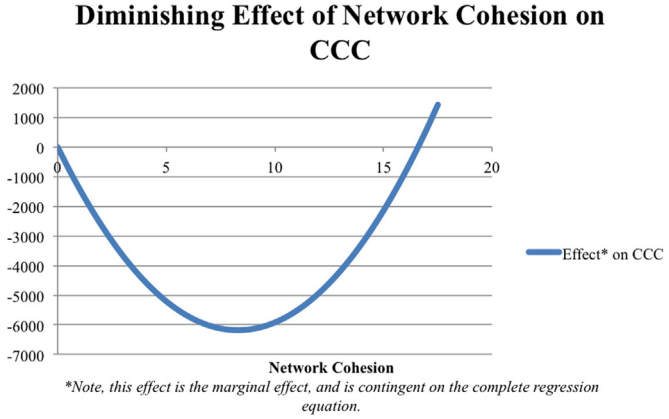

Fig. 1. Diminishing effect of network cohesion on CCC.

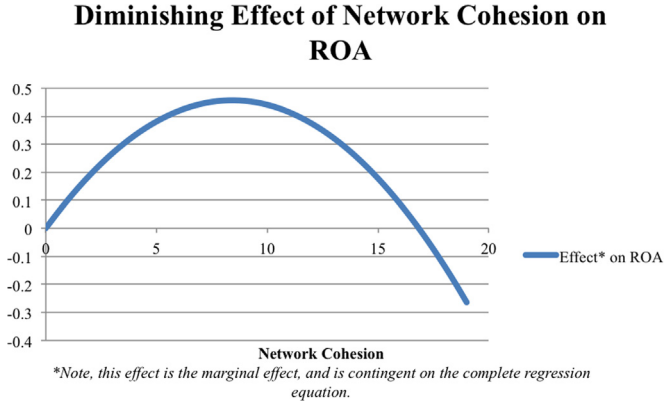

Fig. 2. Diminishing effect of network cohesion on ROA.

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 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 supported. 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 positively 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 between 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 significant (p < .1). Furthermore, in Fig. 2 we see the same optimal point of cohesion (i.e. 8–10%) whereby thereafter the benefit to ROA significantly 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 network size on the CCC model is − 129.27, which is negative and statistically significant (p < .01), suggesting that as a firm's ego network 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.

Table 4
Summary of hypotheses and results.

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. • That is, high levels of this construct increase a 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.	• The results add to the conversation around the contingent benefits of density (i.e. Burt (1992) vs. Coleman, 1988) where by firms experience positive outcomes, but up to a certain point. • Findings suggest that loosely connected networks (Burt, 2004), those with lower levels of cohesion, lead to positive outcomes.	• The approach herein integrates RDT into the SCF conversation to suggest that firms consider both power, and cohesion as critical determinants of financial success. • 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.
Network Power	• 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	• The results extend the context around the importance of eigenvector centrality in networks. Specifically, its use as an operationalization of power in network analysis.	

6. Discussion

The central purpose of this study was to contribute to the existing gap in the supply chain management literature dealing with the intersection 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 collaboration (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 articulating the importance of cohesion for engendering efficiency (i.e. making better use of financial resources). Specifically, when local network 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. Specifically, 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 cohesion actually *reduce* the positive effect. In both the case of the relationship 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

network perspective and financial performance. Thus, it can be concluded that firms seeking to optimize the efficiency with which financial resources are used, and therefore increase their ROA and decrease their CCCs, must be cautious about increasing the connectedness of their networks. This is also substantiated upon examining the negative 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 together, the firms CCC and ROA are, to a certain degree, essentially representing the efficiency with which firms are deploying and managing their financial assets locally (i.e. ego network level) in the supply chain network. One possible explanation for the result is that the exertion of power can lead to opportunistic behavior (Handley, 2012) and, if wielded inappropriately, can lead to negative relational outcomes. 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, fundamental 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 dependence can have a negative effect on performance. This result also accentuates 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 critical to manage in this process. Additionally, the finding extends previous work suggesting that sound partnerships can benefit the focal firm financially (Hertzel et al., 2008), in this case with respect to the earnings 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 efficiency. 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 performance could therefore be affected.

6.3. Managerial implications

Our findings have noteworthy implications for supply chain management 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) primary 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 particularly 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 structure) 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. diminishing 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, when managers consider their extended networks, they must realize that it is these connections have the largest impact on earnings performance. 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, managing 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 perspectives, resource dependency theory and network theory, in an attempt 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 performance. 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 replicate 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 performance. 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 beneficial. 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 research should capture a more updated network structure for this type of analysis. Future research should also perform inter-industry comparisons 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 constructs should be studied.

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