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Global supply network embeddedness and power: An analysis of international joint venture formations

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ABSTRACT

As a subset of the international business literature, cross-border equity based partnerships have drawn significant academic attention. In the context of inter-firm partnerships, the power dynamics between parties and the implications that power has on the relational dynamics between firms is an important consideration. Research that connects power with network theory has recently emerged, suggesting that the network, as a source of power, plays a significant role in inter-firm dynamics. Yet, while there has been a substantial body of work either articulating the antecedents and consequences of power, little research has paid attention to the role that power plays in international JV formations; this presents a significant gap in the international business literature. Consequently, this study investigates the role that global network structure plays in the formation of new equity based international partnerships. Secondly, it contributes to the international JV literature by developing and testing a theoretical framework that examines inter-firm power dynamics as derived from the network position of each firm in the global network. Global network prominence, brokerage and weakness are key factors utilized in the analysis. The hypotheses are tested using a global manufacturing joint venture longitudinal dataset that contains 985,689 observations from 1985 to 2003. The results of the event history analysis indicate that for the manufacturer global network prominence, brokerage and weakness play an important role in new joint venture formations. On the other hand, only global network prominence is a significant factor for the potential partner.

1. Introduction

Firms routinely engage in cross-border partnerships as a means to build and sustain a global market advantage (Yeniyurt, Cavusgil, & Hult, 2005). In fact, "UNCTAD forecasts an upturn in FDI flows to $1.4 trillion in 2015 and beyond ($1.5 trillion in 2016 and $1.7 trillion in 2017)" (UNCTAD, 2015:2) with several of these FDI flows being joint ventures. Joint ventures (JVs) are collaborative partnership formations wherein an autonomous entity is formed with the equity of two or more organizations (Kogut, 1988). JVs are common as they can decrease the cost of arms-length market transactions (Beamish & Banks, 1987; Coase, 1937) and increase control (Hennart, 1988). As a subset of the international business literature, cross-border equity-based partnerships have drawn significant academic attention (Contractor & Kundu, 1998; Contractor, Beldona, & Kim, 2011).

Yet, JVs exist within and are an integral part of the overall inter-organizational supply network of a firm (Carnovale, Rogers, & Yeniyurt, 2016). Accordingly, research has examined inter-firm relationships from a network perspective (Borgatti & Li, 2009; Carnovale & Yeniyurt, 2014; Coviello, 2006; Gimeno, 2004; Meschi & Wassmer, 2013; Polidoro, Ahuja, & Mitchell, 2011; Shi, Sun, Pinkham, & Peng, 2014). For example, Gulati (1999) studies the role that access to network resources has in facilitating future alliance formation, finding that they act as a facilitating mechanism which reduces the hazards of future partnerships. Fundamentally, network theory holds the view that the connections between and among entities are the basis for understanding the relational dynamics between firms (Borgatti, Mehra, Brass, & Labianca, 2009).

Thus, as firms continue to form JVs their network grows, thereby engendering future JV formations (Carnovale & Yeniyurt, 2014). In so doing, their position within this network continues to

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become further embedded. In the network context, "embeddedness refers to the state of dependence of a company on its suppliers and customers in a particular supply network structure" (Choi & Kim, 2008:5). Furthermore, as the firm's embeddedness grows, questions surrounding the power dynamics between parties, arising from their respective network positions, becomes an important consideration in the context of future partnerships (Crook & Combs, 2007; Handley & Benton, 2012a, 2012b). Stated differently, embeddedness can shift the balance of power because "the configuration of network of relations can facilitate or impede an organization's behaviors and performance" (Choi & Kim, 2008:8). In fact, it has been noted that " . . . a firm with significant power might not find it necessary to establish the win–win alliance since it can achieve its own profitability and effectiveness through control of its suppliers" (Benton & Maloni, 2005:2).

Accordingly, power has been looked at from a varying array of perspectives, with its theoretical foundations solidly grounded in the literature emerging out of social psychology (e.g. French & Raven, 1959). Research has been advanced to understand the role that power plays on supply chain satisfaction (Benton & Maloni, 2005), the stability of an IJV (Inkpen & Beamish, 1997), its impact on the JV achieving its strategic objectives (Yan & Gray, 2001), and the interplay that it has with trust on mitigating the potentially negative consequences of uncertainty (Ireland & Webb, 2007). Research that connects power with network theory has recently emerged, suggesting that the network, as a source of power, plays a significant role in inter-firm dynamics (Kähkönen & Virolainen, 2011). Though, while recent work as looked at the effect that network structure has on future JV formations (Carnovale & Yeniyurt, 2014), further work is warranted that studies how a firm's embeddedness and network derived power impacts its future network development in global supply chain management; as this is an understudied area of international business. Hence, the main research question this study seeks to address is: what role does a firm's network embededness and network based power play as an antecedent of its network development?

Consequently, this research has a dual faceted purpose. First, it contributes to the existing body of work that conceptualizes inter-firm relations as networks and studies their embeddedness within them (Choi, Dooley, & Rungtusanatham, 2001; Choi & Kim, 2008; Kim, Choi, Yan, & Dooley, 2011) and investigates the role that global network structure, and a firm's embeddedness within them, plays in the formation of new equity-based international partnerships. Secondly, it contributes to the IJV literature by developing and testing a theoretical framework that examines inter-firm power dynamics as derived from the network position of each firm in the global network.

The rest of this research is organized as follows. First a review of the relevant literature regarding IJVs, power, and network theory is presented. Then, theoretically driven hypotheses are articulated. Next, the empirical context of this study is detailed, including a description of the dataset and methodology employed to test the hypotheses. Finally, the results are presented and the theoretical and managerial implications are discussed; followed by the limitations and future research directions.

2. Literature review

2.1. International joint venture networks

The literature on international joint ventures (IJV) is well established (Christelow, 1987). An early antecedent to research in this domain was Stephen Hymer's doctoral dissertation (Hymer, 1960/1976) wherein he began to explain why firms engage in international production (Dunning, 2008; Forsgren, 2008). He suggested an alternative explanation to the traditional portfolio theory of foreign direct investment (FDI), that firms invest in foreign markets in order to diversify their portfolios. As his research evolved he came to the contention that firms go abroad to exploit their market power in an attempt to create a monopolistic advantage (Forsgren, 2008). Since then, IJV's have been examined from a variety of perspectives. For example, research has demonstrated that as the number of partners in a JV increases, there is a negative effect on both contract completeness and partner cooperation; but that these two variables have a positive effect on JV performance (Gong, Shenkar, Luo, & Nyaw, 2007). Previous research has also examined the impact that the relatedness of the JV (i.e. similar industry or operating characteristics to the parents) has on performance and suggest that, "parents forming joint ventures in the identical and related-complimentary categories reported higher gains . . . then those forming other types of ventures"(Koh & Venkatraman, 1991:888). Others have expanded the definition of distance to include contingency factors at national, industry and firm level and have shown that manufacturing partnerships are affected differently by these factors than research and development partnerships (Choi & Yeniyurt, 2015).

Accordingly, JVs are integral part of the overall inter-firm network and as such, the management of JVs is directly related to the characteristics of these inter-firm networks, and the embeddedness a firm exhibits in such networks. Accordingly, recent academic inquiry has directed attention to examining inter-firm relationships from a network level perspective (Galaskiewicz, 2011). The fundamental premise behind network theory is the idea that structure, as defined by the connections between and among actors, is key to understanding relational dynamics (Coviello, 2006; Coviello & Munro, 1997; Sun, Mellahi, & Thun, 2010). Fundamentally, network structure can be thought of as the combination of two things: nodes (i.e. firms) and edges that connect nodes (i.e. inter-firm ties). The academic development of network theory can be seen in applications ranging from psychology (Moreno, 1934), cultural anthropology (Nadel, 1957), social anthropology (Bott, 1957; Kapferer, 1972; Mitchell, 1974) and graph theory (Freeman, 1982). Modern applications of network theory can be seen in applications examining IJV formations (Coviello & Munro, 1997; Coviello, 2006; Carnovale et al., 2016; Sun et al., 2010), alliances in the bio-tech industry (Powell, Koput, Smith-Doerr, & Owen-Smith, 1999) alliance behavior and management (Gulati, 1995; Gulati, 1999; Gulati & Sytch, 2007) and supply chain management (Carnovale & Yeniyurt, 2014; Carnovale & Yeniyurt, 2015; Choi & Kim, 2008).

Connecting the IJV literature with network theory has revealed some interesting results. Early research has suggested that firms looking to expand internationally via equity-based JVs can gain access to better financing, existing distribution channels and increased market access by leveraging existing networks (Oviatt & McDougall, 1994). Leveraging these network connections has been shown to directly influence the profitability of international activities (Holm, Eriksson, & Johanson, 1996) as well as the outcomes of international negotiations (Money, 1998). Additionally, it has been suggested that "network relationships are intangible resources salient to organizational growth" (Coviello, 2006:723) in that networks have a positive effect on internationalization (Manolova, Manev, & Gyoshev, 2010). These network relationships have also been shown to accelerate the process of internationalization (Coviello & Munro, 1997) as well as international marketing activities (Coviello & Munro, 1995; Evangelista & Hau, 2009) and access to venture capital funds and referrals (Batjargal, 2007).

Additionally, scholars have studied the effects of embeddedness in the unplanned dissolution of JVs, finding that a firm's embeddedness renders them in a fortuitous position for sustaining

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alliances, thereby mitigating the potentially competitive forces that can exist in such alliances (Polidoro et al., 2011). Extending this line of work, extant research in the area has also examined internetwork alliance formations and competition, finding that the effects of embeddedness will change depending upon the degree of co-specialization in between the firms (Gimeno, 2004). Furthermore, dispersion of organizational resources (i.e. resources distributed across networks) drives intra-firm competition (Dörrenbächer & Gammelgaard, 2010). Related to this line of work, scholars have also found that as levels of network density increase, access to viable information also increases, ensuring the longevity of an alliance relationship (Meschi & Wassmer, 2013).

2.2. Structural network power in collaborative ventures

Power is a complex term, in that its academic underpinnings are diverse. Initially, power was explained from an implicitly dyadic perspective with a social agent holding power over another. The main goal was to understand the impact that the exertion of power has on the recipient of power. The seminal research in developing our understanding of power arose from social psychology scholars and has articulated the construct of power in six fundamental "bases" (French & Raven, 1959; Maloni & Benton, 2000). Effectively, these power bases each speak to the source, or mechanism through which, a power holder exerts power over its target. These bases have been termed: coercive, reward, legitimate, referent, expert and legal legitimate power bases.

Power, as a construct, has also been dichotomized to describe the way in which power is being asserted; specifically termed mediated and non-mediated power (Johnson, Sakano, Cote, & Onzo, 1993). Mediated power, from the perspective of the power holder, refers to the use of external motivations in order to elicit the desired response and typically includes reward, legitimate and coercive power (Maloni & Benton, 2000; Tedeschi, Schlenker, & Lindskold, 1972). Non-mediated power essentially refers to power by association, or that its "rooted in the target's perception that the power source is an expert and the target's pride in association with the power source" (Handley & Benton, 2012a, 2012b:58) and includes expert and referent power (Maloni & Benton, 2000).

Coercive power refers to the ability of the power holder to "manipulate the attainment of valences" (French & Raven, 1959:263). Reward power refers to the power holder's ability to "administer positive valences and to remove or decrease negative valences" (French & Raven, 1959:263). Legitimate power can be thought of "as a valence in a region which is induced by some internalized norm or value" (French & Raven, 1959:264). Non-mediated sources of power, expert and referent, are slightly different in scope and impact on buyer supplier relationships. Expert power as a source of influence, results in impacts on the social structure of the relationship (French & Raven, 1959) in that the recipient of the power believes that the power holder is an expert (Handley & Benton, 2012a, 2012b). Referent power elicits a slightly different response, wherein the recipient of the power will have "a desire to become closely associated with" (French & Raven, 1959:266) the source of power.

In the context of networks, power has also been studied. With respect to structural network power, scholars have found empirical support for the idea that can power occur from three (3) fundamental sources: (1) the firm's capabilities/assets; (2) the dyad's joint market power/purchasing volume; (3) or the network's structure and the firm's embeddedness/interconnectedness within it (Kähkönen & Virolainen, 2011). Furthermore, scholars have also studied power in network triads using coalition theory and develop a conceptual framework regarding the role of power, and how firm's exert it, in these triadic relationships (Bastl, Johnson, & Choi, 2013). The power dynamics of buyer/supplier relationships have also been studied, finding supplier network size has a meaningful impact on ongoing relational dynamics (Terpend & Ashenbaum, 2012). Asymmetries with the power dynamics in dyadic relationships have been studied, finding that in certain circumstances levering power is applicable, but contingent upon the nature of the relationship between partners (Nyaga, Lynch, Marshall, & Ambrose, 2013).

Power has been looked at in the literature that studies IJVs (Contractor & Woodley, 2009). Recent research has shown that the local partner's network significantly increases the likelihood of attracting IJV activity (Shi et al., 2014). Instability in IJVs (i.e. when the status of one JV partner is unexpectedly changed) has been traced to changes in bargaining power, which is rooted in one partner acquiring knowledge that decreases said partner's dependence upon the other (Inkpen & Beamish, 1997). Other research has looked at subsidiary bargaining power and has found that technology transfer competence leads to greater subsidiary bargaining power which increases rent seeking behavior (Ciabuschi, Dellestrand, & Kappen, 2012). Further echoing this perspective, the multifaceted nature of power and decision making in multinational firms has been studied, finding that mutual dependence and dependence imbalance leads to subsidiary power (Mudambi, Pedersen, & Andersson, 2014). Additionally, from the perspective of relational dynamics and bargaining power, extant research suggests that compatibility between partners (i.e. equality of power between firms) is a strong factor in understanding ongoing relational norms (Inkpen & Birkenshaw, 1994). Furthermore, research has suggested that cooperation and competition occur simultaneously in IJVs, and that the bargaining power exerted in these ventures can determine management control (Yan & Gray, 2001). Other research has pointed to consolidation of multiple IJVs in order to retain/increase bargaining power (Zhao, Anand, & Mitchell, 2005) as well the role that IJV experience has on the acquisition and retention of bargaining power (Nakamura, 2005).

While there has been work to examine power, and its implications on inter-firm relational dynamics, there has been little work that examines the role of structural network power (i.e. that power which is derived from the structure of the network that the firm exists within) on new IJV formations.

3. Hypothesis development

3.1. Global network prominence

The first source of structural network power we examine is the global network prominence of a particular firm. We define the global network prominence of a firm in the network as the power that is derived from connections with other highly connected network members. Conceptually, global network prominence can be thought of as being connected to "a popular individual should add more to one's popularity" (Bonacich & Lloyd, 2001:192). As a variable, it has also been linked to influence and prestige within networks (Wasserman & Faust, 1994).

Global network prominence is a non-mediated source of power given that the power is "rooted in the target's perception that the power source is an expert" and that the power holder leverages "the target's pride in association with the power source"(Handley & Benton, 2012a, 2012b:58). In the context of new IJV formations access to the network resources of other actors is a vital element to successful international expansion (Coviello, 2006) which is tacitly contingent upon the structure of the network (Cendon & Jarvenpaa, 2001). As firms continue to increase the interconnectedness of their international networks by way of continued IJV formations, their mediated power positions increase and they are in better positions to control the allocation of resources (Burt,

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2004) which can increase managerial performance (Rodan, 2010) and bargaining power (Nakamura, 2005).

From the perspective of a manufacturer who is in the process to initiate a new IJV, being in a position of power allows for a highly advantageous position with respect to the performance of the IJV (Inkpen & Birkenshaw, 1994). Increases in the power position of the manufacturer can render positive impact on the buyer/supplier relationship (Maloni & Benton, 2000) which is a critical factor to the achievement of the IJVs strategic objectives (Yan & Gray, 2001). Moreover, when a firm acquires added bargaining power in an IJV that firm can become less dependent upon its partners (Inkpen & Beamish, 1997) rendering it in a position to dictate terms of a deal (Bloom & Perry, 2001). Other benefits such has the design and coordination of the distribution channel (Kähkönen & Virolainen, 2011) and economies of scale (Cox, 2001) have been also observed. A firm's ability to functionally integrate assets from the IJV is a determinant of overall JV performance (Reuer & Koza, 2000) and thus, when firms increase their global network prominence, integration becomes easier (Zhao, Huo, Flynn, & Yeung, 2008).

For a potential partner, (i.e. foreign components supplier), global network prominence is also important, but for different reasons. As we have noted above, global network prominence is a non-mediated source of power that explicitly takes advantage of "the target's pride in association with the power source"(Handley & Benton, 2012a, 2012b:58). Consequently, increases in global network prominence allows for the partner to gain recognition, and increase its likelihood to be chosen as an IJV partner (Shi et al., 2014). Additionally, increasing a firm's position in the network has can lead to increased access to capital (Batjargal, 2007) and control over technology (Bates & Slack, 1998) which can render a potential partner in an advantageous position in terms of IJV partner selection. Strategic supplier selection has demonstrated positive effects on competitive advantage (Koufteros, Vickery, & Dröge, 2012), thus a powerful supplier can lead to increases in the competitive advantage of the manufacturer. Furthermore, the prestige of the supplier can affect the reputation of the buyer (Lienland, Baumgartner, & Knubben, 2013) and the partner selection decision significantly impacts IJV performance (Pearce, 2001). Thus, we arrive at the following:

Hypothesis 1a. *The greater the global network prominence of a manufacturer, the greater the likelihood it will engage in a new international joint venture.*

Hypothesis 1b. *The greater the global network prominence of a potential partner, the greater the likelihood of it being chosen for a new international joint venture.*

3.2. Global network brokerage

We define the global network brokerage of a particular firm as the power derived from connecting two otherwise unconnected firms in the global network. Theoretically, brokerage refers to the process "by which intermediary actors facilitate transactions between other actors lacking access to or trust in one another" (Marsden, 1982:202). Global network brokerage exists when one firm is connected to two (or more) other firms who are individually not connected to each other (only to the focal firm), and the broker is in the position to be able to connect the two. This network construct has been leveraged in previous research (c.f. Carnovale & Yeniyurt, 2015; Shi et al., 2014). Global network brokerage is a mediated power source, as a firm yielding high levels of global network brokerage can use external motivations in order to elicit the desired response from the target of the power (Handley & Benton, 2012a, 2012b; Maloni & Benton, 2000).

Global network brokerage directly leverages the power that arises out of structural holes in the network. A structural hole "refers to missing relationships that inhibit information flow" (Burt, 2007:119) and occurs when two firms are connected to a single firm, but not to each other (Zaheer, Gözübüyük, & Milanov, 2010). When a firm can navigate these structural holes and broker future IJV relationships, numerous benefits have been observed such as increases to competitive advantage (Burt, 2004) and social capital within the network (Galunic, Ertug, & Gargiulo, 2012). Effectively, much work that relates to brokerage in networks implicitly deals with power (e.g. Marsden, 1982) through the control of, or access to resources. A manufacturer in a position whereby it can control access to potential new IJV partners, by leveraging its global network brokering capabilities, renders itself in an advantageous position for future IJVs (Shi et al., 2014). Specifically, firms that increase their global network brokerage are in a position to act "as brokers between different groups, individuals with many heterogeneous contacts provide information that may otherwise be unavailable" (Wong & Boh, 2010:135). Access to this information is vital in new IJVs, as it has been shown that firms "benefit from competitive capability and informational advantages generated by their network" (Coviello, 2006:724). From the perspective of bargaining power, a firm can leverage its brokerage position in order to pressure actors to whom it is connected by pitting one against the other (Borgatti et al., 2009) to achieve a desired outcome and to retain or acquire control (Inkpen & Beamish, 1997). Leveraging increased power, by way of global network brokerage increases can render positive supply relationships and achieve balanced relational dynamics (Bastl et al., 2013).

For a potential partner in the position to be chosen for a new IJV leveraging brokerage allows them to increase their mediated power bases by controlling information and allocating access to it (Coviello, 2006). Thus increasing their ability to "administer positive valences and to remove or decrease negative valences" (French & Raven, 1959:263) which strengthens their mediated power. Additionally, it has been shown that firms can act as key players in networks by taking advantage of brokerage opportunities (Ballester, Calvo-Armengol, & Zenou, 2006), which renders the supplier in a favorable light from the perspective of the buyer as it adds to its credibility and legitimacy, a key component in partnership formations (Robson, Katsikeas, & Bello, 2008). Furthermore, a potential partner in a position to broker a relationship can facilitate "a social network that would enable the parties to trust one another up and down the supply chain" (Galaskiewicz, 2011:6). Thus, given the increased power that comes with increasing a firm's brokerage, for both the manufacturer as well as the potential partner, we hypothesize the following:

Hypothesis 2a. *The greater the global network brokerage of a manufacturer, the greater the likelihood it will engage in a new international joint venture.*

Hypothesis 2b. *The greater the global network brokerage of a potential partner, the greater the likelihood it will be chosen for a new international joint venture.*

3.3. Global network weakness

Finally, we examine the concept of global network weakness. Global network weakness is the network power dimension related to a firm's ability to connect disconnected sub-networks in its network. Each of these sub-networks individually constitutes a weak component. A weak component refers to a subset of the overall network whereby there exist ties that connect pairs of nodes but where all nodes are not necessarily connected to each

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other (Everett & Krackhardt, 2012). As a network construct we define global network weakness as the extent to which weak components are prevalent in the network. Alternatively stated, global network weakness signifies to the extent to which completely connected subsets are absent from the network. Essentially, a firm's global network weakness (i.e. the level of weak components in their network) refers to the number of pairs of actors who are connected to the firm and to each other, but not to any other nodes (Scott & Carrington, 2011).

Weak components have been studied in various contexts. Montgomery (2007) examines the power dynamics of patronage networks (i.e. relations between patrons and clients) and demonstrates that the number of weak components in an actor's (i.e. a firm's) network has a significant effect on the power dynamics of a relationship. Furthermore, it has been noted that for an actor in a network wherein there exists multiple weak components, each of these can be thought of as separate networks (Doreian, Lloyd, & Mrvar, 2013). Firms that navigate these sub-networks can hold a power position rendering itself in a situation wherein it can control the access to contacts and resources. In network terminology, an actor in this position acts as a bridge. A bridge "links two components of an otherwise disconnected network" (Centola & Macy, 2007:710).

For a manufacturer aiming to engage in a new IJV, having a large number of weak components within its network allows it to draw from a substantial power base and increase its legitimate power. As a bridge it can facilitate transactions due to its status and prestige as a bridge (i.e. legitimate power) between parties who are otherwise not connected to its own benefit. We expect also that the potential partner will benefit from a large number of weak components within its network. Rather than drawing from a coercive power base, the potential partner can leverage network weakness in order to increase its network visibility. From a non-mediated perspective, being a bridge and having the ability to connect a large number of weak components generates significant prestige and influence; rendering it in a more favorable position to be chosen as a partner in an IJV. Consequently, we hypothesize the following:

Hypothesis 3a. *The greater the global network weakness of a manufacturer, the greater the likelihood it will engage in a new international joint venture.*

Hypothesis 3b. *The greater the global network weakness of a potential partner, the greater the likelihood it will be chosen for a new international joint venture.*

4. Empirical study

The data for this study were sampled from the Thomson SDC Platinum database; specifically the section of the database that stores information on strategic alliances and joint ventures. The SDC database provides an ideal source of secondary data containing information on the JV participants, the type of JV and the role each participant plays. The sampling context for this study used the global automotive manufacturing industry. The automotive industry has large global footprint, in terms of sourcing and production, and is manufacturing intensive. Additionally, the automotive industry leverages global sourcing frequently (Kim et al., 2011) thus providing for an ideal sampling context.

The original sample contains 1158 firms, both automotive manufacturers and parts suppliers observed over a 19-year period (1985–2003). We separate companies that are automotive manufacturers and companies that are component suppliers for proper classification. In the case of the automotive industry, the manufacturers of the finished product are referred to as Manufacturers. In the sample, a total of 217 firms are manufacturers.

Due to this study's use of network theory, we needed to assemble all possible permutations of dyadic pairs of manufacturers and potential JV partners over each year so as to properly construct the network. This process was accomplished as follows. First, for each year under observation a binary adjacency matrix, of dimension 1158 by 1158 where each row/column represents a firm in the dataset, was assembled. In cell *ij* for year *t* if the value is 1 this indicates that firm *i* engaged in a JV with firm *j*; a zero indicates there was no relationship between the two parties in these years. By construction, the diagonals are zero so as to remove the possibility that the firm engaged in a JV with itself. These matrices were then cumulatively updated so as to reflect any activity in the network development process the year prior. After including all relevant control variables, the final sample size was 985,689 observations over 19 years.

4.1. Dependent variable

The dependent variable in this study was the probability that two firms would engage in an IJV at a specific point in time. Thus, to properly capture this outcome, the following variable is operationalized:

$$IJV\ Formation_{j,k,t=}\begin{cases}1 & \text{if the dyad } (j,k), \text{ were from different home countries and engaged in a new JV at time } t\\ 0 & \text{otherwise}\end{cases} \quad (1)$$

where *j* represents the manufacturer, *k* represents the supplier and *t* represents the time (i.e. year).

It is important to note that in a the automotive supply chain network, most firms act as both suppliers and sourcing firms, irrespective of their status as an manufacturer or not. To manage this complexity, in each IJV we classified each participant as a sourcing firm or a supplier. That is, we identified who acted as the purchasing organization that utilizes the components manufactured by the JV in its own production process, and who acted as a supplier, without utilizing any of the components produced by the JV in its own production process.

4.2. Independent variables

All independent variables were calculated using UCINET 6.0 (Borgatti, Everett, & Freeman, 2002). The first variable we study was the global network prominence of a firm, which is captured using a firm's eigenvector centrality. Eigenvector centrality "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). Eigenvector centrality takes into account "(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"(Mizruchi & Bunting, 1981:478). Mathematically, we define **A** as a binary adjacency matrix (i.e. the matrix that constitutes all firms within the network) where $a_{jk} = 1$ if firms *j* and *k* engaged in a JV and 0 otherwise. Additionally, we define x_j as the centrality. Finally, 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). Consequently, we calculate global network prominence as:

$$Global\ Network\ \text{Prominence}_{f,t} = \lambda x_f = \sum_{j=1}^{n} a_{jk}x,\ j = 1, \ldots, n \quad (2)$$

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where $f = j, k and j \neq k$ and t represents the year under observation. This operationalization sums the firm's centrality (incident connections) and then weighs each connection based on the importance (based on network position) of the focal firm's connections.

Our next variable was global network brokerage, which measures the degree to which a firm can connect otherwise unconnected firms. The operationalization of this variable is based on (Gould & Fernandez, 1989). Recall that **A**, represented the binary adjacency matrix constituting any JV between firms j and k. In order for firm j to broker a relationship between i and k, the following conditions must hold true:

$$iAj, jAk, \ and \ i\bar{A}k \tag{3}$$

where *iAj* indicates there exists a tie between i and j, *jAk* indicates that there exists a tie between j and k and finally, $iA^{-}k$ indicates that there *does not* exist a tie between i and k. In this scenario, j acts as the broker between i and k. From this we define, following (Gould & Fernandez, 1989):

$$ijk\ Condition_f = \begin{cases} 1 & if\ i\ brokers\ the\ relationship\ between\ j\ and\ k \\ 0 & otherwise \end{cases} \tag{4}$$

where $f = j, k and j \neq k$. Total brokerage for a particular firm within the network is then defined as "is the number of ordered pairs *(i,k)* in the network for which the condition ijk holds" (Gould & Fernandez, 1989:97). Thus, we define brokerage for firm f as:

$$Global\ Network\ Brokerage_f = \sum_{f=1}^{1158} (i,k) \ \ \forall (i,k) such\ that\ ijk\ Condition = 1 \tag{5}$$

where $f = j, k and j \neq k$. Effectively, the operationalization of this measure sums the number of brokered connections that the focal firm has.

Finally, we examined the global network weakness of firms which was the power dimension related to a firm's ability to connect disconnected sub-networks in its network. To properly measure the global network weakness a firm we have to first define the following:

$$\begin{array}{l} iAj, jAk, \ and \ iAk \\ oAj, jAp, \ and \ oAp \end{array} \tag{6}$$

where *iAj* indicates there exists a tie between i and j, *jAk* indicates that there exists a tie between j and k and *iAk*, indicates that there exists a tie between i and k. Note that at this point Eq. (6) is very similar to Eq. (3), with one distinction and one addition. First, note that in Eq. (3) there was *no* connection between i and k, whereas now there is. Additionally, we introduce firms o and p. Note also that o is connected to j, j is connected to p, and o is connected to p. Hence, similar to Eq. (4) we define the following:

$$op_jik\ Condition_f = \begin{cases} 1 & if\ j\ is\ connected\ to\ the\ pairs\ (op)\ and\ (ik) \\ 0 & otherwise \end{cases} \tag{7}$$

Thus, the number of weak components then becomes the sum of unique pairs who are connected to j but not to each other:

$$Global\ Network\ Weakness_f = \sum_{f=1}^{1158} [(i,k),(o,p)] \ \ \forall (i,k),(o,p) such\ that\ op_jik\ Condition = 1 \tag{8}$$

where $f = j, k and j \neq k$. Effectively, this measure sums the number of pairs that are connected to the focal firm, but not connected to each other.

4.3. Control variables

While the above variables represent, to a large degree, the major elements of power within a network, there are additional considerations to take into account. First, previous research has shown (Gulati, 1995; Gulati, 1999) that prior interaction between firms engaging in collaborative ventures must be accounted for; accordingly we include this variable in our model. Additionally, we include the summation of past JV experience each firm has with a potential partner's country. Given the global nature of the study, we include cultural distance in the model operationalized using the conventional Kogut and Singh (1988) average of Hofstede (1980)'s cultural dimensions between each pair of firms under observation. Additionally, we include each firm's size, as operationalized by their number of employees. We also include the size of the ego network of each firm for each year as previous research has shown this to be an important control variable in network studies (Carnovale & Yeniyurt, 2014) (Table 1).

5. Method

In this study we use an event history analysis, with time varying variables. This methodology has been leveraged in previous studies examining events and their respective probabilities over time (Yeniyurt, Townsend, Cavusgil, & Ghauri, 2009). Recall that our dependent variable is dichotomous, either a JV occurred or it did not. Thus, tradition methodologies such as linear regression are not feasible (Wooldridge, 2010). A more appropriate method is a logistic regression (Train, 2003), however given that the data are cumulative and calculated over time, we have a time-series-panel dataset. Thus, we are left with either a fixed or random-effects logistic regression. We chose the random-effects logistic regression (e.g. Larsen, Holm Petersen, Budtz-Jørgensen, & Endahl, 2000). We do so because the random-effects logistic regression methodology takes into account the unobserved heterogeneity that occurs when "responses are measured on the same subject repeatedly over time" (Larsen et al., 2000:909) and allows for "each cross-sectional unit to have a different intercept" (Cameron & Trivedi, 2005:700) where the coefficients on the independent variables remain constant; unlike the fixed-effects regression wherein the intercepts are assigned *apriori*. Hence, the following random-effects logistic regression model was estimated:

$$P(IJV\ Formation_{j,k,t} = 1 | \eta_{j,k,t-1}) = \frac{\exp\left(\eta_{j,k,t-1}\right)}{1 + \exp\left(\eta_{j,k,t-1}\right)}$$

$$\begin{aligned} \eta_{j,k,t-1} = {} & \beta_0 + \beta_1\ Manufacturer\ Global\ Network\ \text{Prominence}_{t-1} \\ & + \beta_2 Partner\ Global\ Network\ \text{Prominence}_{t-1} \\ & + \beta_3\ Manufacturer\ Global\ Network\ Brokerage_{t-1} \\ & + \beta_4 Partner\ Global\ Network\ Brokerage_{t-1} \\ & + \beta_5\ Manufacturer\ Network\ weakness_{t-1} \\ & + \beta_6\ Partner\ Network\ Weakness_{t-1} + \beta_h\ CONTROLS_{t-1} \end{aligned} \tag{9}$$

where $P\left(IJV\ Formation_{j,k,t} = 1 | \eta_{j,k,t-1}\right)$ represents the likelihood that firms j and k will engage in a new IJV at time t, $\beta_h CONTROLS$ represents the h remaining coefficients to be estimated for each control variable, $\mathbf{u}_{j,k,t-1}$ represents the random effects which are

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Table 1
Summary statistics and correlations.

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Manufacturer Global Network Prominence	1															
2. Partner Global Network Prominence	0.0481*	1														
3. Manufacturer Global Network Brokerage	0.3866*	0.0277*	1													
4. Partner Global Network Brokerage	0.0125*	0.2039*	0.0171*	1												
5. Manufacturer Global Network Weakness	0.3987*	0.0542*	0.7996*	0.0357*	1											
6. Partner Global Network Weakness	0.0688*	0.3208*	0.0951*	0.6111*	0.1993*	1										
7. Manufacturer-Partner Previous Experience	0.0460*	0.0278*	0.0418*	0.0417*	0.0517*	0.0602*	1									
8. Manufacturer Country Experience	0.2524*	0.0273*	0.2057*	0.0261*	0.2579*	0.0731*	0.1462*	1								
9. Partner Country Experience	0.0516*	0.1513*	0.0630*	0.2283*	0.1003*	0.3410*	0.1766*	0.1151*	1							
10. Cultural Distance	−0.0610*	0.0001	−0.0480*	0	−0.0851*	0.0001	−0.0108*	−0.0405*	−0.0110*	1						
11. Manufacturer Firm Size	0.1095*	−0.0002	0.1111*	−0.0001	0.0751*	−0.0001	0.0203*	0.0898*	0.0151*	−0.0571*	1					
12. Partner Firm Size	−0.0002	0.1103*	−0.0002	0.0539*	−0.0002	0.1324*	0.0140*	0.0001	0.0510*	0.0001	−0.0016	1				
13. Manufacturer Age	0.0794*	0.0108*	0.0946*	0.0066*	0.1514*	0.0359*	0.0116*	0.0586*	0.0354*	−0.3957*	0.1863*	−0.0003	1			
14. Partner Age	0.0136*	0.0668*	0.0177*	0.0634*	0.0358*	0.1459*	0.0088*	0.0281*	0.0475*	0.0004	−0.0002	0.2199*	0.0065*	1		
15. Manufacturer Network Size	0.4043*	0.0542*	0.8256*	0.0354*	0.9827*	0.1970*	0.0489*	0.2447*	0.1023*	−0.0831*	0.0746*	−0.0002	0.1593*	0.0355*	1	
16. Partner Network Size	0.0665*	0.3284*	0.0918*	0.6554*	0.1922*	0.9886*	0.0618*	0.0725*	0.3471*	0.0001	−0.0001	0.1315*	0.0347*	0.1404*	0.1900*	1
Mean	0.0110	0.0050	0.5779	0.2483	0.6417	0.4587	0.0012	0.1022	0.0398	2.5468	4.5066	4.0655	49.4291	48.8039	0.6798	0.4718
SD	0.0521	0.0289	2.5844	2.9809	1.0920	0.8129	0.0381	0.6449	0.2431	1.3804	0.7268	0.9569	35.6530	36.6365	1.1907	0.8723

normally distributed and captures the unobserved heterogeneity, $\mathbf{z}_{j,k,t-1}$ represents the variables' design matrix for the random effects. Effectively, this model will estimate coefficients that indicate the effect each independent variable will have in explaining the likelihood of a new IJV formation

6. Results

The coefficients of the above model were estimated in Stata 13′s random-effects logistic regression routine. The parameters of the model are calculated by maximum likelihood estimation. In addition, all independent variables are lagged by one year so as to avoid issues with respect to endogeneity. Looking at Table 2, we can see that the final estimated model results in a statistically significant ($p < 0.001$) Wald χ^2 of 134.05 with 16° of freedom and an Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) of 3356.555 and 3568.975, respectively; all of which indicates that the specified model fits the data well. In addition, we tested the random effects specification with a Hausman test (Hausman, 1978) to see whether or not our theoretical supposition, that the random effects specification was preferred over the fixed effects, was correct. The test revealed that the random effects model was preferred over the fixed effects. In Table 3 we include the change in the odds-ratio of a new JV being formed, given a one-unit increase in each variable and its interpretation in the context of the current study. This technique is a common way of gaining additional insight from a logistic regression (Kutner, Nachtsheim, Neter, & Li, 2004).

6.1. Global network prominence

In our first hypothesis we specifically hypothesized that the higher the global network prominence of a manufacturer, the higher the likelihood that the manufacturer will engage in an IJV. Observing the coefficient for manufacturer global network prominence we see that it is positive and statistically significant

Table 2
Random effects logistic regression results.

Independent Variable	B	S.E
Manufacturer Global Network Prominence$_{t-1}$	1.5689**	0.7053
Partner Global Network Prominence $_{t-1}$	2.1345*	1.2925
Manufacturer Global Network Brokerage $_{t-1}$	−0.0742**	0.0368
Partner Global Network Brokerage $_{t-1}$	0.0076	0.0225
Manufacturer Global Network Weakness $_{t-1}$	0.6984**	0.3172
Partner Global Network Weakness $_{t-1}$	−0.3343	0.2822
Manufacturer-Partner Previous Experience $_{t-1}$	−0.3409	0.3166
Manufacturer Country Experience $_{t-1}$	−0.0118	0.0561
Partner Country Experience $_{t-1}$	0.1353	0.1834
Cultural Distance $_{t-1}$	−0.1468**	0.0700
Manufacturer Firm Size $_{t-1}$	0.8193***	0.1552
Partner Firm Size $_{t-1}$	0.5569***	0.1106
Manufacturer Age $_{t-1}$	−0.0057*	0.0030
Partner Age $_{t-1}$	−0.0001	0.0023
Manufacturer Network Size $_{t-1}$	−0.2451	0.3273
Partner Network Size $_{t-1}$	0.1779	0.2792
Intercept	−17.3764***	1.1291
Model fit		
International Joint Ventures	895	
N	985,689	
Wald χ^2 (DF)	134.05***(16)	
Log Likelihood	−1660.28	
AIC	3356.56	
BIC	3568.98	
Sigma U (S.E.)	2.396779 (0.2174944)	
Rho (S.E.)	0.6358517 (0.0420227)	

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$, two-tailed.

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Table 3
Odds Ratios & Interpretation.

Independent Variable	B	Odds Ratio	Interpretation
Manufacturer Global Network Prominence	1.5689	4.8014	A one unit increase in manufacturer global network prominence increases the likelihood that the manufacturer will engage in an IJV by over 4.8 times
Partner Global Network Prominence	2.1345	8.4527	A one unit increase in partner global network prominence increases the likelihood that the partner will be chosen as a partner in an IJV by over 8 times
Manufacturer Global Network Brokerage	−0.0742	0.9285	A one unit increase in manufacturer global network brokerage decreases the likelihood that the manufacturer will engage in an IJV by nearly 8%
Partner Global Network Brokerage	0.0076	1.0076	A one unit increase in partner global network brokerage increases the likelihood that the partner will be chosen as a partner in an IJV by almost 1%
Manufacturer Global Network Weakness	0.6984	2.0106	A one unit increase in manufacturer global network weakness increases the likelihood that the manufacturer will engage in an IJV by over 2 times.
Partner Global Network Weakness	−0.3343	0.7159	A one unit increase in partner global network weakness decreases the likelihood that the partner will be chosen in an IJV by nearly 30%

($p < 0.05$). Further we observe from Table 3 that a one-unit increase in the manufacturer's global network prominence results in a 4.8-fold increased likelihood that the manufacturer will engage in an IJV. Thus, Hypothesis 1a is strongly supported.

In Hypothesis 1b we postulated that for a partner, increasing its global network prominence would lead to increasing the chances that it was chosen as an IJV partner. Observing the coefficient on partner global network prominence, we see that it is positive and marginally statistically significant ($p < 0.1$). Further, we see that a one-unit increase in partner global network prominence corresponds to over an 8-fold increased likelihood that partner will be chosen for an IJV. Thus, Hypothesis 1b is supported.

6.2. Global network brokerage

In Hypothesis 2a we postulated that for a manufacturer, if it has the ability to act as the go-between to an increasingly large number of firms, its power position increases and the likelihood that it will engage in an IJV also increases. Observing the coefficient on manufacturer global network brokerage, we see, contrary to our hypothesis, the coefficient is negative and statistically significant ($p < 0.05$). Furthermore, we see that a one-unit increase in global network brokerage leads to an approximately 8% decreased likelihood that the manufacturer will engage in an IJV. Thus, Hypothesis 2a is not supported.

In Hypothesis 2b we further alluded to the positive effects that global network brokerage within transactional networks can have, this time with respect to the partner in the transaction. Specifically, we suggested that as the level of global network brokerage increases for the partner, the higher the probability that it will be chosen as an IJV partner. Observing the coefficient on partner global network brokerage, we see that while it is positive and results in an approximately 1% increase in the likelihood that it will be chosen as an IJV partner, the coefficient is not statistically significant ($p > 0.1$). Thus, Hypothesis 2b is not supported.

6.3. Global network weakness

In Hypothesis 3a we suggested that for a manufacturer, it is highly advantageous for the number of weak components to be large because as the number increases, the manufacturer acts as a bridge that spans multiple networks and thus the higher the likelihood that the manufacturer would engage in an IJV. Observing the coefficient on manufacturer global network weakness we see that it is positive and statistically significant ($p < 0.05$). Furthermore, we see that a one-unit increase in the global network weakness of the manufacturer results in over a 2-fold increase in the odds that the manufacturer will engage in an IJV. Thus, Hypothesis 3a is supported.

Finally, in Hypothesis 3b we further reiterated the benefits of global network weakness, but for the partner in the transaction. Our argument derived from the idea that legitimacy and network position would increase as the bridge spanning capabilities increased, thus as network weakness increases, the higher the likelihood that the partner would be chosen as an IJV partner. Looking at the coefficient for partner global network weakness, we see that it is negative and not statistically significant ($p > 0.1$) and corresponds to a nearly 40 percent decrease in the odds of being chosen as an IJV partner. Thus, Hypothesis 3b is not supported.

7. Discussion

This study contributes to the international collaborative ventures literature by developing and testing theoretically driven hypotheses regarding the effect of global network power on new equity-based partnership formations. The empirical results provide significant insights into the role of global network prominence, brokerage and weakness in new international partnership formations. Our findings suggest that power derived from the relative position of each firm in the global network is an important factor in cross-border equity based partnerships and can mitigate uncertainties and challenges associated with international endeavors, such as high cultural distance or lack of market specific experience.

7.1. Global network prominence

The principle arguments regarding global network prominence dealt with the firm's ability to take advantage of its mediated power as derived from network position. Recall that global network prominence can be practically understood as increasing a firm's connectedness with other highly connected firm's increases its network prominence. Essentially, being connected to "a popular individual should add more to one's popularity" (Bonacich & Lloyd, 2001:192) and prestige (Wasserman & Faust, 1994). Our results indicate that as a firm increases its global network prominence the likelihood of engaging in an IJV also increases. A particularly interesting result arises when we examine the impact on the odds ratios for each firm. For the manufacturer, we can see that there is a 4.8-fold increase in the likelihood of engaging in an IJV whereas for the partner the increase is nearly doubled at over an 8-fold increase. This suggests that global network prominence is even more important for the potential partner as it increases its global visibility and provides legitimacy, making it a more attractive partner. These findings complement existing research that stresses the importance of careful supplier selection (Koufteros et al., 2012) and indicates that a powerful partner can lead to increases in the competitive advantage of the manufacturer (Shi et al., 2014). In addition, previous research has

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suggested that increasing a firm's position in the network has demonstrated positive benefits such as access to capital (Batjargal, 2007) and resources such as control over technology (Bates & Slack, 1998). Accordingly, our results suggest that choosing a foreign partner with high levels of global network prominence can render a manufacturer in an advantageous position in terms of future IJV engagements and global expansion (see: Sea-Jin & Rosenzweig, 2001) by further increasing its global network prominence.

7.2. Global network brokerage

Previous research indicates that a firm's ability to span these boundaries generates significant benefits to the firm such as competitive advantage (Burt, 2004), positive effects on social capital within the network (Galunic et al., 2012) and increased innovation through the reduction of structural holes (Ahuja, 2000). Yet, our hypothesis regarding the positive effect of global network brokerage on new JV formation is not supported by the results of the event history analysis; in fact the coefficient is negative. While this result is contrary to our expectations, it provides interesting implications for research. The logic underpinning our hypotheses was that as the manufacturer increases its global network brokerage power it would increase its ability to generate future IJV partnerships. We argued that from a bargaining power stand point, a firm can leverage its brokerage position in order to pressure actors to whom it is connected by pitting one against the other (Borgatti et al., 2009) to achieve a desired outcome and to retain or acquire control (Inkpen & Beamish, 1997). Perhaps the negative coefficient suggests that bargaining power can work against a firm, rendering it in a position with too much power and thus give it a bad reputation within the network. In fact, empirical results suggest that a one-unit increase in a manufacturer's global network brokerage results in the firm decreasing its odds of engaging in a new IJV by nearly 8%. Additionally, we found no support for our Hypothesis 2b, which, taken together with the empirical results for Hypothesis 2a, seem to suggest that global network brokerage leads to a decreased advantage for new IJV formations.

7.3. Global network weakness

The level of global network weakness in a firm's JV network increases the likelihood of that firm engaging in a new IJV. For the manufacturer the effect is positive and statistically significant and a one unit increase in global network weakness corresponds to a 2-fold increase in the likelihood of the manufacturer engaging in a new IJV. This suggests that global network weakness allows the focal firm to act as a bridge, which "links two components of an otherwise disconnected network" (Centola & Macy, 2007:710), in the globally dispersed JV network and thus increase its power position. We argued that for a firm that can bridge each of these sub-networks, the firm could hold a power position and render itself in a situation wherein it can control the access to resources. This result indicates that for firms looking to expand internationally, power to bridge otherwise unconnected networks engenders further international expansion through collaborative partnerships. Accordingly we contribute to the existing literature in this domain (Coviello & Munro, 1995; Coviello & Munro, 1997; Coviello, 2006; Sea-Jin & Rosenzweig, 2001; Yeniyurt et al., 2009) Yet, this effect was not present in the case of the potential partner. The coefficient was actually negative, leading to a decrease that the partner would be chosen as an IJV partner. This result suggests that a partner that has bridging power is undesirable to the manufacturer; perhaps concerns of opportunism arise necessitating the need for more formal safeguards.

These results have significant managerial implications as well. First, the results indicate that both network and power theories can help better predict the relational dynamics in new IJVs. It was shown that for a potential partner, being connected to other prominent global actors within the network increased its chances of being selected for an IJV by a manufacturer. Consequently, mangers must take care to align their firms with other prominent firms within the network to ensure and maintain their prominence and increase their network power. Second, managers need to keep track of their own as well as their competitors' network positions as this can be utilized to predict the future international partnership engagements of each actor in the global network.

7.4. Limitations and future research

To the best of our knowledge, this paper marks the first attempt to explain the network derived power dynamics at play in the formation of new IJVs. To that end we have made significant progress in understanding the effect that power has on new global equity-based partnerships. Yet, work still remains. We only consider equity-based collaborative partnerships (i.e. JVs). While JVs are vital organizational arrangements to be studied, future research should examine the impact that power has on strategic alliances in a cross border context. In addition, future research should examine JV dissolution and the impact that power and network embeddedness has on this process; thereby extending the work of Meschi and Wassmer (2013). It has been shown that as the number of IJVs a company has increases, there are diminishing returns to additional new IJVs (Yeniyurt et al., 2009), so it can be expected that network variables have diminishing returns on new IJV formations. As a company gains more network prominence, the benefit of additional network connections is likely to diminish and disappear. Additionally, IJVs are a common way of entering new markets and the effects of network structure characteristics on the likelihood of new market entry and the choice of entry mode remain to be explored. It is expected that the network structure of a company's connections plays a significant role in the markets it enters, its merger and acquisition decisions, and wholly owned subsidiary locations.

The dataset utilized in this study is form the global automotive industry. While the automotive industry constitutes an ideal setting to test our research hypotheses, it is expected that the tenets of the network and power theories hold in other industries as well. Finally, learning is critical mechanism in international expansion and the network theory can be utilized to further elucidate the diffusion of knowledge and technologies across the world via inter-firm linkages.

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