NTU Management Review
Vol. 29 No. 3 Dec. 2019, 125-166
DOI:10.6226/NTUMR.201912_29(3).0004

Does Efficient Social-Network Structure Benefit the Performance of Business Groups and Core Firms? The Underlying Mediation Mechanism for Small World Network Structure and Internationalization in Cross-Level Business Group Network

有效率的網絡結構對組織的營業績效真的有幫助嗎？探討小世界網絡結構對集團企業以及核心母公司的績效影響

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Received 2017/3, Final revision received 2018/3

Abstract

Small-world networks have received much theoretical attention from sociologists, business-management researchers, and others. In the present study, I examine both financial and internationalization performance under a small-world network structure of business groups. Using the perspective of network analysis, I set out to clarify the effects of small-world network structures on the financial performance of groups and their core firms. I also test the internationalization performance of groups and its mediating role between small-world networks and group financial performance. This study extends business-group research by examining the effects that group and cross-level nested dimensions can have on financial and internationalization performance. With longitudinal business-group data in Taiwan from the BGT directory spanning the years between 2009 and 2013, I present evidence that small-world networks have shaped dynamic financial outcomes. The result indicates that the relationship between small-world networks and the financial performance of groups is U-shaped. The evidence additionally indicates that an inverted U-shaped relationship characterizes the interactions between the small-world networks and the nested core firms of groups. However, small-world network structures do not affect the internationalization performance of groups.

【Keywords】 small-world network, business group, financial performance, internationalization performance, core firm

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摘 要

小世界網絡近幾年來在管理領域已受到諸多學者的關注，本研究主要探討在集團企業所形成的小世界網絡結構與其績效之相關性。該績效包含財務面的營業績效以及國際化績效。本研究採用過去較少用來探討集團企業的網絡觀點，所探討重點為小世界網絡結構對整體集團企業及其所屬核心母公司的財務績效所造成之影響；除此之外，集團企業的國際化績效，在過去集團企業研究領域也較少被觸及，本研究也嘗試探討小世界網絡結構對集團企業的國際化績效影響，以及國際化績效所扮演的中介角色。本研究透過集團層次以及跨層次 (集團對公司層次) 之研究情境，延伸過去集團企業這一脈的文獻研究。針對為期 5 年的集團企業資料之實證結果顯示：集團企業的小世界網絡結構與其財務績效呈 U 型的非線性相關；小世界網絡結構與其所隸屬的核心母公司之財務績效卻呈倒 U 型的非線性相關。值得一提的是，小世界網絡結構與集團的國際化績效並未呈現相關性，集團的國際化績效也未在小世界網絡及其財務績效之相關性帶來中介效果。

【關鍵字】小世界網絡、集團企業、財務績效、國際化績效、核心母公司

1. Introduction

Scholars have long recognized the importance of social structure in shaping the behaviors and outcomes of individual and social actors (Granovetter, 1985; Uzzi and Spiro, 2005). The mechanism shaping actors' behaviors and outcomes is primarily the patterns and contexts of social interactions in which actors are embedded (Ahuja, 2000; Fang, Huang and Chen, 2010; Fernandez and Fernandez-Mateo, 2006). According to Watts and Strogatz (1998), a systematic social structure (a set of connections) is assumed to be either completely regular[1] or completely random;[2] however, many social networks lie somewhere between these two extremes. For instance, a small-world network (SWN) can involve regular networks rewired to introduce increasing amounts of disorder (Watts and Strogatz, 1998). This network mechanism yields the properties of part order and part random, and seems to reflect some features of real networks. Scholars posit the SWN is a nonsystematic network structure representing both locally dense clusters (i.e., regular graphs) and sparse links between clusters (i.e., random graphs) (Watts and Strogatz, 1998; Watts, 1999b). The recombination of locally dense clusters and sparse links injects dynamism into network systems (Uzzi and Spiro, 2005; Watts and Strogatz, 1998; Watts, 1999b). Thus, owing to their dynamic properties, SWNs have received a great deal of attention from scholars (Sytch and Tatarynowicz, 2014; Uzzi and Spiro, 2005). Additionally, because the SWN features locally dense clusters and short between-cluster paths, this network system has also been recognized as an efficient network structure (Burt, 1992; Granovetter, 1973; Lovejoy and Sinha, 2010).

Rooted in the six-degrees-of-separation experiment conducted by Milgram (1967), the concept of small-world networks contends that the efficiency of the network stems from exchanges of ideas that occur in the network structure of non-redundant bridging clusters (see Figure 1). Dense intra-cluster relationships between actors (i.e., firms) indicate that the more frequent the interactions are between the actors, the more reciprocity there will be among them, while the non-redundant bridging ties can promote the development and the dissemination of novel information between disparate clusters (Watts, 1999a). Actors in this small-world social structure not only have high interconnectivity within local clusters, but can also reach disparate clusters through a

1 Regular networks have high local clustering and high average path lengths across clusters (Gulati, Sytch, and Tatarynowicz, 2012).

2 Random networks have low local clustering and low average path length across clusters (Gulati et al., 2012).

relatively small number of intermediaries. A network with this structural pattern exhibits great efficiency in moving resources that promote organizational learning and competitive advantage (Baum, Shipilov, and Rowley, 2003). Scholars have increasingly investigated how actors can shape the innovation performances of SWNs. For example, Davis, Yoo, and Baker (2003) examined the structure of American corporate elites (e.g., directors) during the 1980s and 1990s and found a small-world structure that is resilient in the face of macro and micro changes affecting corporate governance. Newman (2001) investigated scientific coauthoring in seven diverse science fields and also found that each had an SWN. Uzzi and Spiro (2005) analyzed the creative artists who made Broadway musicals from 1945 to 1989, and found that the SWNs to which these artists belonged affected their creativity and the success of their musicals in a curvilinear fashion. Research has shown that SWNs account for how quickly ideas flow from point A to point B. For example, Gulati, et al. (2012) explored the SWNs characterizing interfirm ties in the global computer industry from 1996 to 2005. Likewise, to predict firms' patenting outcomes, Sytch and Tatarynowicz (2014) investigated the SWNs characterizing the industry's partnerships from 1981 to 2001. SWNs are considered to be ubiquitous, and are increasingly recognized as drivers of individual and collective actions that may forcefully affect behavior and innovative outcomes (Uzzi and Spiro, 2005). Although SWNs are the subject of a great deal of theoretical attention in innovation productivity (Baum, Cowan, and Jonard, 2010; Fleming, King III, and Juda, 2007; Lovejoy and Sinha, 2010), little research has examined their contextual or economic-outcome natures. In the current study, thus, I extend this line of research by developing and testing arguments about how an SWN can affect economic outcomes, with an emphasis on financial as well as internationalization outcomes.

To address this topic, I contextualized the current study's research question in terms of the social structures characterizing business groups, which play a dominant role in business landscapes and are common in many countries (Carney, Gedajlovic, Heugens, van Essen, and van Oosterhout, 2011; Fang and Chang, 2018; Khanna and Yafeh, 2005). Such groups are a constellation of legally independent firms whose highly relational and structurally embedded status helps them to overcome environmental uncertainty (Brookfield, 2010). The growth in business groups has generated a significant body of literature examining both their emergence and their implications for performance. Researchers understand business-group performance through various theoretical lenses, including transaction-cost analyses (Khanna and Palepu, 1997), resource-based views of

firms (Wernerfelt, 1984; Guillen, 2000), and exchange theory (Keister, 2001). According to these studies, affiliations of a business group improve a group's performance by helping the group to internalize market transactions and to access scarce resources via value-creating relationships. The strategic network of a group's affiliates, acting as an intermarket network, establishes resource-interdependent relationships within it (Gerlach, 1992). Affiliates within a group may use their internal capital markets to subsidize small or poorly performing partners (Chang and Hong, 2000). Additionally, because of the wide range of business-group affiliates, the efficiency of resource exchange is essential for those affiliates in need. Studies have found, for example, that Japanese business groups (keiretsu) enhance their overall viability by realigning their affiliates' prospects and resources to improve the survival chances of financially troubled partners (Lincoln, Gerlach, and Ahmadjian, 1996).

In this study, I propose that if a business group's strategic business structure is organized as an SWN, affiliates connected multiple subclusters within the business group can act as intermediary firms that cohesively link the otherwise disparate subclusters to one another. Likewise, evidence suggests that SWNs enhance innovative outcomes (Sytch and Tatarynowicz, 2014; Uzzi and Spiro, 2005). These findings, taken together, suggest that the efficiency of resource sharing within a business group may significantly affect the performance of both the group and its affiliated firms.

Research shows that internationalization has been used as means to achieve firm performance and growth (Geringer, Beamish, and DaCosta, 1989; Li, Wu, Liu and Liu, 2018). Internationalization performance can be an important strategy for business groups pursuing superior economic performance (Glaum and Oesterle, 2007). The literature on business groups has rarely investigated factors that affect the groups' internationalization. An SWN can facilitate resource exchange within a network (Watts and Strogatz, 1998) so that non-redundant connections among group members help ensure efficient inter-firm coordination, ultimately benefiting the economic outcomes of both the firms and the group itself. For this reason, SWNs constitute an important antecedent in the current study.

Because individual action is closely connected with opportunities and constraints produced by evolving macro-level social structures, researchers would do well to explore the nested effects that a network structure can have on individual actors from the macro-level perspective. Most of the recent research has analyzed small-world structures on a macro-level and focused primarily on global networks as they relate to the overall structure and the network ties of firms (Schilling and Phelps, 2007; Uzzi and Spiro, 2005).

My current study examines how the business group's SWN effects on economic performances might vary depending on firms' structural position in their nested global network. In this regard, I investigate cross-level effects from both a macro-level perspective (global networks) and a micro-level perspective (ego networks). The macro-level perspective sheds light on knowledge diffusion in broad social spaces, emphasizing the overall structure of firms and their ties to one another (Schilling and Phelps, 2007; Uzzi and Spiro, 2005). However, the angle of an ego network suggests that a firm's innovative outcomes are critically influenced by the firm's direct and indirect partners, which are sources of knowledge inputs to the firm (Ahuja, 2000; Zaheer and Bell, 2005). To test the effects of ego networks on financial performance, I analyze founding firms of business groups (hereafter "core firms") that are located in structural holes. Specifically, I examine how these effects can vary depending on both the firms' structural position in their embedded business-group network and the overall diversity of knowledge across clusters within a group. This multi-level approach helps form a more comprehensive view of social systems by clarifying the performance effects accrued from efficient small-world network structures not only at the group-network level, but also at the firm level.

From a social-network perspective, an efficient network mechanism facilitates connections and coordination of resource exchanges within a group. This suggests that participation in a group increases the efficiency and effectiveness of internationalization as well. Thus, in the current study, I postulate that participation in a small-world network may increase the efficiency and effectiveness of organizational performance and internationalization. However, most of the related business-group research centers on the resource-based view (Guillen, 2000), institutional theory (Khanna and Palepu, 2000), transaction-cost theory (Chang and Choi, 1988; Chang and Hong, 2000; Chen, Li, Shapiro, and Zhang, 2014), and market failure (Khanna and Palepu, 1997). Since little research has examined either groups' network mechanisms or groups' cross-level nested effects on economic performance in the context of small-world networks, my aim in the current study is to answer two central questions. First, from a network perspective, do small-world networks shape the financial performance of groups and their core firms? Second, do small-world networks shape groups' internationalization performance, which can play a mediating role in the relationship between small-world networks and group economic performance?

In answering these questions, I intend to make several contributions to the literature on business groups and structural theories. First, researchers argue that actors may gain

substantial benefits by residing in small-world structures (Uzzi and Spiro, 2005; Schilling and Phelps, 2007). Addressing this point, I explore various opportunities and constraints that may derive from small-world structures' effects on economic performance at various group levels. Second, the small-world network perspective advances the existing network perspectives by shedding light on business group affiliates' efficient access to heterogeneous resources in social systems of business groups. By probing the intertwined relationships between the micro-level actions of core firms and the macro-level social structures of small worlds, I explore the performance mechanisms underlying the small-world dynamics of a business group network. I show that the financial performances of global networks and ego networks, guided by small-world structures, exhibit curvilinear effects. It is noteworthy that, in business groups, global networks are associated with greater financial performance at both the high and low levels of small-world structures than are ego networks, in core firms, which are associated with greater financial performance at the mean value of small-world structures than are global networks. By performing nested cross-level analysis, researchers can better understand small-world structures, in turn disclosing social structures' origins in—and effects on— the actions of individual firms (Baker and Faulkner, 2009; Coleman, 1990). Indeed, such analysis can advance the structural theories of actions and outcomes beyond global-network implications.

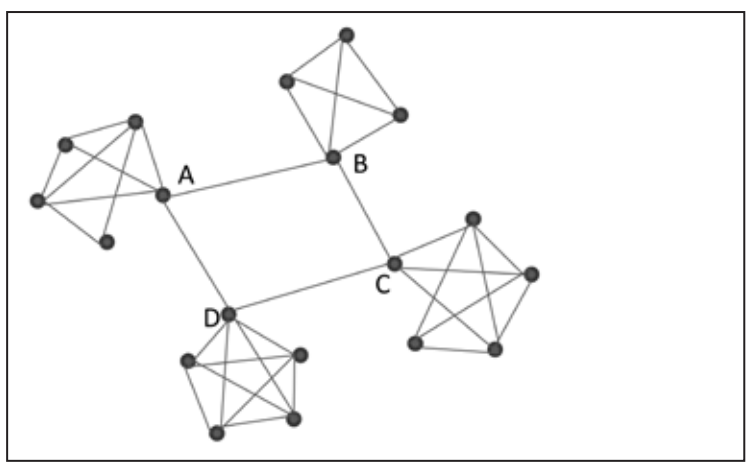

Figure 1 A Diagram of a Sample Small-World Network

Note: Small-world networks consist of locally dense clusters that are linked to one another by a few non-redundant bridging ties (Watts and Strogatz, 1998; Watts, 1999b). For instance, actors A, B, C, and D in the diagram are non-redundant bridging ties.

2. Theoretical Background and Hypotheses

2.1 Theoretical Bases

2.1.1 Defining Small-World Network Phenomena

The idea of "small world" phenomena, articulated by Watts and Strogatz (1998), refers to the interconnectedness of everyone through a maximum of six degrees of separation. According to their research, small-world networks are typified by clusters of locally dense interactions across a few short bridging ties. These dense and clustered relationships facilitate coexistence with distant and more diverse relationships. Such dense and clustered relationships lead to reciprocity and close collaboration, while distant ties bring fresh and non-redundant information to the cluster. This type of network sits in between an ordered and a random network in that parts are well coordinated and structured clusters (Watts, 1999a). The network manages the behavior of actors embedded in the structure by shaping the level of connectivity and cohesion (Granovetter, 1973; Moody and White, 2003; Watts, 1999b). Small worlds reveal efficient network structures for moving information, innovation, and other resources from one point to another, particularly regarding firms that are interconnected to one another through a relatively small number of intermediaries (network connections) (Baum et al., 2010). Researchers assert that small-world properties facilitate network effectiveness, which is evidently beneficial to network outcomes (Provan, Fish, and Sydow, 2007).

2.1.2 A Social-Network Perspective on Business Groups

A business group is a collection of legally independent firms, bounded by a constellation of formal (such as ownership) or informal (such as kinship) relationships, operated in diverse industries, and orchestrated by a common dominant owner (Chang and Hong, 2000; Khanna and Palepu, 1997; Khanna and Rivkin, 2001; Yiu, Lu, Bruton, and Hoskisson, 2007). This organizational form has been prevalent in emerging and developed markets (Carney et al., 2011; Jean, Tan, and Sinkovics, 2011; Khanna and Yafeh, 2005). For example, in 2008, the top 300 business groups accounted for over 50 percent of the nation's gross business income in Taiwan (Chen and Jaw, 2014). In 1996, the top 30 business groups generated 40 percent of the country's total output in South Korea (Chang and Hong, 2000). The dominant explanation for the formation of business groups is that these groups offset institutional voids created by market failure in emerging economies (Khanna and Palepu, 1997; Yiu et al., 2007). However, coupled with the presence of business groups in some advanced markets of the world (e.g., the United States and

Japan), scholars suggest that the institutional-void argument is inadequate (Carney et al., 2011; Manikandan and Ramachandran, 2015).

Adopting a social-network perspective, researchers have visualized business groups as strategic networks because the groups reflect patterns of interdependence among affiliated firms (Baum et al., 2003). Within a business group, group embededness is a critical mechanism to bind group members to one another. Embedded relationships are the ties of family, friendship, or shared equity that directly or indirectly connect firms to one another in a way that forges a true business group (Granovetter, 1994; Verspagen and Duysters, 2004). Uzzi (1996) argues that firms in an embedded network operate an exchange system that produces both opportunities and constraints. This exchange system includes the overall structure of firms and their ties within a business group. In the current study, exchange systems constitute a global network that emphasizes the benefits of knowledge dispersion through a broad social space (Sytch and Tatarynowicz, 2014).

Hamilton and Kao (1990) find that Chinese business groups normally start with a founding firm, also referred to as the core firm, which acts as the headquarters to a dominant entity exerting its authority over different layers of affiliated members in the group (Chen and Jaw, 2014; Lu and Yao, 2006). This dominant position is referred to as a structural hole because it confers on itself both preferential access to affiliates' diverse resources and asymmetric within-group benefits. The core firm is considered the ego network (Ahuja, 2000). From its key position, core firms can manipulate information and exert power over linked affiliates (Bizzi, 2013). By virtue of ego networks' multiple linkages (including direct and indirect partners), the performances of core firms are typically associated with the magnitude, diversity, and accessibility of knowledge stocks in a given business group's global network.

2.1.3 Literature on the Economic Performance of Business Groups

Findings that pertain to business groups' beneficial effects on economic performance remain mixed (Chang and Choi, 1988; Khanna and Palepu, 2000; Carney et al., 2011). Some studies have shown that business groups promote the performance of affiliated firms. For example, Chang and Choi (1988) demonstrate that South Korean chaebols (business groups) reflect internal capital and labor-market structures that help mobilize valuable resources for group members. This internal market structure not only reduces transaction costs, but also provides economies of scope and scale for affiliates, resulting in superior performance. Adopting a social-network perspective, scholars have emphasized benefits arising from enduring and multiple relations among business-group affiliates:

these enduring relations help reduce uncertainty for affiliates by strengthening their investment-related decision making and their access to intermediate goods (Gerlach, 1992; Granovetter, 2005; Keister, 2000). Luo and Chung (2005) emphasize that enduring relations among group members can serve as conduits for the timely dispersion of resources for new business opportunities.

Other scholars, by contrast, have argued that business groups are not beneficial to affiliates' performances (Kim, Hoskisson, and Wan, 2004; Morck and Yeung, 2003). In the context of Japanese keiretsu, Nakatani (1984) identifies a negative relationship between affiliated group members and their performance. Khanna and Yafeh (2005) uncover negative performance outcomes for affiliated group members in emerging markets. Some scholars have suggested that business groups promote stability rather than maximize profits (Gerlach, 1992). The business group serves as an "insurance policy" (Lincoln et al., 1996) that reduces bankruptcy risk for group affiliates. These results show the existence of costs for firms affiliated with business groups.

The mixed results of empirical findings on business groups' economic performance indicate the need for testing of other factors. Additionally, since most business groups in emerging markets are organized to compensate for institutional voids or market failure (Khanna and Palepu, 2000; Manikandan and Ramachandran, 2015), the resources or scale of domestic markets must be relatively limited. According to the network perspective, a firm in one country establishes relations with firms in other countries as a means to managing environmental uncertainty as the firm develops its position in foreign markets (Andersson and Johanson, 1997; Johanson and Mattsson, 1988). Business groups' expansion in global markets not only compensates for the limited resources of domestic markets, but also enables the groups to acquire strategic assets needed to compete more effectively against global competitors (Luo and Tung, 2007). However, business-group literature has focused chiefly on investigating the financial performance of business groups, and has rarely examined the antecedents of business groups' internationalization performance. In the current study, I use small-world networks as a framework for understanding their effects on business groups' financial and internationalization performance.

2.2 Hypothesis Development

Business-group networks facilitate social embeddedness, reciprocity, and coordination between firms (Grabher and Powell, 2004; Jones, Hesterly, and Borgatti,

1997). In the specific context of small-world networks, group members' connections serve as intermediaries that facilitate the exchange of resources. In the current study, I treat ownership links (i.e., shareholding) as social connections among business-group members, as these links—which enable one firm to exert control over another firm's decisions—can shed considerable light on dyadic interfirm relationships (Burt, 1983; Haunschild, 1993; Kogut and Walker, 2001).

2.2.1 Group-Level Effects Relative to Small-World Networks and Business Groups' Financial Performance

Burt (1992) argues that efficiency and effectiveness are two fundamental ways to optimize network benefits and outcomes. Networks with non-redundant contacts can efficiently maximize firms' exposure to diverse and relevant sources of information. Small-world networks represent systems with few non-redundant contacts who bridge information gaps between separate clusters. Scholars have argued, in consequence, that small-world networks efficiently move resources from one spot to another (Baum et al., 2010; Chen and Jaw, 2014). By building networks through indirect ties, firms can reduce the maintenance costs accruing from direct ties (Burt, 1992).

Nevertheless, there are situations in which highly clustered networks can decrease network diversity and, thus, increase organizational inertia (Burt, 1992). For example, under a high degree of global interconnectedness, firms can reach each other through relatively short network paths, and this close proximity, though helpful for exchanges of knowledge, may restrain diversity (Lazer and Friedman, 2007). The tradeoff is this: the accessibility of existing resources grows for all network members but can hamper the generation of new knowledge (Gulati et al., 2012). Since competitive advantage often depends on creativity, the dissemination of common knowledge beyond clusters can reduce their prospects in the long run (Moldoveanu, Baum, and Rowley, 2003). As stated by Uzzi and Spiro (2005), cohesiveness can thus be a liability for creativity: cohesive groups tend to overlook discrepant information in their current thinking because unique perspectives rarely present themselves. Moody and White (2003) analyzed political behavior and observed that the greater the connectivity of a cluster, the more similar the behavior of the cluster's actors.

Business groups may develop a high degree of interfirm connections to exchange complementary resources with affiliated firms to offset institutional voids or market failure. However, research has seldom discussed the advantages and disadvantages of greater interfirm connectivity within a group. Drawing on these research findings, I posit

that information homogeneity restricts exchanges of novel ideas within a business group's subclusters, thereby reducing competitive advantage and weakening performance. More specifically, for business groups, prominent small-world networks negatively affect financial performance up to a certain extent, owing largely to information redundancy and organizational inertia within each group. In addition, I argue that the network closure (i.e., network cohesiveness) of these local clusters enhances the mutual monitoring capability (Burt and Knez, 1995; Coleman, 1988) of affiliated firms by fostering concern for local reputation and by reducing each affiliated firm's power. Due to actors' concern for their reputation in a dense network, they will gravitate toward sanctioned behavior and the network will accept fewer newcomers. However, after reaching a threshold, small-world networks in business groups yield benefits that outweigh costs. As the degree of small-world structure increases, business groups realize the benefits of high interfirm connectivity for creating relationships of trust and reciprocity which increase the likelihood of collaboration among group affiliates (Uzzi, 1997). The growing collaboration among group affiliates can enhance the collective benefits from building knowledge together by virtue of efficient exchange of information, knowledge, and resources, which boosts the group's performance. This argument indicates that business groups may not immediately capture potential benefits derived from small-world networks. Thus, I propose the following hypothesis:

Hypothesis 1: For group-level networks, there is a curvilinear (U-shaped) relationship between the extent of a small-world network and the financial performance of the corresponding group.

2.2.2 Group-Level Effects Relative to Small-World Networks and Business Groups' Internationalization Performance

Even though business groups can develop resources domestically, the limited nature of such resources can render competitive advantages unsustainable. To create unique resources that maintain as sustainable competitive advantage, business groups may need to go abroad and acquire resources internationally. According to the network perspective, firms can develop internationally through their connections with businesses in external markets (Andersson and Johanson, 1997).

Internationalization, therefore, indicates that a firm has established network positions in foreign markets (Johanson and Mattsson, 1988). Business groups often must

continuously develop these foreign network positions to maintain competitiveness. Johanson and Mattsson (1988) also propose that the success of a firm's internationalization performance is driven by two factors: the firm's own business network and foreign markets' network structure, the latter being critical to the former. Johanson and Vahlne (2009) proposed that a well-established firm in a relevant network acts as an insider, yet insidership is an insufficient—though necessary—condition for better business development. To achieve optimal success, a business network needs outsider links, which are not only necessary, but indeed also create sufficient conditions (Johanson and Vahlne, 2009). A firm's outsidership status indicates that the firm does not hold a position in a relevant network. When a firm goes abroad where it does not have a relevant network position, the liabilities of an outsidership status may assert themselves (Johanson and Vahlne, 2009).

However, small-world network links between an insider cluster and other clusters that are native to the foreign market of the business group can help facilitate the business group's affiliates efficiently access complementary resources across clusters in the international-market expansion. Thus, I propose the following hypothesis:

Hypothesis 2a: For group-level networks, there is a positive relationship between the extent of a small-world network and the internationalization performance of the corresponding group.

By expanding their scale, business groups can overcome resource depletion in poorly developed markets (Hamilton and Kao, 1990; Lamoreaux, 1996). An intermarket network among affiliated firms within a business group can forge substantial links between domestic and foreign entities (Chen and Chen, 1998). Some affiliates, chiefly small ones, have limited financial resources and seek resources from within the interfirm network. The development of a foreign network enables them to overcome the liabilities of foreignness in operating abroad (Glaum and Oesterle, 2007).

Small-world networks help affiliated firms competitively expand into international markets. Non-redundant across-cluster intermediaries may also help affiliated firms detect market opportunities. As stated by Johanson and Vahlne (2009), the development of market opportunity is an interactive process characterized by inter-firm trust and by the firms' increased recognition and exploitation of opportunities. Since small-world networks can effectively promote interfirm collaboration (Sytch and Tatarynowicz, 2014), they may

foster group members' learning, trust, and commitment, all of which can attenuate the liability of outsidership and foster the ability to identify market opportunities (Johanson and Vahlne, 2009). Therefore, I propose the following hypothesis:

Hypothesis 2b: For group-level networks, internationalization performance mediates the relationship between the extent of a small-world network and the financial performance of a corresponding business group.

2.2.3 Cross-Level Nested Effects Relative to Small-World Networks as Antecedents of Core Firms' Financial Performance

Organizations are multilevel systems (i.e., nested networks) of relationships (Hitt, Beamish, Jackson, and Mathieu, 2007). Consequently, a network theory of business groups should be similarly multilevel in its scope. Multilevel network theory postulates the cross-level effects whereby higher levels may affect lower levels of a network (Moliterno and Mahony, 2011). However, there is relatively little research examining the effects that a global network comprising all actors in a given network of an ego network can have on a single actor (Sytch and Tatarynowicz, 2014). According to Hamilton and Kao (1990), Chinese business groups usually start with core firms (i.e., founding firms), which are the most influential firms in each group. A core firm that uses shareholding to link group affiliates to one another is a lead organization (Dhanaraj and Parkhe, 2006) or NAO (Network Administrative Organization) (Human and Provan, 2000) that plays a significant role in coordinating decision making within the business group network. As a result, even though the group's affiliates are legally independent firms, they can use ownership ties to operate coherently. Since ownership links indicate both the presence of control and the availability of diverse information between firms (Kogut and Walker, 2001), core firms play the role of the broker in a business network because they occupy the structural-hole position (Burt, 1992). Broker firms benefit from diverse and preferential access to their group affiliates' resources (Chen and Jaw, 2014). Firms positioned in a network's structural holes have easy access to resources (Baum et al., 2010).

In the current study, I use the ego-network perspective to examine the performance advantages that a core firm can derive from its network position. With the preferential network position at the convergence points of diverse resources (Galunic and Rodan, 1998; Becker, 1970), a core firm is well placed to control and obtain benefits from distant linked clusters. Core firms can control affiliated firms' behaviors by bridging gaps

between the affiliated firms and, in so doing, by granting them access to superior resources (Bizzi, 2013). Such benefits can, in turn, bolster the affiliated firms' competitive advantage and competence (Barney, 1991).

Although a small-world network can strengthen its core firm's status in a business group, the network—if too insular—can undermine this status. As discussed above, when the small worldness of a small-world network increases, the network becomes notably dense in a way that, while providing actors with quick access to information across clusters, sharply decreases the diversity of the information (Gulati, et al., 2012). A business network's core firm, in particular, may rely on increasingly redundant information, which, from the structural-holes perspective, constrains the development of new opportunities for the core firm, its affiliated firms, and the business group as a whole. Given the aforementioned points, I propose the following hypothesis:

Hypothesis 3: For cross-level networks, there is a curvilinear (inverted U-shaped) relationship between the extent of a business group's small-world network and the financial performance of the business group's nested core firm.

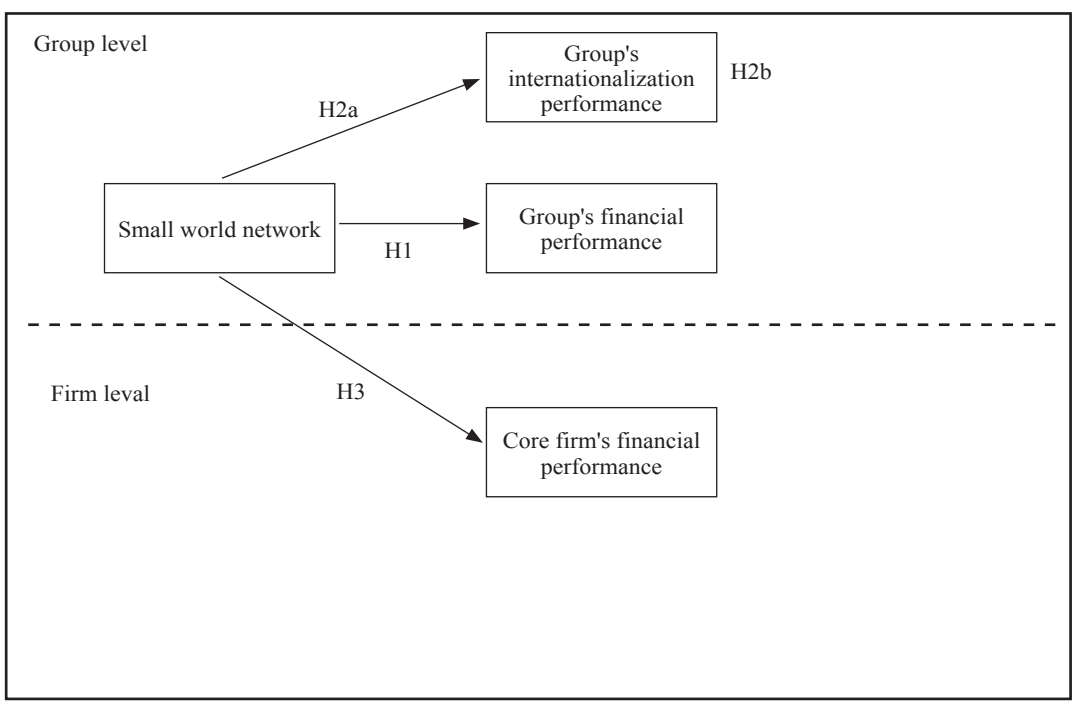

Figure 2 Conceptual Framework

3. Methodology

3.1 Research Setting and Data

In most emerging economies, many firms grow domestically or internationally as members of business groups (Chung, 2001; Khanna and Palepu, 2000). This pattern applies specifically to Taiwan, where business groups are a major contributor to the economy. For example, the China Credit Information Service (CCIS) Annual Survey reported that, in 2008, the global sales of the top 300 Taiwanese business groups accounted for 52.8% of the gross business operational income in Taiwan (Chen and Jaw, 2014). Thus, Taiwanese business groups constitute a useful research setting for exploring the antecedents that influence economic performance.

The current study's group-dimension data derive from the directory of Business Groups in Taiwan (BGT) as compiled by the CCIS (an affiliate of the US-based Standard & Poor's company). CCIS defines "business groups" as "a coherent business organization including several independent firms." A business group's affiliated firms must meet one of the following three objective criteria: (1) an affiliate must hold over 50 percent of the voting-right shares of at least one other affiliate, or hold over 33 percent of the inter-locking shareholdings of at least one other affiliate; (2) an affiliate must hold over 50 percent of total shareholdings or total capital of at least one other affiliate; or (3) over 50 percent of any two affiliates' directors and executive shareholders must be identical (Chen and Jaw, 2014; Jean et al., 2011).

The BGT directory, a comprehensive source for business groups in Taiwan, has been cited in previous studies (Khanna and Rivkin, 2001; Luo and Chung, 2005). The directory reveals the ownership structure of each business group by identifying the percentage of each affiliate's shares held by other affiliates. As an indicator of ownership control, the shareholding percentage of dyadic firms is an appropriate indicator of relationship building because the percentage accurately reflects situations characterized by mutual exchanges of hostages (Williamson, 1983). Such an ownership relationship can also help predict the extent to which affiliates influence one another (Keister, 2000).

Compiled by the BGT, my data sample consists of the top 100 business groups for each financial year during the 2008–2012 period (the BGT directory publication year during 2009-2013 period). Since financial holding groups have a financing system distinct from other groups, I have excluded those groups from the current study's data sample. The final sample consists of 460 business groups that covered 33,628 affiliated firms spread

across 16 industries.[3] By employing Taiwan's Standard Industrial Classification (SIC) codes, I whittle those 16 industries down to four basic types of industries: the service industry, the logistics and transportation industry, the manufacturing industry, and the high-technology industry.

I code the data pertaining to the firms that engaged in equity shareholding. I also collect the corresponding 460 core firms' data from the database of the Taiwan Economic Journal (TEJ). The TEJ, founded in 1990, provides accurate data on companies throughout Asia. From this database, I collect the financial data of core firms for my analysis of the firms' dimensions.

3.2 Primary Measures

3.2.1 Business-Group Performance and Core-Firm Performance

As firms' capacity depends highly on the firms' economic outcomes, both business-group performance and core-firm performance serve as this study's proxies for the effects of economic outcomes from the SWNs in business groups. Studies of business-performance measurement focus primarily on such financial measures as sales, profit margins, and returns on investment and such non-financial measures as customer satisfaction or market effectiveness (Song, Di Benedetto, and Nason, 2007; Song, Droge, Hanvanich, and Calantone, 2005). In empirical studies related to business and strategy, the most frequently used proxy for performance has been accounting data (e.g., ROA, ROE, ROS) (Glaum and Oesterle, 2007). However, scholars have observed that accounting data have serious drawbacks for the measurement of firm performance (Fisher and McGowan, 1983; Whittington, 1979). Since economists generally consider a firm's sales that capture the current monetary terms to be a likely indicator for the firm's performance (Geringer et al., 1989), I employ net income (ln) as the proxy for the economic performance in order to gauge current monetary outcomes—and, in turn, the productivity—of business groups and their core firms.

3.2.2 Business Groups' Internationalization Performance

Previous studies have used several measures of internationalization performance (or degree of internationalization; DOI). In line with the most prevalent trend (Geringer et al.,

3 These 16 industries refer to (1) food, (2) textiles, (3) leather and shoe manufacturing, (4) petrochemicals, (5) glass and ceramics, (6) cement, (7) steel, (8) electrical and mechanical products, (9) information and technology, (10) automobiles and bicycles, (11) construction engineering, (12) general merchandise retail, (13) transportation, (14) telecommunications, (15) media, and (16) trade.

1989; Grant, 1987; Stopford and Wells Jr, 1972; Tallman and Li, 1996), the current study uses the ratio of foreign sales to total sales (FSTS) to clarify business groups' internationalization performance. Recently, some scholars have criticized unidimensional measures (Gomes and Ramaswamy, 1999; Hitt, Hoskisson, and Kim, 1997; Sullivan, 1994), recommending instead a multidimensional measure[4] (Sullivan, 1994). However, after testing such a multidimensional measure, Ramaswamy, Kroeck, and Renforth (1996) cast serious doubts on the recommendation owing to problems with reliability and validity. Moreover, my current study uses the FSTS measurement index because it can directly measure the dependence of firms on their overseas activities (Daniels and Bracker, 1989). Despite the drawbacks of unidimensional measures, the FSTS ratio has long been the most commonly used measure among scholars (Stopford and Dunning, 1983; Hassel, Höpner, Kurdelbusch, Rehder, and Zugehör, 2003). Specifically, a substantial number of prior studies have used the FSTS ratio as a validated measurement for DOI (Ruigrok, Amann, and Wagner, 2007; Ruigrok and Wagner, 2003; Hsu and Boggs, 2003; Elango and Pattnaik, 2007). Gomes and Ramaswamy (1999) assert that the FSTS ratio is highly correlated with such ratios as FATA and OSTS, and that this correlation provides further support for the use of the FSTS ratio as a suitable measure of DOI.

3.2.3 Small-World Networks

Small-world networks can be measured by the degree to which nodes in a graph tend to cluster together (Watts, 1999a). Watts and Strogatz (1998) quantify the structural properties of these graphs by their *characteristic (average) path length (L)* and *clustering coefficient (C)*. In the current study, I divide *C* by *L* in order to calculate the quotient of the small-world network measurement (Uzzi and Spiro, 2005; Fleming et al., 2007).

L is the average number of links that constitute the shortest path between any two actors (i.e., affiliated firms) in a network. By definition, *L* measures the typical separation between two actors (firms) in a network. High values of *L* indicate that resources or information must pass through a large number of intermediaries so that links among affiliates can establish themselves in a business-group network (Baum et al., 2003). As a measure of local networks, *C* represents the extent to which firms are directly connected to a focal firm and are also directly connected to each other (Baum et al., 2003). To

4 The multidimensional measures of DOI include foreign sales to total sales (FSTS), foreign assets to total assets (FATA), overseas subsidiaries to total subsidiaries (OSTS), top managers' international experience (TMIE), and psychic dispersion of international operations (PDIO) (Sullivan, 1994).

calculate *C*, take the number of existing ties among all *k* direct neighbors of a focal firm and divide it by the number of possible ties that could exist among the focal firm's direct neighbors [k(k-1)/2]. For example, focal firm A is connected to 6 affiliated firms with one ownership linkage, and 4 of the affiliated firms are also directly connected to each other. Ci for focal firm A would be 15 (the number of pairwise ties between the 6 affiliated firms) divided by 6 (the number of possible ties among all 6 affiliated firms in focal firm A's set), or 2.5. The clustering coefficient of a network is the average Ci for all the firms in the network.

3.2.4 Control Variables

Drawing on previous studies, I conclude that some contextual factors may influence the hypothesized relationships. In the group dimension, I control for *business-group size* by using variables of *total number of affiliated firms* and *total assets* (ln). The resource-based perspective (Barney, 1991) positions firms that are affiliated as group-sharing resources in a way that allows them to benefit from valuable, rare, and inimitable resources. Firms affiliated with a large business group can benefit their performance by accessing spillovers and divergent resources with relative ease (George and Kabir, 2012). Large business groups are more capable than small business groups both at internalizing costs associated with structure and at generating benefits for affiliated firms (Khanna and Palepu, 2000). Firms can also use large, substantial networks to tunnel resources. By contrast, small business groups might lack sufficient resources to offset costs generated by individual firms or by the business group itself.

Like size, age is important. Thus, in the current study, I control for *group age*. The older a firm is, the more likely it is to suffer from inertia due to proliferation of rules and organizational resistance, and thus the less likely it is to acquire new market opportunities or novel information (Manikandan and Ramachandran, 2015). In the current study, I use the founding year attributed to a given core firm to calculate its business group's age, which is the same as the core firm's age.

I control for *core-firm size* by using the logarithm of *total number of employees*. Other variables included *liability ratio* (total liability divided by total assets), *liquidity ratio* (current assets divided by current liabilities), and *leverage ratio* (long-term debt to equity) as measures of financial indicators that could affect firm performance (Chang and Hong, 2000). I also control for industry effects by encompassing *industry dummy variables* as the logistics and transportation industry (IND1), manufacturing industry (IND2), and high-technology industry (IND3). The residual industrial sector is employed by the service industry.

3.2.5 Research Models

The following equations serve to test this study's main hypotheses:

Model 1: $\textbf{\textit{group financial performance}}_{it} = \alpha_{0i} + \alpha_1 \text{small-world network}_{it} + \alpha_2 \text{small-world network}_{it}^2 + \varepsilon_{it}$,

Model 2-1: $\textbf{\textit{group financial performance}}_{it} = \beta_{01i} + \beta_{11} \text{small-world network}_{it} + \varepsilon_{it}$,

Model 2-2: $\textbf{\textit{group internationalization performance}}_{it} = \beta_{02i} + \beta_{12} \text{small-world network}_{it} + \varepsilon_{it}$,

Model 2-3: $\textbf{\textit{group financial performance}}_{it} = \beta_{03i} + \beta_{13} \text{small-world network}_{it} + \beta_{23} \text{group internationalization performance}_{it} + \varepsilon_{it}$,

Model 3: $\textbf{\textit{core-firm financial performance}}_{it} = \gamma_{0i} + \gamma_1 \text{small-world network}_{it} + \gamma_2 \text{small-world networ}_{it}^2 + \varepsilon_{it}$,

where i = entity (i.e., a core firm or its corresponding business group), t = time, α_{0i}, β_{01i}, β_{02i}, β_{03i}, and γ_{0i} indicate the unknown intercepts for each entity in each model, and ε_{it} is the error term.

3.3 Analytical Techniques

My hypotheses concern the effects that small-world networks can have on business-group and core-firm economic outcomes in the context of group embeddedness. In this regard, I estimate the effects as they relate to business-group and core-firm performance, and I estimate the underlying mediated effect of business-group internationalization performance in the context of small-world networks. Since the construction of small-world networks is attributable to social networks, I apply the UCINET social-network analytical technique to the current study (Borgatti, Everett, and Freeman, 2002). To model business groups' small-world networks, I follow three steps. Firstly, I code interfirm-shareholding data, which shed light on the dyadic links in business groups. Secondly, I transform the data, computing the network variable by changing all the shareholding percentages into network data language. Thirdly, applying social-network analytical techniques to the 460 business group networks, I compute the values of the clustering coefficients and the values of the average path lengths for each group in the study's 5-year data set.

Given that my data was longitudinal, I test the research models with multiple regression analysis for panel data. I test all the models with the STATA (Version 13) statistical analytical technique (StataCorp, 2013). Additionally, I use my research models to investigate each business group's small-world network effects not only on the group itself, but also on its corresponding core firm (cross-level). I choose not to use multilevel

linear models to test for cross-level effects because, at the firm level, each business group has only one core firm. Maas and Hox (2005) suggest that, for an acceptable non-coverage rate, a sufficient sample size for multilevel analyses is at least 50. Therefore, multilevel analysis is not suitable for this current study.

Before undertaking the panel-data analyses, I conduct a Hausman test to determine whether a fixed-effect estimator or a random-effect estimator is more appropriate for the data (Antonakis, Bendahan, Jacquart, and Lalive, 2010). Since the *p* value is 0.00 (and less than the 0.05 threshold), I reject the null hypothesis. In other words, the fixed-effect model proves to be more appropriate than the random-effect model. I therefore use the fixed-effect estimators in my research models. Studies also indicate that the fixed-effect model is more appropriate than the random-effect model for predicting a causal relationship that is strongly affected by contingency factors (Antonakis et al., 2010).

I then use the hierarchical linear regression to test my research models. In models 1 and 3, I explore the curvilinear relationships proposed in hypotheses 1 and 3. Specifically, I test the statistical significance of the coefficients of the main variables' squared terms. As suggested by other scholars, calculating a turning point[5] is a necessary step in determining whether or not the point falls within the data range because a curvilinear relationship exists only when the turning point is within the data range[6] (Aiken, West, and Reno, 1991; Haans, Pieters, and He, 2016). In my second model corresponding to hypothesis 2b, I propose the mediating effect of a group's internationalization performance on the relationship between the group's small-world network and the group's economic performance. To test for mediation, I employ the three-step[7] regression model from Baron and Kenny (1986). This involves first regressing the dependent variable on the independent variable, then regressing the mediator on the independent variable, and finally regressing the dependent variable on both the independent variable and the mediator. The coefficients for each equation should be estimated and tested separately

5 One can calculate the turning point by using the first differentiation of the independent variable (i.e., this study's "small-world network" variable) (Aiken et al., 1991).

6 In this study, the data range indicates the range between minimum and maximum values of small-world networks.

7 Step 1: test the relationship between the predictor (β_{11}) and the outcome variable ($y = \beta_{01} + \beta_{11x}$). Step 2: test the relationship between the predictor variable (β_{12}) and the mediator ($m = \beta_{02} + \beta_{12x}$). Step 3: test the relationships among the predictor (β_{13}), mediator, and outcome variables ($y = \beta_{03} + \beta_{13x} + \beta_{23m}$). Step 4: check for complete or partial mediation and compare the predictor's coefficients of β_{11} and β_{13} with each other to determine whether mediation is complete or partial.

(Baron and Kenny, 1986). In each model, the control variables are systematically entered into the regression analysis.

4. Results

Table 1 shows the descriptive statistics and the correlation matrix of all variables. The results show that the correlation coefficients between the pairs of independent variables are low (less than 0.4). According to Mansfield and Helms (1982), multicollinearity might not be a problem in the current study's model. Table 1's results show that neither the correlation coefficients pertaining to small-world networks and group financial performance (coefficient = .07) nor the correlation coefficients pertaining to small-world networks and core-firm financial performance (coefficient = .05) are significant. These results indicate that small-world networks do not correlate directly with a group's financial performance or a core firm's financial performance. I test other regression analyses in my models and find that the group-age variable's correlation results for group financial performance (coefficient = -.03), for group internationalization performance (coefficient = -.14), and for core-firm financial performance (coefficient = -.11) are all negative. Although these correlation results for group financial performance are not significant, the negative relationships imply that older groups can impair business groups' or core firms' economic performance.

Table 2 provides the testing results for the hypotheses, and represents the results as Model 1, 2-1, 2-2, 2-3, and 3 by group and cross-level dimensions of the regression analyses. Hypotheses 1, 2a, and 2b relate to the group dimension in Models 1, 2-1, 2-2, and 2-3, while Hypothesis 3 refers to the cross-level dimensions in Model 3. The control variables of the group and cross-level dimensions were incorporated into each model. Hypothesis 1 predicts a curvilinear (U-shaped) relationship between the extent of a group's small-world network and a group's financial performance, and the squared result for the small-world network is positive and significant (α_2 = 1.82, $p < .1$). According to Haans et al. (2016), a significant and positive coefficient of a quadratic term indicates a U-shaped relationship. I also compute the turning point of the small-world network in the curvilinear relationship, and find that the value is 0.54, which falls within the data range of 0 (the minimum value) and 0.77 (the maximum value). The result indicates that the marginal effect of a denser small-world network may be negative. However, the marginal effect will become positive when the extent of a small-world network reaches the extreme turning point (see Figure 3). The empirical results support Hypothesis 1.

Hypothesis 2a predicted that a positive relationship exists between small-world

networks and the internationalization performance of groups. Likewise, Hypothesis 2b predicted that groups' internationalization performance can have a mediating effect on the relationship between small-world networks and the financial performance of groups. By employing Baron and Kenny's (1986) three-step regression models, I initially test for the relationship between small-world networks and group financial performance, and the result is significant (β_{11} = -.60, p < .1) in step 1 (see Model 2-1). I then test for the relationship between small-world networks and group internationalization performance in step 2 (see Model 2-2) for Hypothesis 2a. This time, the result is not significant (β_{12} = .14). Following the first two steps of the mediation test, I incorporate both the "small-world network" variable and the "group internationalization performance" variable into this study's three-step regression model in step 3 (see Model 2-3): when group internationalization performance is controlled, both the coefficient of the mediator (group internationalization performance) is significant (β_{23} = -31.33, p < .05) and the coefficient of the small-world network is significantly positive (β_{13} = 36.09, p < .05). According to Baron and Kenny (1986), the establishment of a mediation effect has to meet three conditions. First, it must be shown that the independent variable affects the dependent variable (step 1). Second, it must be shown that the independent variable affects the mediator (step 2). Third, it must be shown that the mediator affects the dependent variable (step 3). If these three conditions are met, perfect mediation or partial mediation may then be evaluated. However, the mediating test in step 2 was not significant, which indicates that the independent variable (small-world networks) does not affect the mediator (group internationalization performance). I thus conclude that the results do not support Hypotheses 2a and 2b.

Model 3 shows the cross-level nested effect related to Hypothesis 3. Hypothesis 3 predicted that a curvilinear (inverted U-shaped) relationship exists between a group's small-world network and the corresponding nested core-firm's financial performance. My study's result supports this hypothesis (γ_2 = -31.33, p < .05) because a significant and negative quadratic term indicates an inverted U-shaped relationship (Haans et al., 2016). In addition, I calculate the turning point of the small-world networks in this type of curvilinear relationship, and find that the value is 0.58, which falls within the data range of 0 and 0.77. As with the relationship between a group's small-world network and the corresponding core firm's performance, the positive marginal effect that the SWN has on the core firm's financial performance increases only up to a certain point before becoming negative (see Figure 4). Consequently, this study's results support Hypothesis 3.

Table 1 Descriptive Statistics for All Variables

Variable	Mean	S.D.	1	2	3	4	5	6
1. Group financial performance (ln)	18.69	1.45	1.00					
2. Group internationalization performance	0.3	0.36	0.25* (0.00)	1.00				
3. Core-firm financial performance	21.24	2.43	0.27* (0.00)	0.18* (0.00)	1.00			
4. Small-world network (SWN)	0.47	0.06	0.07 (0.20)	0.01 (0.86)	0.04 (0.42)	1.00		
5. Group size (total assets (ln))	18.69	1.1	0.75* (0.00)	0.03 (0.58)	0.31 (0.00)	0.01 (0.84)	1.00	
6. Group size (total no. of affiliates)	74.46	79	0.65* (0.00)	0.06 (0.21)	0.19* (0.00)	0.01 (0.80)	0.58* (0.00)	1.00
7. Group age	35.45	16.68	-0.03 (0.55)	-0.14* (0.00)	-0.10* (0.03)	-0.04 (0.40)	0.15* (0.00)	0.19* (0.00)
8. Core firm size (total no. of employee (ln))	8.47	1.72	0.43* (0.00)	0.32* (0.00)	0.38* (0.00)	0.16* (0.00)	0.22* (0.00)	0.18* (0.00)
9. Core-firm liability ratio	0.52	0.22	0.10* (0.04)	-0.04 (0.43)	-0.10* (0.04)	-0.10* (0.04)	0.07 (0.17)	0.01 (0.89)
10. Core firm liquidity ratio	1.86	1.36	-0.21* (0.00)	-0.09* (0.04)	0.01 (0.71)	0.01 (0.77)	0.01 (0.83)	-0.20* (0.00)
11. Core-firm leverage ratio	0.4	0.95	-0.10* (0.04)	-0.09 (0.07)	-0.22* (0.00)	-0.21* (0.00)	-0.00 (0.98)	-0.09 (0.07)
12. Transportation (IND 1)	0.02	0.15	-0.02 (0.74)	-0.12* (0.00)	-0.08 (0.11)	0.02 (0.75)	0.12* (0.00)	-0.08 (0.08)
13. Manufacturing (IND 2)	0.08	0.27	0.05 (0.29)	-0.22* (0.00)	-0.07 (0.13)	-0.04 (0.36)	0.06 (0.24)	0.07 (0.14)
14. High-tech (IND 3)	0.5	0.5	-0.31* (0.00)	-0.14* (0.00)	-0.05 (0.28)	0.00 (0.99)	-0.14* (0.00)	-0.14* (0.00)

Note: N1 = 460 groups, n1 = 33,628 affiliates, N2 = 460 corresponding core firms, * $p < 0.05$,
p = value in parentheses, two-tailed tests

Variable	7	8	9	10	11	12	13	14
1. Group financial performance (ln)								
2. Group internationalization performance								
3. Core-firm financial performance								
4. Small-world network (SWN)								
5. Group size (total assets (ln))								
6. Group size (total no. of affiliates)								
7. Group age	1.00							
8. Core firm size (total no. of employee (ln))	-0.03 (0.55)	1.00						
9. Core-firm liability ratio	-0.11* (0.01)	-0.06 (0.23)	1.00					
10. Core firm liquidity ratio	0.05 (0.28)	-0.24* (0.00)	-0.20* (0.00)	1.00				
11. Core-firm leverage ratio	-0.04 (0.39)	-0.08 (0.10)	0.31* (0.00)	-0.14* (0.01)	1.00			
12. Transportation (IND 1)	-0.02 (0.71)	-0.12* (0.01)	0.31* (0.00)	0.48* (0.00)	0.01 (0.87)	1.00		
13. Manufacturing (IND 2)	0.22* (0.00)	-0.04 (0.46)	0.12* (0.01)	-0.13* (0.01)	0.13* (0.01)	-0.04 (0.36)	1.00	
14. High-tech (IND 3)	0.36* (0.00)	-0.17* (0.00)	-0.09 (0.06)	-0.01 (0.81)	-0.03 (0.49)	-0.15* (0.00)	-0.29* (0.00)	1.00

Table 2 Results of the Regression Analyses

Model/ Hypothesis	Model 1/**H1**	Model 2-1	Model 2-2/**H2a**
VARIABLES	Group financial performance	Group financial performance	Group internationalization performance
Small-world network (SWN)	-2.00** (0.01)	-0.60* (0.05)	0.14 (0.70)
Small-world network	1.82* (0.05)		
Group internationalization performance			
Group size (total assets (ln))	0.42*** (0.00)	0.42*** (0.00)	0.04 (0.52)
Group size (total no. of affiliates)	0.00*** (0.00)	0.00*** (0.00)	-0.00* (0.09)
Group age	0.02* (0.07)	0.02* (0.07)	-0.11*** (0.00)
Core-firm size (total no. of employees (ln))			
Core-firm liability ratio			
Core-firm liquidity ratio			
Core-firm leverage ratio			
Transportation (IND1)	-	-	-
Manufacturing (IND2)	-	-	-
High-tech (IND3)	-	-	-
R-squared	0.38	0.38	0.35
N1/N2	460 groups	460 groups	460 groups

Note: N1 = 460 groups, n1 = 33,628 affiliates; N2 = 460 corresponding core firms; * $p < 0.1$; ** $p < .05$; *** $p < .01$; p value in parentheses; two-tailed tests

Model/ Hypothesis	Model 2-3/**H2b**		Model 3/**H3**
VARIABLES	Group financial performance	Core-firm financial performance	Core-firm financial performance
Small-world network (SWN)	-0.62** (0.05)	5.31** (0.04)	36.09** (0.01)
Small-world network^2			-31.33** (0.03)
Group internationalization performance	0.10** (0.04)		
Group size (total assets (ln))	0.42*** (0.00)	0.78*** (0.00)	0.71*** (0.01)
Group size (total no. of affiliates)	0.00*** (0.00)	-0.00 (0.70)	-0.00 (0.60)
Group age	0.03*** (0.01)	0.05 (0.27)	0.07 (0.14)
Core-firm size (total no. of employees (ln))		-	-
Core-firm liability ratio		0.75 (0.67)	1.16 (0.51)
Core-firm liquidity ratio		0.00 (0.14)	0.00 (0.15)
Core-firm leverage ratio		-2.01*** (0.00)	-1.95*** (0.00)
Transportation (IND1)	-	-	-
Manufacturing (IND2)	-	-	-
High-tech (IND3)	-	-	-
R-squared	0.38	0.16	0.18
N1/N2	460 groups	460 core firms	460 core firms

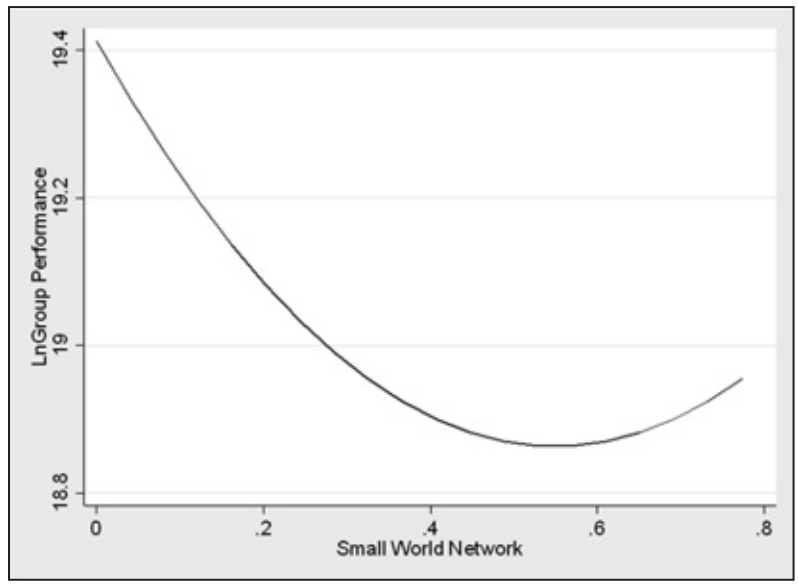

Figure 3 Curvilinear (U-Shaped) Relationship between Small-World Networks and the Corresponding Business-Groups' Financial Performance

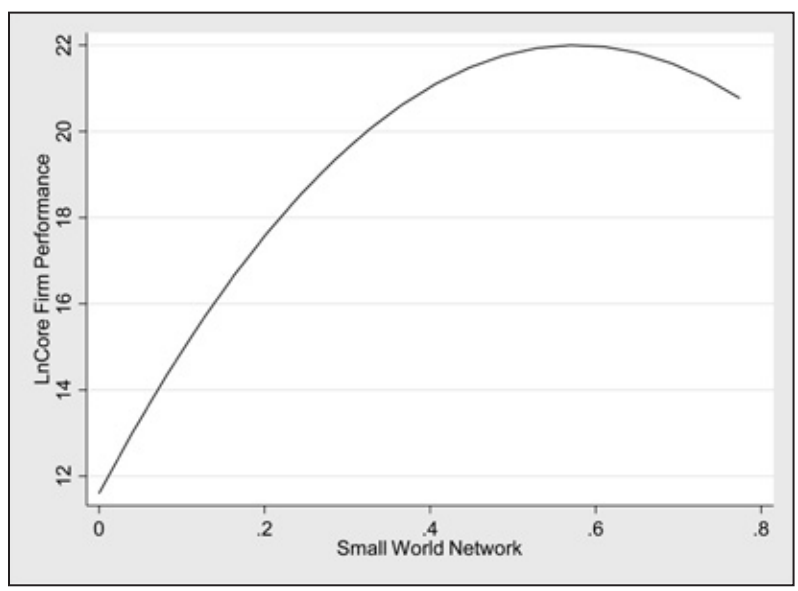

Figure 4 Curvilinear (Inverted U-Shaped) Relationships between Small-World Networks and the Corresponding Core Firms' Financial Performance

5. Discussion

In this study, I used a network perspective to examine (1) the effects that small-world networks can have on business groups' and cross-level nested core-firms' financial performance, and (2) the mediating effect of business groups' internationalization performance that lies between the relationship of groups' small-world networks and their financial performance. I developed a framework for studying small-world phenomena, and tested it on the basis of data collected from Taiwanese business groups. The results support my postulations that small-world networks have curvilinear effects on group-level and cross-level financial performance (the relationships being U-shaped and inverted U-shaped respectively). The findings of my study make important contributions to both scholars and practitioners regarding the aforementioned focus of this study: the effects that small-world networks have on the economic performance of business groups and core firms.

My research offers several theoretical contributions to related studies. Its first major theoretical contribution pertains to small-world networks. These networks represent systems with few non-redundant intermediaries who serve as information conduits that bridge the information gaps between disparate clusters. Scholars thus argue that the properties of small-world networks strengthen network efficiency (Baum et al., 2010; Chen and Jaw, 2014). Consequently, actors embedded in network systems can reap benefits from the knowledge recombinations arising from the diverse resources attributable to clusters (Schilling and Phelps, 2007). Owing to the knowledge recombinations arising from small-world systems, prior research has paid considerable attention to network systems' effects on actors' innovative outcomes (Baum et al., 2003; Lovejoy and Sinha, 2010; Sytch and Tatarynowicz, 2014; Uzzi and Sipro, 2005) rather than to network systems' effects on actors' economic outcomes. In this study, I have examined and evidenced consequences of economic outcomes that–as related to the financial outcome and internationalization outcome–are influenced by business groups' small-world networks. The research findings extend knowledge stemming from prior small-world networks literature.

This study's second contribution lies in explaining how perspectives on small-world networks help uncover some novel ways in which business groups–for the purpose of improved network efficiency–can reduce the maintenance costs of interfirm relationships by modifying their non-redundant links. According to Lovejoy and Sinha (2010), a link

between two firms represents their mutual investment in an interfirm relationship. If a firm wants ready access to a diverse set of ideas at a minimum cost, the firm might do well to enter into a business network, whose structure can reduce redundant links. Prior research has placed a greater emphasis on business groups' creation of cohesive dyadic relationships than on business groups' creation of disconnected relationships because cohesive relationships seem to facilitate trust and cooperation between partners (Baum et al., 2010; Gulati and Gargiulo, 1999). However, the cohesive ties in a dense business network can lead to redundant-as well as bonding-relationships (Coleman, 1988), which may increase the cost of dyadic relationships in a business group. For this reason, much extant theory and evidence on interfirm relationships overlook the effects that interfirm links, such as triadic ties, have on clusters (Baum et al., 2003). Efficient small-world structures can facilitate not only the movement of resources, but also the minimization of maintenance costs of interfirm relationships within a business group. These effects would improve a business group's collective performance.

This study's third major theoretical contribution to the literature pertains to business groups. By focusing on market failure and on resource-based or transaction-based cost theories, prior business-group literature on the beneficial effects of group affiliates' economic performance has consistently yielded mixed findings (Chang and Choi, 1988; Khanna and Palepu, 2000; Carney et al., 2011). Rarely have studies investigated either the relationship between a business group's ownership network structure and its economic outcomes or a group's cross-level effects on its nested core firm's economic performance. Drawing on small-world networks, I have examined in the current study the distributed multilevel nature of resources, which is characterized by nonlinear patterns of change. At the group level, I have found evidence that a rarely examined U-shaped relationship exists between small-world networks and the financial performance of business groups. Even though small-world networks facilitate interconnectivity and resource sharing between a business group's affiliates, the bonding may initially inhibit creativity in the affiliates because the growth in their interconnections may constrain each affiliate's creative power (Burt and Knez, 1995; Krackhardt, 1999). However, as the degree of the small-world networks increases, the corresponding business groups begin enjoying the beneficial effects of high interfirm connectivity on trust and reciprocity, which increase the likelihood of collaboration between group affiliates. These beneficial effects are in line with the network-closure argument proposed by Coleman (1988), who states that, among

firms, better relationships lead to more social capital.[8] Of special note is the inverted U-shaped relationship between a group's small-world network and the corresponding core firm's financial performance (Watts and Strogatz, 1998; Watts, 1999b). The current study presents considerable evidence that the properties of ego (core-firm) networks interact with the key features of business groups' small-world systems to shape group affiliates' behaviors and outcomes. Therefore, understanding the structural and dynamic effects of a small-world system on the economic outcomes of a business group can advance the structural theories of action and outcomes beyond conventional business-group literature.

Findings in this study have significant managerial implications for business-group practitioners. From the macro (group-level) perspective, the research findings should familiarize business-group managers with how small-world networks can affect the financial performance of business groups. Even though these networks can constrain business groups' performance initially, the resource recombination and collaborative behavior derived from this efficient network eventually yield positive marginal effects. Moreover, with regard to the micro (firm-level) perspective, core-firm managers should know that affiliated firms residing in a small-world network may reap substantial benefits from it (Uzzi and Spiro, 2005; Schilling and Phelps, 2007), resulting in a self-contained, homogenized small-world network (Gulati et al., 2012). In such a network, firms are less accepting of and less attractive to creative newcomers, thereby limiting bridges to outside clusters. Ego networks might thus decrease in diversity and increase in organizational inertia, preventing core firms from acquiring novel information and from developing a proactive business-expansion strategy. In small-world networks, non-redundant bridging ties (affiliated firms) across clusters may provide those actors (affiliated firms) located in one cluster with efficient access to non-redundant information and novel resources residing in other clusters (Burt, 2005; Granovetter, 1982). In turn, core-firm managers may pursue new partnerships with outside firms so as to tap the resource pools of diverse or novel information in business-group networks.

8 Social capital can be viewed as collective or individual property (Tan, Zhang, and Wang, 2015). Collective property refers to resources created and shared by all members in a network (Burt, 1992; Kwon and Arenius, 2010). By contrast, social capital as individual property is the sum of resources that accrue to an individual actor (Bourdieu and Wacquant, 1992).

6. Conclusion

This study has shed light on how the complex and dynamic nature of small-world networks affects the economic performance attributable to business groups and their nested core firms. My research findings affirm the important role that social structures play in the behaviors and behavioral outcomes of social actors (Granovetter, 1985; Uzzi and Spiro, 2005). These findings extend our interdisciplinary knowledge of the topics by linking them simultaneously to sociology and economics. In particular, it is imperative that I view complex social structures as multilevel systems in which network dynamics deeply intertwine with actors (e.g., affiliated firms) in multiple diverse layers and thus act in tightly interdependent relationships with these actors.

The current study deals primarily with business groups, treating them as strategic money-making networks dependent on patterns of interdependence among affiliated firms (Baum et al., 2003). However, few studies exploring the performance of business groups have made use of network-oriented theory. The current study complements studies undertaken by Coleman (1990), who examined the link between macro-social and micro-social levels of analysis, and by Giddens (1984), who examined the duality of structure and action. In its complementary function, the current study fills a significant research gap in extant empirical studies by highlighting a mechanism that uses a group-level social structure embedded in business groups to elicit from them certain patterns of firm-level behavior. By using an interdisciplinary approach, my research findings show that small-world networks are multilevel systems that have disparate nonlinear performance effects on business groups and core firms. My findings, thus, extend knowledge beyond the conventional literature on small-world networks and business groups.

In conclusion, my study advances our understanding of the group-level and cross-level effects of embedded small-world networks on the performance of business groups. My research findings contribute specifically to not only the theoretical literature examining small-world networks and business groups, but also business-group practitioners seeking to understand small-world networks' influence on the performance and internationalization outcomes of business groups. This study is limited by its reliance on business-group data exclusively from Taiwan. Future studies would do well to explore business-group data from other countries.

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I gratefully acknowledge the help of two anonymous reviewers and editors at *NTU Management Review* for their valuable suggestions and comments on my manuscript. I also appreciate and gratefully acknowledge the financial sponsor on this research from the MOST (MOST 103-2410-H-259-078).