Assessments of Organizational Modularity, Network Bandwidth, and Social Capital in the MNC's Value Network

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Paper presented on July 1, 2008 at the AIB Annual Conference, Milan, Italy  
http://aib.msu.edu/events/2008/

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Assessments of Organizational Modularity, Network Bandwidth, and Social Capital in the MNC’s Value Network

H. J. Chiu, Cheng-Li Myron Tien, and I-Fon Yvonne Ho

Abstract: We attempt to exam the direct effects of both organizational modularity and group social capital on strategic choice of effective configuration of the MNC’s value network. This research further investigates three important mediators on these direct effects, such as network bandwidth, value growth path, and political ties to regional economic blocs. We denote these mediators as strategic drivers for deploying the MNC’s group social capital.

Our findings generally support four sets of hypotheses developed from these theoretical arguments. Organizational modularity, measured by the within-module degree of the value network, affects positively strategic choice of effective network configuration of the MNC’s value network. Group social capital also determines strategic choice of effective configuration of the MNC’s value network in an invert-U fashion. In addition, group social capital has positive impact on network bandwidth as expected; it also affects value growth path positively in an exponential fashion only. Finally, the relationship between strategic choice of effective network configuration and group social capital is mediated fully by both network bandwidth and the geo-political factor.

Key words: Value Network, Organizational Modularity, Social Capital

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INTRODUCTION

Due to strong demand growth especially from China and India, the crude oil price has doubled since the beginning of 2007. This tumultuous disequilibrium in the crude oil market has destabilized the global economies and the geo-politics of energy-sensitive countries. For instance, the failed project of building natural gas pipelines between Baku, Tbilisi, and Ceyhan (i.e., the BTC Pipeline) in Central Asia has witnessed how energy price hikes and conflicting geo-politics could derail global co-operations in exploring and delivering crucial natural resources. One adverse impact is that the value networks (Stabel & Fjeldstad, 1998) of energy-related multinational corporations (MNCs) are strictly constrained for proactively profiting from environmental uncertainty (Shoemaker, 1985).

We are interested in the modular MNCs as the research target. Modular MNCs refer to the firms that structure their global operations into organizational modules and that complement such modules with roles. This research draws on the perspective that the complex network characterizes intensive interactions within the network by both modules and roles: Modules divide the whole network into identifiable parts, while roles highlight important players (Newman & Girven, 2003). For instance, Galunic and Eisenhardt (2001) suggested that modular business unit capabilities be quickly leveraged into other markets as opportunities change; in the disintegrated industry structure, a firm can leverage the design capabilities of loosely coupled networks of suppliers through outsourcing modules (Takeishi & Fujimoto, 2001).

Focal firms in this research were the MNCs in face of increasing complicated value networks, so as to have incentives to redesign their network configurations. Effective configuration of the MNC’s value network (Stabel & Fjeldstad, 1998) has strategic impact on the firm’s value creation capability. This research drew on the notion that the firm could deploy its core assets and activities more effectively to create value (Chesgrough, 2003; McGarth, 2004). Thus, we proposed that value creation of the network-type MNC came from the more effective deployment of the firm’s core assets and activities in its value network worldwide.

Configuration of organizational routines within the MNC affects the firm’s adaptive capabilities for succeeding in the global marketplace (Eisenhardt & Martin, 2000; Nelson & Winter, 1982). These routines of the MNC could help its executives to leverage its assets and coordinate its activities toward higher performance. That is, the firm’s improved network configuration that institutionalizes value delivery
processes could increase effectiveness of the firm (Chesbrough, 2003), or survival of the firm with early internationalization (Sapienza, Autio, George, & Zahra, 2006).

Motivated by these observations, we state our two research questions as follows:

**What determines strategic choice of the configuration of the MNC’s value network?**

**In addition to direct effects on network configuration, are there mediating effects on the relationships between network configuration and its determinants?** This research focuses mainly on the direct effects of both organizational modularity and group social capital on such strategic choice (Burt, 2005; Oh, Labianca, & Watts, 2006). Also, we attempt to examine some important mediators on these direct effects, such as network bandwidth, value growth path, and geo-political factors (e.g., political ties to regional economic blocs). We denote these mediators as strategic drivers for deploying the MNC’s group social capital, and classify the MNC’s value networks into two categories (i.e., downstream- and upstream-delivery networks).

Moreover, organizational modularity affects the firm’s ability to obtain inter-temporal economies of scope (Helfat & Eisenhardt, 2004), which could alter the boundaries of the firm’s assets and activities or configuration of the firm’s value network. When network grows in size, modules become modular clusters (Baldwin & Clark, 2000) that help manage networked relationships due to their flexibility for newly-conceived opportunities or threats. Thus, modularization of the network positions could be a strategic response to increasing requirements for effectiveness.

Downstream value-delivery activities guarantee market accesses, while upstream ones ensure supply stability. Two recent changes of value-delivery activities in emerging markets have called for re-examination into the MNCs’ global value networks. The former is Yangshan Deepwater Port that lies outside Yangtze River Delta of China; the latter is the Baku-Tbilisi-Ceyhan (BTC) natural gas pipeline that connects oil fields around Caspian Sea with a Turkish port on East side of Mediterranean Sea.

Well-configured value networks could facilitate exchanges of valuable resources and value-added products with global trading partners. Thus, this research aims at elaborating on the strategic choice of effective configuration of the MNC’s value networks. Extant literature has provided alternative arguments that made diverse predictions for network configuration. Burt (2005) suggested that network bandwidth required for social-network design be helpful in configuring value networks. The concept of network bandwidth can be comprehended in the niche width – i.e., scope
of the firm: To attain broad scope, firms must repeatedly explore outside the boundaries of their current niches (Sorenson, McEvily, Ren, & Roy, 2006).

Changes in a firm’s core activities and assets could lead to the restructuring of its organizational architecture and foundations (Chesbrough, 2003; McGhan, 2004). In the business context that product modules outperform single products – e.g., the hub-and-spoke system in such industries as transportation or energy distribution – a firm’s core activities should focus on designing, commercializing, manufacturing modular products (Chesbrough, 2003). In the world where modular products prevail, well-managing organizational modularity in the MNC’s global value networks should be the core activities. The capability for adapting the effectiveness of value networks could depend on such core activities (McGrath, 2004).

Furthermore, Baldwin and Clark (2000) further proposed two rules for managing product modularity: Modular design creates growth options; modular design could evolve. That is, product modules could extend or recombine the original product designs into brand new applications; technological trajectories and market forces might enhance or reduce the value of modular design exogenously. When networks grow in size, modules help manage networked relations due to their flexibility for newly-conceived opportunities or threats (Baldwin & Clark, 2000). In such a case, network scale and reputation for managing interactions within the large-scale network become important. Our research hereby turned to the complex-network perspective: A complex network characterizes intensive interactions within the network by both modules and roles (Newman & Girven, 2003).

The MNC’s value network is a large-scale complex network. We further suggest that these exists an optimal configuration of routines that allow an organization to achieve its goals (Nelson & Winter, 1982), such as accumulation of group social capital (Oh, Labianca, & Watts, 2006). In this research, the focal organization is the MNC with group social capital embedded in the networked relations with host-country governments.

The structure of this research proceeded as follows. In Section Two, literature on the value network and social capital is reviewed. Then, we move to discuss the changing regional landscape in value networks located in emerging markets in Section Three. In the next section, we propose a mediation model of organizational modularity, group social capital, and value network configuration of the MNC; we then develops a set of hypotheses from the model. This research clarifies its research
methods and discusses its empirical findings in the next two sections, respectively. We conclude this research in Section Seven.

PERSPECTIVES OF VALUE NETWORK, SOCIAL CAPITAL, AND ORGANIZATIONAL MODULARITY

The purpose of our model-building efforts is two folds: To clarify what leads to strategic choice of effective configuration of the MNC’s on the one hand; to assess the linkages between such strategic choice, organizational modularity, and group social capital owned by the MNC on the other. We believe that the following perspectives are relevant to this purpose. First, our research focused on how value created in the deployment strategy of group social capital (Oh, Labianca, & Watts, 2006). We take the value-network perspective to elucidate the nature of value creation mechanisms as simultaneous interdependence (Stabel & Fjeldstad, 1998).

Second, to further clarify how value network configuration (i.e., structure of networked relations) could affect its effectiveness (Burt, 1992), we draw on social capital theory. Social capital is embedded in the social network, where resources are acquired and deployed by social actors in their moves (Lin, 2001). In this research, social actors are defined as the MNCs that participate in the transportation or energy-distribution networks in regional economic blocs, such as Caspian Sea & Central Asia, and Greater China Area.

By coining “group social capital,” Oh et al. (2006) attempted to advance the concept of social capital collectively owned by social actors bounded in network closure (Coleman, 1988). This research interprets group social capital shared by these MNCs as the ownership of entrepreneurial opportunities (Burt, 1992) for supply stability or market access granted by governments of regional economic blocs.

Third, when network scale expands, organizational modularity becomes an important determinant of effective network configuration. Since modules of the value network are the nodes where networked relations are built upon, modularity in the network design is an organizational issue. For instance, an regional headquarters unit of an MNC could serve as the operational hub (i.e., functioning like a computer server) in a regional economic bloc, where other organizational units of the MNC in this region (i.e., playing roles like computer terminals) link among themselves and the hub in a modular fashion to make effective use of common resources and capabilities owned by the MNC.
The complex network perspective is suitable for addressing the issues on modular design of the network (Newman, Barabasi, & Watts, 2006). At the product level, modular design practices shed light on the relationships between product architecture, imitation, and dynamic capabilities that concern the firm’s long-term effectiveness (Pil & Cohen, 2006). By extending this principle into the modular MNC setting, we attempt to integrate organizational modularity, group social capital, and deployment of group social capital into coherent design criteria for effective value network configuration.

Value Network

The value network created around a given business shapes the roles that stakeholders play in influencing the value captured from the commercialization of an innovation (Chesbrough, 2003). Furthermore, interdependence among value-creation activities in the value network is simultaneous, unlike the sequential interdependence of ones in the value chain (Stabel & Fjeldstad, 1998).

The value-network perspective predicates that building strong connections to a value network can leverage the values of resources in general (Stabel & Fjeldstad, 1998), technologies in specific (Chesbrough, 2003). Failure to construct such a network could diminish the resources’ potential value. If the boundary adjustment of a network depends dynamically on the economies of scope, then organizational modularity affects the firm’s ability to achieve inter-temporal economies of scope, without requiring a high degree of coordination (Helfat & Eisenhardt, 2004).

The construct of social innovation could be inferred from extant literature that changes in social landscape driven by increasing network brokerage or closure could affect the network’s effectiveness significantly (Burt, 1992; Coleman, 1988). In this research, value enhanced through social innovation in modular design of the value network could be regarded as a proactive response to changing rules of game in value-delivery activities in regional economic blocs. Transportation and energy-distribution and transportation are two major value-delivery activities that we focus on.

Social Capital

We propose that group social capital (Oh, et al., 2006) have both direct effect and indirect effect on the effective configuration of the MNC’s value network. Social capital construct addresses returns to individuals and collectives generated from social
resources commonly embedded in networks of relationships.

We measure the construct of social capital in the following. Social capital is such resources acquired and deployed by social actors and is embedded in the social network where social actions take place (Lin, 2001). In this research, social actors are defined as the MNCs that participate in the transportation or energy-distribution networks of the host country.

Two competing perspectives have different views on how such network mechanisms play. On the one hand, the “closure” perspective argues that densely connected networks will generate returns to the constituent members, primarily by creating an informal system of monitoring and sanctioning deviant actors (e.g., Coleman, 1988). On the other, the “structural-hole” perspective proposes that individual actors who broker relations between otherwise disconnected actors will enjoy positive returns arising from competitive advantages (Burt, 1992).

To synthesize these competing perspectives, Burt (2005) proposed four stylized facts on the creation of social capital. First, informal networks are structured into dense clusters separated by structural holes. Second, actors who span structural holes have improved vision of the social landscape, and this provides them with greater exposure to alternative opportunities.

Third, closure increases the probability of catching and sanctioning deviant beliefs and behavior, where “bandwidth” plays as a network mechanism to enhance mutual trust arising from mutual monitoring and the efficient diffusion of information that evolves into each actor’s reputation. The concept of network bandwidth can be comprehended in the niche width – i.e., scope of the firm. To attain broad scope, firms must repeatedly explore outside the boundaries of their current niches (Sorenson, et al., 2006). Furthermore, Firms with broad niches operate under a set of routines that repeatedly propel them into new market segments, expanding their niche.

Fourth, while network closure may create an environment that makes trust possible, it also reinforces the status quo, stabilizes social structures, and exaggerates distrust between groups. Burt (2005) called the underlying network mechanism responsible for these socioeconomic outcomes “echo” – i.e., bandwidth gone bad. Where bandwidth is closure as capital, echo is closure as liability. Burt’s empirical findings also demonstrated that echo won over bandwidth.
Furthermore, to advance the applicability of social capital theory into collectively-owned social capital within a network boundary, Oh, et al. (2006) proposed a perspective of group social capital. Greater group social capital resources lead to greater group effectiveness and different conduits through which social capital flows. Oh et al. (2006) referred group social capital to the set of resources made available to a group through members’ social relationships within the social structure of the group, as well as in the broader formal and informal structure of the organization.

Our research focuses on group social capital owned by the MNC and shared by the each organizational units within the MNC’s value network. Accordingly, the MNC’s group social capital is interpreted as the ownership of entrepreneurial opportunities for supply stability or market access granted by host-country governments. Group social capital in regional transportation or energy-distribution networks is shared by the MNCs in the same value network.

**Complex Network and Modularity**

When network grows in size, modules become modular clusters (Baldwin & Clark, 2000) that help manage networked relationships due to their flexibility for newly-conceived opportunities or threats. Baldwin and Clark (2000) further proposed two rules for managing product modularity: Modular design creates growth options (Myers, 1977); modular design could evolve. Similar to the growth option that links its value to future growth opportunities, product modules could extend or recombine the original product designs into brand new applications. However, technological trajectories and market forces might enhance or reduce the value of modular design exogenously (Baldwin & Clark, 2000).

Following this stream of research, Pil and Cohen (2006) proposed that the scope and timing of a firm’s modular strategy affected the developments of innovativeness capabilities. In turn, such capabilities are critical to sustainable advantage for modularity. This line of arguments regards modularity as a means of managing complexity and designing flexible organizational and technological systems (Baldwin & Clark, 2000). In particular, simplified links between design and performance outcomes in modular environments reduce complexity that drives development of dynamic capabilities (Ethiraj & Levinthal, 2004; Phil & Cohen, 2006).

A complex network characterizes intensive interactions within the network by both modules and roles: Modules divide the whole network into identifiable parts,
while roles highlight important players (Newman, et al., 2006). In the complex
network, network scale and reputation for managing complex interactions arising
expanding networking relationship become important.

We argue that the accumulation of group social capital could be a concave
function of the capabilities for configuring assets and activities in the value network.
That is, these exists an optimal configuration of routines that allow the firm to achieve
its goals (Nelson & Winter, 1982), such as accumulation of group social capital (Oh,
et al., 2006). That is, there is an invert-U relation between effective network
configuration and group social capital. In this research, the focal organization is the
MNC with group social capital embedded in the networked relations with the
host-country governments.

Our reasoning is as follows. Social capital is those resources acquired and
deployed by social actors and is embedded in the social network where social actions
take place. Initially, increasing interactions among social actors could result in
positive networked relations, due to sharing assets and coordinating activities for such
collective objectives as building common platforms for value delivery. Cooperation
among member firms is highly emphasized initially for achieving legitimacy and
accountability, which nurtures group social capital shared by the member firms within
the same value network. After reaching an optimal level, interactions among social
actors might turn to proactive competitive moves so as to undermine the effectiveness
of collective actions. Thus, the group social capital-network configuration relationship
is concave in nature.

Moreover, modular organizations that are composed of loosely coupled simple
rules can be reconfigured as environmental shift (Galunic & Eisenhardt, 2001).
Galunic and his colleague suggested that modular business unit capabilities be quickly
leveraged into other markets as opportunities change.

Finally, in the disintegrated industry structure, a firm can leverage the design
capabilities of loosely coupled networks of suppliers through outsourcing modules
(Takeishi & Fujimoto, 2001). That is, by shifting among suppliers as conditions
change, the firm can maximize the benefits arising form organizational modularity.

CHANGING VALUE NETWORKS IN REGIONAL ECONOMIC BLOCS
Two Case Studies
Changing configurations of transportation and energy-distribution routes in regional economic blocs have harbingered upcoming strategic renewal for those MNCs that participate in these regional value networks. Downstream delivery networks guarantee market accesses, while upstream ones ensure supply stability. The former is Yangshan Deepwater Port that lies outside Yangtze River Delta of China and is one of the major offshore outsourced manufacturing sites in the world. The latter is The Baku-Tbilisi-Ceyhan (BTC) oil pipeline that connects oil fields by Caspian Sea with a Turkish port on East side of Mediterranean Sea.

**Case 1: Yangshan Deepwater Port, Greater-China Economic Bloc –**

The importance of Yangshan Deepwater Port is based on the fact that the Yangtze River Delta is currently one of the most important cluster of information technology (IT) industries in the world. In East Asia, Busan Port that has positioned itself to prosper from its fast-growing Korean IT clusters; Now it suffers from intensive competition from Yangshan Deepwater Port. In response, Busan Port Administration cut its port usage fees by 40%.

China’s government aims at further leveraging its mass-product manufacturing prowess in the Yangtze River Delta. Accordingly, marine transshipment in the Greater Shanghai Area plays a central role in such policy pushes. Yangshan Deepwater Port has become the transshipment center for those ports in the Yangtze River. This strategic location has been strengthened by the nearby Pudong International Airport by just a 50-minute driving distance. Furthermore, several newly constructed super-highways connecting Shanghai with other industry clusters in China have further enhanced the competitiveness of Yangshan Deepwater Port’s marine-airborne-land delivery networks in East Asia.

**Case 2: The BTC Natural Gas Pipeline, Central-Asia Economic Bloc –**

Then, we turned to the BTC Pipeline. This proposed natural gas pipeline attempts to provide an alternative route for deliver natural gas from Caspian Sea to Europe, without passing through the territories of Commonwealth of Independent States. The existent natural gas pipelines have been mainly under the command of Russia. The BTC Pipeline has been integrating into Turkish pipeline networks, which is more pro-Western in geopolitics. Moreover, shifting regional pipeline networks could have long-term impact on value networks of the oil-sensitive firms, as well as the oil geopolitics in the West Asia and Caspian Sea.

Furthermore, stimulated by the incentive of EU membership, Turkish institutions
have been driven to reconfigure its national pipeline networks. The proposed BTC Pipeline reflects the increasing expectations for political and economic institutions located in Turkey, which calls for new pipeline networks in regional economic blocs, especially in Central- and West-Asia. As Turkey speeds up its application for EU membership, strategic importance of Turkish institutions – e.g., governmental taxation and industry-policy units, oil refineries, and energy distributors – for energy-sensitive firms in Europe is increasing. Accordingly, tightly coordinated policy mechanisms for pipeline networks are highly expected for Turkish institutions.

However, Turkish government and its allies just lost this competition with Commonwealth of Independent States. This planned BTC Pipeline project failed in December 2007 due to Russian political-economic intervention, this project still sheds light on the importance of upstream value-delivery activities for energy-sensitive countries and for energy-related MNCs. This unexpected outcome signals the importance of geo-political factors in configuring the value networks in regional economic blocs. Thus, we propose that political ties to regional economic blocs (i.e., a proxy for geo-political factors) should be taken into account when the MNC makes strategic choice of effective configuration of the firm’s value network in the region.

The MNCs that this research focuses have business activities in energy distribution or marine transportation, according to North American Industry Classification System (NAICS) Code developed jointly by U.S., Canada, and Mexico. The following codes are used to confirm the sample firm’s activities in energy distribution or marine transportation: (1) Code 486210 defined by transmission of natural gas via pipeline (i.e., processing plants to local distribution systems), (2) Code 486110 defined by crude oil pipeline transportation, (3) Code 483111 defined by deep sea freight transportation to or from foreign ports. The first two NAICS Codes are related to fossil-based energy (i.e., natural gas and crude oil), while the third Code is concerned with marine transportation (i.e., Yangshan Deepwater Port is strategically important for its deep sea freight transportation node for the Yangtze River Delta of China.

Configuration of the MNC’s Value Network

The unit of analysis of this research is at the firm level. The focal firm is the modular MNC that participates in transportation or energy-distribution in emerging markets. Modular MNCs refer to the firms that structure their global operations into organizational modules and that complement such modules with roles. This research draws on the perspective that the complex network characterizes intensive interactions
within the network by both modules and roles: Modules divide the whole network into identifiable parts, while roles highlight important players (Baldwin & Clark, 2000; Newman & Girven, 2003).

In the case of Yangshan Deepwater Port, those MNCs that rely on this port’s marine transshipment for international trade – e.g., US-based HP Corp exports personal computers from its local original design manufacturers – constitute one part of our observations. In addition, those MNCs that are sensitive to oil sources from the Caspian Sea and West Asia – e.g., UK-based BP Corp has oil delivered from Baku (Azerbaijan) through Tbilisi (Georgia) to its refineries in Ceyhan (Turkey) – comprise another part of our observations.

Effective configuration of value networks entails the social construction of network structure including port administration and product sites within an industry cluster. Such effectiveness is also affected by the extent to which social capital is accumulated. Network positions and group social capital co-determine the extent to which the network’s routines are reconfigured. Reconfiguration of routines affects the firm’s adaptive capabilities for succeeding in global industrial landscape (Eisenhardt & Martin, 2000; Nelson & Winter, 1982). These routines help the firm to leverage its assets and coordinate its activities toward higher performance.

Finally, effective network configuration could also affect the required degree of modularity for each network configuration. Organizational modularity affects the firm’s ability to obtain inter-temporal economies of scope (Helfat & Eisenhardt, 2004), which could alter the boundaries of the firm’s assets and activities. When network grows in size, modules become modular clusters (Baldwin & Clark, 2000) that help manage networked relationships due to their flexibility for newly-conceived opportunities or threats. Thus, modularization of the network positions could be a strategic response to increasing requirements for effectiveness.

**THE MODEL AND HYPOTHESES**

This research attempted to address two research questions. The first is related to what determines strategic choice of the configuration of the MNC’s value network. Second, in addition to direct effects on network configuration, we are curious about the extent to which there exist mediating effects on the relationships between network configuration and its determinants.
In specific, we aim at examining how organizational modularity and group social capital affect the extent to which value networks are configured effectively. Effective configuration of value-delivery routines within the MNC affect the firm’s adaptive capabilities for succeeding in global industrial landscape (Eisenhardt & Martin, 2000; Nelson & Winter, 1982). These routines of the MNC could help its executives to leverage its assets and coordinate its activities toward higher productivity. That is, the firm’s improved network configuration that institutionalizes value delivery activities could increase effectiveness of the firm (Chesbrough, 2003), or survival of the firm with early internationalization (Sapienza, Autio, George, & Zahra, 2006).

The logic of our model-building efforts is stated as follows. Value delivered in the MNC’s value network could be enhanced through modular design. In the business context that product modules outperform single products, a firm’s core activities should focus on such product-module activities as the module’s splitting, substitution, augmentation, exclusion, inversion, and porting (Baldwin & Clark, 2000). Moreover, as group social capital owned by the MNC’s value network increases, the firm would be more capable for deploying its core assets and activities across different modules within the value network. This is due to the rationale that effective resources deployment could lead to better implementation of value-creation strategy (Chandler, 1962; Grant, 2005).

Other factors are also important for modular design of the value network. Burt (2005) proposed that network bandwidth required for desirable socioeconomic outcomes – i.e., acquisition of social capital in specific – was an important design parameter. Network bandwidth could be elaborated on through the scope of the firm: To attain a broad scope, the firm must repeatedly explore outside the boundaries of their current niches (Sorenson, et al., 2006). When economies of scope define the network boundary, network bandwidth affects the firm’s ability to obtain inter-temporal economies of scope (Helfat & Eisenhardt, 2004).

A Value Network by Modular Design
This research draws on the complex-network perspective for elaborating on value delivery through modular design. The reason why we rely on this theoretical lens is because organizational modularity within a network is a phenomenon of complex networks widely observed in biology and other natural science (Newman et al. 2006). Newman and Girvan (2003) advocated that a complex network characterized intensive interactions within the network by both modules and roles: Modules divide the whole network into identifiable regions, while roles highlight
important players. Moreover, we hereby discuss the concept of the modularity of a partition proposed by Newman and Girvan (2003):

\[ M = \sum_s (d_s - D_s) \]  
--- (1)

Where \( d_s \): fraction of links within module \( s \)
\( D_s \): expected fraction of links within module \( s \), for a random partition of the nodes

Nevertheless, to make the measures more relevant to the context of value networks, we refine \( M \) in equation (1) into the within-module degree of the regional delivery network as follows.

Let \( k \) be the number of links (e.g., pipeline or shipping route) of a node (e.g., transshipment city or port) to other nodes in the same module (e.g., sub-region in a regional economic bloc). Then, the within-module degree (\( Z \)):

\[ z = \frac{k - \langle k \rangle}{\sigma_k} \]  
--- (2)

Next, we defined the participation coefficient in the following.

Let \( f_{is} \) be fraction of links of node \( i \) in module \( s \) (e.g., the relative importance of transshipment city or port in the value network), then participation coefficient is:

\[ P_i = 1 - \sum_s (f_{is})^2 \]  
--- (3)

Where \( P = 0 \), all links in one module
\( P = 1 \), links all distributed

The within-module degree (\( Z \)) and the participation coefficient (\( P \)) jointly define the module’s role in the network. In particular, \( Z \) shows the degree of network centrality because the number of the links among nodes within a module defines the location of the network center (Burt, 1992). Moreover, \( P \) is concerned with the degree of network density because it shows the percentage of links of node \( i \) in a certain module. This measure of network density shed lights on the extent to which economies of scope a firm can realize from the network – i.e., the denser the links are within the module, the more synergies can be achieve from cross-utilizing such links. Overall, the roles of modules in the network affect how the network is configured effectively.
There are two basic roles played by the module: While modules in the high-modularity group could play multi-focal roles in the value delivery activities, modules in the low-modularity group have similar inter-dependent roles in those activities. Put differently, the degree of the module’s role discussed above affects effective configuration of the value network. The roles of modular networks are divided into seven categories: Provincial hub, connector hub, kinless hub, extra-peripheral non-hub, peripheral non-hub, non-hub connector, and kinless non-hub (Newman and Girven, 2003).

We hereby argue that while Z measures network bandwidth (Burt, 2005), P serves as a proxy for organizational modularity. This measurement of network bandwidth is consistent with the modular system theory (Schilling, 2000). In the world where modular products prevail, managing the centrality (Burt, 1992) of the product modularity network should be the core activities of the firm. Thus, the bandwidth required for an effective value network should be contingent on the within-module degree (Z). On the other hand, the participation coefficient (P) concerns the fraction of links of node i in module s (e.g., the relative importance of transshipment city or port in the delivery network), so it demonstrates the degree of organizational modularity.

In conclusion, we finalized our research model as follows and depicted it in Figure 1. There are four sets of hypotheses concerning the relationships of the modular MNC’s effective value network configuration with organizational modularity, group social capital, and strategic drivers for deploying group social capital in the MNC’s value network.

H1: Organizational modularity affects strategic choice of effective network configuration positively due to its impact on the firm’s ability to achieve economies of scope.

Modular organizations that are composed of loosely coupled simple rules can be reconfigured as environmental shift (Galunic & Eisenhardt, 2001). Galunic and his colleague suggested that modular business unit capabilities be quickly leveraged into other markets as opportunities change. Thus, a modual MNC is supposed to achieve economies of scope faster than otherwise, which could alter the boundaries of the firm’s assets and activities.

H2: Group social capital determines strategic choice of effective
configuration of the value network in an invert-U fashion.

Social capital is such resources acquired and deployed by social actors and is embedded in the social network where social actions take place (Lin, 2001). Oh, et al. (2006) proposed a perspective of “group social capital,” by arguing that the greater group social capital resources lead to greater group effectiveness and different conduits through which social capital flows. Oh and his colleagues referred group social capital to the set of resources made available to a group through members’ social relationships within the social structure of the group. The MNC’s group social capital is interpreted as the ownership of entrepreneurial opportunities for supply stability or market access granted by host-country governments.

The reason behind this invert-U relationship could be due to the competing arguments regarding whether or not network closure (e.g., there exists the network boundary of the MNC’s value network) always does good to the social actors (Coleman, 1988); Burt (1992) suggested otherwise. At the early stage of group social capital accumulation, legitimacy-seeking behavior shared by most of the members leads to increasing effectiveness of the value network configuration. However, after reaching a certain level of group social capital, competition among members occur because a limited network boundary constrains the value enhancement routes of group social capital in the value network.

Next, there are three sets of hypotheses that relate group social capital of the MNC to strategic drivers (or scopes of conduits) for deploying group social capital. This research focuses on three strategic drivers: Network bandwidth (Burt, 2005), value growth path, and geo-political factors.

$H_3(a):$ Group social capital has positive impact on network bandwidth.

The centrality of the MNC’s value network serves as the proxy for network bandwidth (Burt, 2005). In the world where modular products prevail, managing the centrality of the product modularity network should be the core activities of the firm. Thus, the bandwidth required for an effective value network should be contingent on the within-module degree ($Z$). Group social capital helps modular products distribution more effectively in the value network, by utilizing the center (or hub) advantage for socially-embedded distribution networks.

$H_3(b):$ Group social capital affects value growth path positively in the
first linear then exponential fashion.

As Metcalfe’s Law (Baldwin & Clark, 2000) predicts, the network-type industry’s effectiveness index (e.g., revenue, value-added) could grow along the exponential path, after the scale of such an industry reaches a critical mass. Group social capital is treated a collective scale of the MNC’s value network, which could lead to the exponential path of value growth.

\[ H3(c): \text{Group social capital affects positively political ties to regional economic blocs.} \]

Political ties in political-sensitive industries are valuable in mobilizing geo-political resources for market access. Energy distribution and transnational air/marine shipments entail regulatory approvals or government-granted licenses. When petroleum and transportation have increasing economic contributions to the countries in regional economic blocs, the MNC should be skillful in handling such geo-political issues. Group social capital owned by the MNC could increase the flexibility in acquiring political supports.

Finally, three strategic drivers for deploying group social capital mediate differently the relations between group social capital of the MNC and effective configuration of the firm’s value network.

\[ H4(a): \text{The strategic choice of effective network configuration is mediated positively by network bandwidth.} \]

Network bandwidth plays as a network mechanism to enhance mutual trust arising from mutual monitoring and the efficient diffusion of information that evolves into each actor’s reputation (Burt, 2005). While network closure (Coleman, 1988) may create an environment that makes trust possible, it also reinforces the status quo, stabilizes social structures, and exaggerates distrust between groups. Burt (2005) called the underlying network mechanism responsible for these socioeconomic outcomes “echo” – i.e., bandwidth gone badly. Where bandwidth is closure as capital, echo is closure as liability.

Thus, network bandwidth serves as a positive driver for enhancing effectiveness of the value network (i.e., capital, not liability), given the invert-U impact of group social capital on such effectiveness. Put differently, network bandwidth is the capital
derived from closed network (e.g., the MNC’s value network), which should strengthen the legitimacy-seeking behavior of the organizational units of the MNC and then the effective configuration of the value network.

\[ H4(b): \text{The strategic choice of effective network configuration is mediated positively by the value growth path.} \]

Either linear or exponential value growth path will enhance the value delivery through effective configuration, though the contributions of these two paths differ in magnitude.

\[ H4(c): \text{The strategic choice of effective network configuration is mediated negatively by political ties to regional economic blocs.} \]

This hypothesis points out the downside that over-dependence on political allies in the regional economic bloc where the MNC have equity positions. Strong political ties with governments of the regional economic bloc may loosen the value enhancement behavior of the MNC’s organizational units. Political ties usually lead to mis-allocated efforts for value appropriation, instead of value creation (Morgan, 1986). Accordingly, disruptive cooperation constrained by cognitive architecture (Kahneman, 2003) could strengthen rent-seeking behavior of the firms within the same network (Chiu, 2007).

RESEARCH METHODS

Sample

The sample firms we analyzed have business activities in energy distribution or marine transportation, according to North American Industry Classification System (NAICS) Code developed jointly by U.S., Canada, and Mexico. This new industry classification system established in 1997 has replaced widely-used Standard Industrial Classification (SIC) Code launched by U.S. Census Bureau in 1987. The following codes are used to confirm the sample firm’s activities in energy distribution or marine transportation: (1) Code 486210 defined by transmission of natural gas via pipeline (i.e., processing plants to local distribution systems), (2) Code 486110 defined by crude oil pipeline transportation, (3) Code 483111 defined by deep sea freight transportation to or from foreign ports. In such cases that NAICS Code is not applicable for, we use SIC Code because there is corresponding relationship between these two systems (www.census.gov, 2007).
Our data sources include the following: *Compustat*, the Industry Intelligent Reports of *The Economist*, and *Wall Street Journal* Archives. We select a total sample of 385 firms from 24 countries in the time period from 1997 to 2006. *Compustat* Database helps us collects all firm-level data, while *The Economist* Reports contain industry-specific data. *Wall Street Journal* Archives provides us with all crucial industry- and corporate-events needed by this research.

This research first chose a cut-off point for assessing the sample firm’s degree of internationalization: The ratio of the firm’s foreign sales to its total sales must exceed 51%. Over one half of sales that are sensitive to international market and supply conditions should be critical enough to incorporate international factors into the firm’s value network worldwide. 236 firms in our initial sample set meet this sample selection criterion. Next, to select out modular MNCs from this refined sample set, we review the organizational charts and background data in Annual Reports. If one firm’s annual report was not available, we searcher for the firm’s website.

Some indicators may help clarify the modularity of the MNC’s organizational structure. To meet this modularity criteria, the sample firms ought to have at least one of the following characteristics (Baldwin & Clark, 2000; Galunic & Eisenhardt, 2001): (1) the existence of organizational modules, (2) the functioning of regional headquarters units or operational centers, (3) the documentation of loosely coupled simple rules for responding to environmental shift, (4) the statement of capabilities that can be quickly leveraged into other markets as opportunities change. 127 firms passed this modularity test. However, we could not gather data on some independent variables in 15 out of the 127 sample firms.

The final sample set is composed of 112 modular MNCs from 19 countries. The NAICS Code distribution of this final sample set is as follows: (1) the number of sample firms with Code 486210 or SIC equivalent is 36; (2) that of the firms with NAICS Code 486110 or SIC-equivalent is 43; (3) that of the firms with NAICS Code 483111 or SIC-equivalent is 64. In the sample set, 37 firms have businesses in two NAICS Codes, while 6 firms have businesses in three NAICS Codes. We further checked the relative sales of each NAICS Code of the firm, and then picked the largest relative sales to find out the main NAICS Code-based business activities. As an upshot, this sampling process ended up with 112 sample firms.

**Measurement**
**Dependent Variable:**

Network configuration choice. This variable is a limited dependent variable with value equal to 1 or 0. To be qualified as an effective configuration of the value network, the strategic choice made by the MNC should align strategy with organizational structure. If the choice is an effective configuration, this variable is assigned 1; otherwise, 0. As suggested by Newman and Girven (2003), the roles of modular networks are divided into six main categories: Kinless hub, connector hub, provincial hub, kinless non-hub, non-hub connector, and peripheral non-hub. To simplify our analysis, we contrast Type I network configuration (i.e., “kinless hub” which has both the highest Z and P in equations (2) and (3) shown above) with Type II one (i.e., “peripheral non-hub” which has both the lowest Z and P). Type I requires loose coordination among organizational modules for enhancing value; while type II entails tight coordination among modules.

Thus, this variable is assigned 1 if Type I is aligned with loose coordination (i.e., the number of reported events of intra-MNC coordination by the regional headquarters units) between different regional headquarters units (i.e., the centers of the organizational units in regional economic blocs); otherwise, this variable is assigned 0. By the same token, this variable is assigned 1 if Type II is aligned with tight coordination between all organizational units in regional economic blocs; otherwise, this variable is assigned 0.

**Independent Variables:**

Organizational modularity. This variable is measured by the participation coefficient (P) stated in equation (3), where P serves as a proxy for organizational modularity. P concerns the fraction of links of node $i$ in module $s$ (e.g., the relative importance of transshipment city or port in the delivery network), so it demonstrates the degree of organizational modularity.

Group social capital. This variable is measured by the cumulative number of social capital earned by the MNC and shared by the all organizational units of the MNC. Such corporate events as winning awards or recognitions from non-for-profit organizations worldwide ought to serve as a proxy for inflow of social capital.

**Mediators:**

Network bandwidth. This variable is measured by the within-module degree (Z) stated in equation (2), where Z measures network bandwidth (Burt, 2005). This measurement of network bandwidth is consistent with the modular system theory
(Schilling, 2000). In the world where modular products prevail, managing the centrality (Burt, 1992) of the product modularity network should be the core activities of the firm. Thus, the bandwidth required for an effective value network should be contingent on the within-module degree ($Z$).

**Value growth path.** This variable is measured by the time-series data of annual sales between 1997 and 2006. If there exists an exponential pattern of sales growth during this time period, this variable is assigned 1; otherwise, 0.

**Geo-political factor.** This variable is measured by the number of political ties with host-country governments in the regional economic bloc. Each reported events shown in *Wall Street Journal* Archives is counted one.

**Control Variables:**

**Firm sales (log).** This variable is measured as the average of the firm’s annual sales between 1997 and 2006. We take the log-transformation of this value to ensure the linearity of the data distribution.

**Return on assets.** This variable is measured as the average of annual return on net of all tangible assets acquired or disposed by the firm during the sampling time-period.

**Firm age.** This variable is measured as the number of years since the headquarters unit established its business operations in energy-distribution or marine transportation.

**Type of industry.** This variable is assigned 1 if the firm’s NAICS code shows its core business in energy-distribution industry; 0 if the firm’s in marine-transportation industry.

**Foreign/total sales.** This variable is measured as the ratio of the firm’s average annual foreign sales to its average of annual total sales during the sampling time-period.

**Analytical Tools**

We employ multi-nominal logit regression models (Greene, 2002) for examining the main effects and mediation effects on the strategic choice of the effective value network configuration. SPSS 16.0 software package is employed to performed
EMPIRICAL ANALYSIS. Add-on modules and stand-alone software from SPSS 16.0 offer
generalized linear models (GENLIN) in SPSS Advanced Models, linear mixed models,
also known as hierarchical linear models (HLM), in SPSS Advanced Models,
Multinomial logistic regression (MLR) in SPSS Regression Models, and inferential
statistics (i.e., Chi-square ($\chi^2$), Log-likelihood, Pseudo-$R^2$, pair-wise comparisons of
means) in SPSS Tables.

There are six models for serving this research purpose. Our major analytical
tools are HLM and MLR. To confirm robust estimation, we also used GENLIN to
check alternative modeling if random variables of the sample are not independently
and identically distributed (i.i.d.) (Greene, 2002). In Models 1, 2, and 4, the dependent
variable is network configuration choice. In Models 3(a), 3(b), and 3(c), three
mediators serve as the dependent variable, respectively. Because Model 2 and Model
3(b) contains non-linear independent variables (i.e., (Group social capital)$^2$ and $2 \cdot$
$\exp($Group social capital$)$, respectively), so we performed two extra non-linear
regression analyses: Nonlinear regression (NLR) and constrained nonlinear regression
(CNLR) in SPSS Regression Models.

EMPIRICAL RESULTS AND DISCUSSIONS
Analysis of Results

We present descriptive statistics and correlations of all variables in Table 1. The
normality test shows that firm sales entail variable transformation. To ensure the
linearity of sampling distribution, we chose log-transformation of firm sales, i.e., firm
sales (log). All coefficients are not correlated significantly. We examine several pairs
of variables drawn from our database, to test the reliability and validity of the sample.
For instance, return on equity is tested against internal rate of return. The Cronback $\alpha$
is 0.62, which ensures a reasonable level of reliability. Moreover, the squared root of
the Cronback $\alpha$ is 0.787, which indicates an acceptable level of validity (Kerlinger
and Lee, 1999). Durbin Watson statistics is 2.06, which indicates no serial correlation
(Greene, 2002). Overall, the quality of data is acceptable.

The analytical results are presented in Table 2. We did six sets of multi-nominal
logit regressions for testing what affects strategic choice of effective configuration of
the MNC’s value network. Network configuration choice is a limited dependent
variable, which is assumed to follow a logistical distribution (Greene, 2002). We
performed multinomial logistic regression (MLR) in SPSS Regression Models of
SPSS 16.0.
Model 1 fails the fitness test, as shown by $\chi^2$ value = 11.23 in Column 2 of Table 2. Nevertheless, the coefficient of organizational modularity is 6.25, which is statistically significant at the 1-percent level. That is, organizational modularity, along with control variables, accounts for the 11 percent of variation in network configuration choice, as shown in $R^2 = 0.11$. Accordingly, H1 is moderately supported by the results of Model 1.

In the third column of Table 2, results show that group social capital has an invert-U impact on network configuration choice. The coefficient of (group social capital)$^2$ (i.e., = - 3.67) is statistically significant at the 5-percent level. The model fitness is statistically significant at the 5-percent level, as shown in $\chi^2$ value = 27.39. $R^2 = 0.21$, which indicates a comparatively high level of explanatory power of Model 2. Thus, H2 is strongly supported by the results of Model 2. To ensure the coefficient estimates to be robust, we also performed GENLIN in SPSS Advanced Models. Nevertheless, the alternative modeling did not improve the results of our analytical efforts.

Results of Model 3(a) through Model 3(c) confirm or refute the roles of three mediators in this research. These mediators serve as strategic drivers for deploying group social capital. We hypothesize that strategic choice of effective configuration of the MNC’s value network depends mainly on group social capital, but such impact could be eliminated fully (or partially) if these mediators are controlled.

In the fourth column of Table 2, the coefficient of group social capital is 4.66, which is statistically significant at the 1-percent level. That is, as expected by H3(a), network bandwidth is correlated with group social capital. The explanatory power of Model 3(a) is reasonably good, as indicated by $R^2 = 0.16$; this model also passes the fitness test, as shown by $\chi^2$ value = 50.62.

In Column 5 of Table 2, the results just confirm H3(b) partially. The coefficient of $2^{\exp(\text{group social capital})}$ is 5.27, which is statistically significant at the 5-percent level. However, the coefficient of group social capital (i.e., = - 0.27) is not statistically significant, nor is the sign of this coefficient in the expected direction. Overall, group social capital affects value growth path positively in an exponentially fashion.

This model also passes the fitness test, as indicated by $\chi^2$ value = 32.86. Nevertheless, the explanatory power is relatively low (i.e., $R^2 = 0.09$). That is,
value growth path is correlated exponentially with group social capital. To ensure the coefficient estimates to be robust, we also performed GENLIN in SPSS Advanced Models. However, this model adjustment did not improve the results of our analytical efforts.

Model 3(c) fails the fitness test, as shown by $\chi^2$ value = 4.06 in the sixth column of Table 2. The explanatory power of the model is also absolutely low (i.e., Pseudo-$R^2$ = 0.03). Nor is the coefficient of group social capital statistically significant. Thus, results reject H3(c). The geo-political factor as measured by political ties to regional economic blocs is not correlated with group social capital in the statistical sense.

Finally, in the seventh column of Table 2, results generally confirm the mediating effects of the three mediators on the relationship between network configuration choice, organizational modularity, and group social capital. Model 4 passes the fitness test at the 1-percent level, as shown in $\chi^2$ value = 43.58. So is explanatory power relatively good (i.e., Pseudo-$R^2$ = 0.28). To check the mediation effects, we find out that the invert-U impact of group social capital disappears when there mediators enter the model step-wisely. In particular, the coefficient of network bandwidth (i.e., $= 12.23$) is statistically significant at the 1-percent level, while that of the geo-political factor (i.e., $= -1.53$) is statistically significant at the 10-percent level. That is, results strongly support the full mediation effect of strategic drivers for deploying group social capital, as specified in H4(a) and H4(c). However, value growth path does not mediate the relationship between group social capital and network configuration choice, which rejects H4(b).

**Discussions**

The unexpected finding comes from Model 3(b), where group social capital affects value growth path positively in an exponentially fashion only. We have hypothesized that by Metcalfe’s Law (Baldwin & Clark, 2000), value grows exponentially after the network scale reaches a critical mass. However, empirical evidence shows that prior to reach a critical mass, value growth path seems to be latent or undetermined. This research scenario is plausible because group social capital, which is intangible and latent in nature, defines the collective scale of the MNC’s value network. We measure group social capital by the cumulative number of social capital earned by the MNC and shared by the all organizational units of the MNC. Such corporate events as winning awards or recognitions from non-for-profit organizations worldwide ought to serve as a proxy for inflow of social capital. Overall, the accumulation of group social capital is time-consuming and path-dependent, so
group social capital does not take effect unless it reaches a recognizable level.

Next, our assessment of this full mediation effect could come mainly from two parts. First, the statistically significant negative effect of the geo-political factor deducts the positive part of the invert-U effect of group social capital. Second, the statistically significant positive effect of network bandwidth reduces the negative part of the invert-U effect of group social capital. In specific, reliance heavily on political ties to regional economic blocs could disturb the accumulation process of group social capital, due partly to unexpected disruption in the MNC-host country government relationship.

A high degree of network centrality helps tight coordination between the regional headquarters unit and organizational units in regional economic blocs, which could mitigate the negative impact of network closure – i.e., the “echo” (Burt, 2005). As a result, the invert-U impact of group social capital on network configuration choice disappears after the joint mediating roles played by network bandwidth and the geo-political factor.

If these trade-offs go the other way around, then the main effect of group social capital (i.e., \( \hat{b} = -2.14 \)) on network configuration choice should be strengthened, instead. However, we found out no theoretical justifications for this research scenario.

However, there still exists a puzzle for explaining the effect of the geo-political factor. As in the results of Model 3(c), group social capital is not correlated with the geo-political factor. Rather, we find out that geo-political factor mediates the relationship between group social capital and network configuration choice in Model 4. So, where is the mediation effect of geo-political factor come from? Let’s turn to Table 1: The correlation between firm age and the geo-political factor is 0.75, though this correlation is not statistically significant. Now move back to Model 4 of Table 2: The coefficient of firm age is –2.69, which is statistically significant at the 5-percent level.

Accordingly, we suspect that the mediation effect of the geo-political factor (i.e., \( \hat{b} = -1.53 \)) comes from its co-variation with firm age. An MNC’s reputation comes partly from its fulfillment of global social responsibility, supported by its administrative heritage (Bartlett & Ghoshal, 1989). To be perceived as well-regarded global corporate citizenship in the host country, a well-established foreign firm has plenty of resources and connections to overcome the liability of newness more easily.
than otherwise.

CONCLUSIONS

This research focuses on the direct effects of both organizational modularity and group social capital on strategic choice of effective configuration of the MNC’s value network. Also, we attempt to examine some important mediators on these direct effects, such as network bandwidth, value growth path, and political ties to regional economic blocs. We denote these mediators as strategic drivers for deploying the MNC’s group social capital. Organizational modularity affects the firm’s ability to obtain inter-temporal economies of scope (Helfat & Eisenhardt, 2004). When network grows in size, modules become modular clusters (Baldwin & Clark, 2000) that help manage networked relationships due to their flexibility for newly-conceived opportunities or threats.

Well-configured value networks could facilitate exchanges of valuable resources and value-added products with global trading partners. Changes in a firm’s core activities and assets could lead to the restructuring of its organizational architecture and foundations (Chesbrough, 2003; McGhan, 2004). In the world where modular products prevail, well-managing organizational modularity in the MNC’s global value networks should be the core activities. The capability for adapting the effectiveness of value networks could depend on such core activities (McGrath, 2004). The MNC’s value network is a large-scale complex network. We further suggest that these exists an optimal configuration of routines that allow an organization to achieve its goals (Nelson & Winter, 1982), such as accumulation of group social capital (Oh, Labianca, & Watts, 2006).

Our findings generally support four sets of hypotheses developed from these theoretical arguments. Organizational modularity, measured by the within-module degree of the value network, affects positively strategic choice of effective network configuration of the MNC’s value network. Group social capital also determines strategic choice of effective configuration of the MNC’s value network in an invert-U fashion. In addition, group social capital has positive impact on network bandwidth as expected; it also affects value growth path positively in an exponential fashion only. However, group social capital is not correlated with the geo-political factor. Finally, the relationship between strategic choice of effective network configuration and group social capital is mediated fully by both network bandwidth and the geo-political factor, though not by value growth path.
REFERENCES


Organizational modularity of the MNC

Group social capital of the MNC

Strategic drivers for deploying group social capital:
(a) Network bandwidth
(b) Value growth path
(c) Geo-political factor (i.e., political ties to regional economic blocs)

Note: * H4(a): + ; H4(b): + ; H4(c): −

Figure 1 The mediation model of organizational modularity, group social capital, and value network configuration of the MNC
<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>S.D.</th>
<th>1</th>
<th>2</th>
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<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
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<td>Value network</td>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Firm sales (log)</td>
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<tr>
<td>Return on assets</td>
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<td>0.83</td>
<td>.52</td>
<td>-.18</td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>Firm age</td>
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<td>50.66</td>
<td>.27*</td>
<td>-.35*</td>
<td>.15</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Type of industry</td>
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<td>0.57</td>
<td>-.21</td>
<td>-.49*</td>
<td>-.02</td>
<td>.27*</td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>Foreign/total sales</td>
<td>0.59</td>
<td>0.16</td>
<td>.54</td>
<td>-.63</td>
<td>.36**</td>
<td>.12</td>
<td>.03</td>
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<tr>
<td>Organizational modularity</td>
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<td>0.38</td>
<td>.63*</td>
<td>.12</td>
<td>-.09</td>
<td>-.41*</td>
<td>-.18*</td>
<td>.13</td>
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<td>Group social capital</td>
<td>4.53</td>
<td>6.20</td>
<td>.26*</td>
<td>.71</td>
<td>-.23*</td>
<td>-.63</td>
<td>.25*</td>
<td>.37</td>
<td>.46</td>
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<td>Network bandwidth</td>
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<td>-.51**</td>
<td>.36*</td>
<td>.42*</td>
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<td>.21*</td>
<td>.73</td>
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<td>Value growth path</td>
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<td>-.26</td>
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<td>.03</td>
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<td>Geo-political factor</td>
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<td>.75</td>
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<td>.09</td>
<td>.43*</td>
<td>-.32</td>
<td>.07</td>
<td>.41</td>
</tr>
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</table>

Note: N = 112;  * p<.05   ** p<.01
Table 2  The multinominal logit regression models for the choice of the effective value network configuration

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Model 1 Value network</th>
<th>Model 2 Value network</th>
<th>Model 3(a) Network bandwidth</th>
<th>Model 3(b) Value growth path</th>
<th>Model 3(c) Geo-political factor</th>
<th>Model 4 Value network</th>
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<td>Control variable</td>
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<td>Firm sales (ln)</td>
<td>1.31</td>
<td>4.88+</td>
<td>7.21**</td>
<td>4.31</td>
<td>5.27*</td>
<td>8.32**</td>
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<td>Return on assets</td>
<td>1.22</td>
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<td>2.32</td>
<td>6.91**</td>
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<td>1.98</td>
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<td>Firm age</td>
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<td>- 3.72+</td>
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<td>0.44</td>
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<td>Foreign/total sales</td>
<td>- 0.74</td>
<td>- 0.29</td>
<td>- 6.20**</td>
<td>- 1.85</td>
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<td>- 2.31+</td>
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<td>Organizational modularity</td>
<td>6.25**</td>
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<tr>
<td>Group social capital (Group social capital)^2</td>
<td>13.14</td>
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<td>4.66**</td>
<td>- 0.27</td>
<td>1.08</td>
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<td>2-exp(Group social capital)</td>
<td>- 3.67*</td>
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<td>Drivers for deployment</td>
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<td>Log-likelihood</td>
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<td>- 190.59</td>
<td>- 263.72</td>
<td>- 178.42</td>
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<td>Pseudo-$R^2$</td>
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<td>.16</td>
<td>0.09</td>
<td>0.03</td>
<td>0.28</td>
</tr>
<tr>
<td>$\chi^2$</td>
<td>11.23</td>
<td>27.39*</td>
<td>50.62**</td>
<td>32.86*</td>
<td>4.06</td>
<td>43.58**</td>
</tr>
</tbody>
</table>

Note: N = 112; + p<.1  * p<.05  ** p<.01