The dark side of trust in global value chains: Taiwan's electronics and IT hardware industries

Noemi Sinkovics
The University of Auckland Business School, NZ
noemi.sinkovics@auckland.ac.nz
https://www.sinkovics.com/noemi
http://orcid.org/0000-0002-5143-6870

Chia-Ling 'Eunice' Liu
National Taiwan University, Department of Business Administration, TW
euniceliu66@ntu.edu.tw
https://orcid.org/0000-0002-3250-2553

Rudolf R. Sinkovics
The University of Auckland Business School, NZ
rudolf.sinkovics@auckland.ac.nz
http://www.sinkovics.com/rudolf
http://orcid.org/0000-0002-4471-5054
and
LUT University, FI

Ram Mudambi
Fox School of Business, Temple University, US
Ram.Mudambi@temple.edu
http://www.fox.temple.edu/mcm_people/rammudambi/
http://orcid.org/0000-0002-5396-5602

Document version:
Author accepted manuscript (pre-print)

Citation for published version:
Sinkovics, Noemi, Chia-Ling Liu, Rudolf R. Sinkovics, and Ram Mudambi (2021), "The dark side of trust in global value chains: Taiwan's electronics and IT hardware industries," *Journal of World Business*, 56 (4), 101195. https://doi.org/10.1016/j.jwb.2021.101195

The dark side of trust in global value chains: Taiwan' s electronics and IT hardware industries

ABSTRACT

This paper contributes to theory building efforts around the concept of knowledge connectivity and its role in suppliers' new product innovation capability under different inter-firm knowledge pipeline conditions. We use the Taiwanese electronics and IT hardware industries as our study context, given Taiwan's phenomenal success story in entering global value chains (GVCs) in these industries. Our results demonstrate that different pipeline conditions in the form of combinations of the levels of inter-firm trust and supplier functional sophistication indeed shape the way knowledge connectivity is activated and how it impacts on suppliers' new product innovation capability and ultimately GVC status. Our results indicate that suppliers' new product innovation capability is larger under low inter-firm trust conditions. Suppliers in such low inter-firm trust relationships are also more likely to use the ensuing increase in their GVC status to pursue new, better paying buyers than their counterparts in high inter-firm trust relationships. As a consequence, if multinational buyer firms in low trust relationships would like to benefit more from their suppliers' enhanced innovation capabilities, they may need to strengthen their supplier relations using modalities other than trust.

Keywords**:** global value chains; knowledge connectivity; new product innovation capability; upgrading; Taiwan

1 Introduction

This paper investigates the role of knowledge connectivity in suppliers' new product innovation capability under different inter-firm knowledge pipeline conditions. Knowledge connectivity can be defined as "continuous two-way interactions in knowledge development" as opposed to one-off, sporadic knowledge transfer (Cano-Kollmann, Cantwell, Hannigan, Mudambi, & Song, 2016: 255). In other words, it constitutes the communication and interaction mechanisms between two parties that facilitate the flow of tacit knowledge in addition to codified knowledge (Sinkovics, Choksy, Sinkovics, & Mudambi, 2019). From a theoretical perspective, the concept of knowledge connectivity is increasingly important in international business (IB) research as scholars direct their focus to the shifting boundaries of multinational enterprises (MNE). Specifically, the recognition about the increasing disaggregation of global value chains (GVCs) places knowledge connectivity and the contribution of suppliers at the center of investigations (Cano-Kollmann et al., 2016; Sinkovics et al., 2019; Sinkovics, Hoque, & Sinkovics, 2018a).

One of the key advantages of GVC organization is the distributed approach to innovation that is based on knowledge connectivity amongst the constituent firms (Gereffi, Humphrey, & Sturgeon, 2005). Hence, firms' capabilities are enhanced through the integration of their own R&D efforts with knowledge transfers from other firms. Scholars have established that GVCs are organized hierarchically and that distribution of the value created is strongly related to firms' position or 'status' (Dedrick, Kraemer, & Linden, 2010). In this paper, we posit that firms' knowledge connectivity enhances their hierarchical status within the GVC. We model the mechanism through which this occurs in the context of local suppliers' relationships with GVC orchestrating multinational enterprises (MNEs). In particular, we argue that connectivity improves knowledge acquisition and integration that in turn improves the firm's new product innovation capability – which is the objective, observable metric that accords them a status in a GVC.

We theorize that the modeled mechanism linking knowledge connectivity to GVC status is subject to two fundamental contingencies – inter-firm trust (Sako, 1996) and suppliers' functional sophistication (Primo & Amundson, 2002). Jointly evaluating these two contingencies generates four relationship configurations for empirical analysis corresponding to high and low trust on the one hand and high and low functional sophistication on the other. We hypothesize that the mechanism linking knowledge connectivity to new product innovation capability varies systematically across these four configurations.

In this paper we argue that different combinations of the extent of suppliers' functional sophistication and the degree of inter-firm trust shape the way knowledge connectivity will impact suppliers' new product innovation capability and thus GVC status. Suppliers' functional sophistication is likely to affect their ability to leverage knowledge connectivity in new product innovation. Concurrently, inter-firm trust is likely to affect suppliers' perceived risks regarding the cooperation of their MNE partner in translating knowledge connectivity into improved new product innovation capability (Choksy, Sinkovics, & Sinkovics, 2017; Ponte & Ewert, 2009; Sinkovics et al., 2018a).

Thus, inter-firm trust has two opposing effects on suppliers' incentives to invest in knowledge connectivity. On the one hand, low inter-firm trust can incent the supplier to reduce its risk by cutting back on their expenses associated with the relationship, like those on knowledge connectivity. On the other hand, it can incent the supplier to lower its risks by increasing the value of the relationship to its MNE client by increasing its investments in knowledge connectivity. We find that supplier investments in knowledge connectivity to be higher in configurations involving low inter-firm trust, a finding that is at odds with much of the literature on inter-firm trust (Sako, 1996).

We choose the Taiwanese electronics and IT hardware industries as our study context because their innovation efforts over the past three to four decades occurred within GVCs wherein local suppliers worked with orchestrating MNEs (Saxenian, 2002; Saxenian & Hsu, 2001). Further, results of relevant research in this context have been mixed. These studies employ constructs that – at least partially – capture the essence of knowledge connectivity, such as customer participation (e.g. Chang & Taylor, 2016), relationship learning (e.g. Jean, Kim, & Sinkovics, 2012), joint learning (e.g. Jean, Chiou, & Sinkovics, 2016), interactive learning (e.g. Huang & Chu, 2010), and relational governance (Roath & Sinkovics, 2006; Zhang, Cavusgil, & Roath, 2003). For example, while Jean et al. (2012) and Jean et al. (2016) find support for the positive relationship between knowledge connectivity and supplier innovation in the Taiwanese electronics industry, Lin and Huang (2013) find a negative relationship. Similarly, Chang and Taylor's (2016) meta-analysis shows no significant relationship between customer participation in the idea generation and product development stages and new product innovativeness.

The structure of the paper is as follows. The next section will introduce the conceptual background and hypotheses. This is followed by the methods section describing the research design and the study context. After presenting the outcomes of the analysis in the results section, we will discuss the findings and outline the main contributions and avenues for future research. We will conclude the paper by detailing the managerial implications of the study as well as its limitations.

2 Conceptual background

In this section, we first introduce the general research model (see Figure 1). We seek to contribute to the theory of upgrading within GVCs. We do so by introducing the knowledge connectivity concept into the generic GVC framework. We begin by developing a model linking knowledge connectivity to GVC status that operates by activating the firm's knowledge processes[1] and linking it to new product innovation capability that is the foundational basis for GVC status. The firm's knowledge process model includes the well-known components of knowledge acquisition and knowledge integration. Our first major theoretical contribution is to root both of these knowledge process components in knowledge connectivity with the GVC orchestrating MNE (see Figure 1).

Our second major theoretical contribution is to nest and analyze the model of the supplier firm's GVC status development within its external and internal operational context. The external context is summarized by the extent of trust between the focal supplier firm and the MNE orchestrator. The internal context is summarized by focal supplier firm's functional sophistication. Amalgamating the external and internal contexts produces a general model of four relationship configurations (see Figure 2). Our theoretical analysis investigates the path changes in the general model in these four relationship configurations. In so doing, we generate more nuanced insights into the role of knowledge connectivity in suppliers' new product innovation capability under different contextual conditions.

---

[1] We use the term "activating" to specify the path through which knowledge connectivity affects new product innovation capability.

2.1 The general model of new product innovation capability

New product innovation capability has long been recognized to be dependent on the firm's knowledge stocks (Menguc, Auh, & Yannopoulos, 2014). Over the last few decades, the external markets for knowledge have grown increasingly sophisticated. This has led firms to rely more on external sources for knowledge that would be expensive for them to produce in house (Dunlap, McDonough III, Mudambi, & Swift, 2016). GVCs are a particularly relevant context within which the participating firms' knowledge processes become co-dependent. We therefore incorporate knowledge connectivity as a crucial antecedent construct to those of knowledge acquisition and knowledge integration that have been recognized in the extant literature (Cassiman & Veugelers, 2006; Veugelers, 1997).

Insert Figure 1 about here

Given the government's long-term investment in creating and developing Taiwan's high-tech industry, including incentives for supplier firms to learn and upgrade their technologies and capabilities, managers easily recognize the value of, and the need for, learning from their MNE buyers (Jean et al., 2016). This forms the core of the knowledge connectivity construct of our model. In the GVC context, the knowledge acquisition construct in our model focuses on the content of the knowledge exchange between the supplier and the MNE orchestrator and includes items such as R&D expertise, manufacturing processes, and managerial practices. Knowledge integration is defined as the assimilation and transformation processes that allow the firm-wide diffusion of the acquired knowledge, as well as its combination with existing experiences and with knowledge from other sources (cf. Cuervo-Cazurra & Rui, 2017; Nevis, DiBella, & Gould, 1995; Sinkovics et al., 2018a).

The firm's knowledge processes summarized by the inter-linked functioning of the constructs of connectivity, acquisition and integration form the antecedent foundation of the construct of new product innovation capability. We define it as a firm's ability to recognize opportunities in the market and rapidly translate them into improved or new product offerings (cf. Shane, 2007).

The model culminates with the concept of GVC status. While the firm's new product innovation capability arguably could be an outcome concept in itself, empirical evidence suggests that without the promise of a competitive advantage resulting from upgrading their innovation capabilities, suppliers are not likely to take the risks associated with such an investment (cf. Choksy et al., 2017; Ponte & Ewert, 2009). As documented in the GVC literature, a higher status within this context is associated with increased financial returns (Dedrick et al., 2010; Mudambi, 2008).

We argue that leveraging the knowledge connectivity concept can provide additional insights. Specifically, we propose that both theoretically and practically, it makes a difference whether knowledge connectivity contributes to suppliers' new product innovation capability via knowledge acquisition or knowledge integration. This difference conceptually manifests itself in whether the additional knowledge development occurs during the knowledge transfer process from buyer to supplier, or during the knowledge leveraging/integration process.

2.1.1 Knowledge connectivity and knowledge acquisition

In our model, the link between knowledge connectivity and knowledge acquisition represents the extent of knowledge development during the knowledge transfer process. Frequent communication and face-to-face interactions have been shown to facilitate learning outcomes in both a classroom setting (Kunin, Julliard, & Rodriguez, 2014) and in the context of supplier learning (Nobeoka, Dyer, & Madhok, 2002). However, the scope of knowledge development during the transfer process will depend on the extent to which the buyer who is transferring the knowledge encourages feedback and interactive learning. When suppliers are free to share observations and question current processes, the ensuing insights may lead to changes that are beneficial for process and/or product innovation (Argyris, 1976; Argyris & Schön, 2003; Williams & Kumar, 2014).

In particular, if the employees from supplier firms are encouraged to challenge the transmitted knowledge while or after it is transmitted, or ask for clarifications or discuss their observations and ideas, this can lead to beneficial learning outcomes for both parties (cf. Williams & Kumar, 2014). It can be expected that if a supplier has the ability to recognize and articulate the areas that could be improved, it will enhance the scope of their acquired knowledge, regardless of the buyer's encouragement to openly share these realizations. Nobeoka et al. (2002) distinguish between relationship specific knowledge and re-deployable knowledge. In short, we argue that if a supplier is engaged in the learning process, they will be able to extract and leverage more re-deployable knowledge from the relationship.

2.1.2 Knowledge connectivity and knowledge integration

The link between knowledge connectivity and knowledge integration represents the process of value co-creation between the buyer and the supplier (cf. Sinkovics, Kuivalainen, & Roath, 2018b). It is different from the link between knowledge connectivity and knowledge acquisition. With knowledge integration, the purpose of the knowledge sharing is not to teach the partner something that they did not know before. Although knowledge acquisition will occur as a by-product, the main purpose of this link is to integrate and combine complementary resources and capabilities to create something more than the two parties could have accomplished independently (Zhang, Jiang, Shabbir, & Du, 2015). In other words, the objective is to integrate the knowledge that arises in this context with the extant knowledge bases of both the cooperating parties.

As a consequence, the emphasis is on achieving synergies between the two parties' respective repositories of accumulated previous learning, ideas, and creativity (cf. Ranjan & Read, 2016). For this reason, the supplier firm's new product innovation capability will ensue directly from the joint leveraging of existing knowledge that is embedded in organizational processes, capabilities and individuals.

2.1.3 Shaping the effect of knowledge connectivity

To sum up the main arguments from the two previous sections, we posit that knowledge connectivity can impact suppliers' new product innovation capability through two routes. We use the term "activation" to specify that a particular route is "switched on". If knowledge connectivity is activated in the knowledge acquisition process (teaching metaphor), any additional knowledge development, on top of the initially intended knowledge transfer from the MNE buyer to the supplier, will depend on the ability of the supplier firm to identify ways to make its own improvements to it (Sato & Fujita, 2009). The ensuing knowledge development is reactive and more or less incidental.

If, however, the effect of knowledge connectivity on suppliers' new product innovation capability is activated directly via the knowledge integration link, the ensuing knowledge development is the product of co-creation between the buyer and the supplier. In this case the knowledge development is proactive and deliberate. In contrast to the link between knowledge connectivity and knowledge acquisition (that we likened to a teaching setting), the link between knowledge connectivity and knowledge integration is more comparable to a research setting.

However, both knowledge links are influenced by two organizational contingencies; namely, the internal context summarized by the level of the supplier's functional sophistication and the external context based on the extent of inter-firm trust (cf. Sako, 1998). Functional sophistication can be defined as the width of functional areas in which a supplier has at least a basic level of capability (Fujita, 2011; Sato & Fujita, 2009). For instance, a supplier firm that mainly focuses on production related activities is likely to have less functional sophistication than one that additionally performs functions related to product design including research and development (R&D). In turn, a supplier firm that extends their functional range to include branding and distribution activities is likely to have even greater sophisticated capabilities. Based on the reasoning of Alcacer and Oxley (2014), greater functional sophistication is likely to be associated with a wider the range of functional capabilities of a supplier, irrespective of the depth of those capabilities (cf. Fujita, 2011; Sato & Fujita, 2009), the greater the extent of its functional sophistication. In turn, the greater a supplier's functional sophistication the more knowledge it is able to absorb and leverage.

An important additional factor that influences the extent and nature of knowledge transfer between buyers and suppliers is trust. Cuervo-Cazurra and Rui (2017) suggest that a lack of trust with respect to how the imparted knowledge will be used by the recipient will limit the extent of the knowledge transfer or hinder it altogether. Alternatively, if competitive conditions force the buyer to transfer knowledge despite their low level of trust, it can be expected that they will apply measures to keep it from being used in an undesired manner (cf. Takeishi, 2002). Sako (1992, 1998) differentiates between three types of trust. Contractual trust refers to whether the other party carries out its contractual agreements. Competence trust is about whether the other party is capable of carrying out what they promised to carry out. The third type of trust is goodwill trust that can only exist if there is an "open ended commitment to take initiatives for mutual benefit and refraining from unfair advantage taking" (Sako, 1998). In our study, we use the concept of goodwill trust. Whether such trust is an antecedent or an outcome of knowledge connectivity will partially depend on whether it is viewed by the MNE buyer as "a determinant of 'governance structure' or as a governance structure in itself" (cf. Jean, Sinkovics, & Kim, 2010; Sako, 1998: 90; Zhang et al., 2003). Yet, our purpose here is not to establish causality. Rather, we aim to examine the influence of the knowledge connectivity construct under different relationship conditions with regard to functional sophistication and trust. To this end, the next section presents our hypotheses.

3 Hypothesis development

New product innovation capability (NPIC) is the main outcome or dependent variable in our model while GVC status (GVCS) is a consequent dependent variable. This is because the only path to GVCS is through NPIC. We expect the relationship between NPIC and GVCS to be positive in all scenarios, so this baseline relationship is not hypothesized, though it will be estimated in the following empirical analysis.

Figure 2 offers a graphical representation of how we expect the paths in the main model to behave across four scenarios (A, B, C, D in Figure 2). Specifically, whether the impact of knowledge connectivity (KC) is activated via the link to knowledge acquisition (KA) or knowledge integration (KI). Four pipeline scenarios arise by embedding the model within the dimensions of trust and functional sophistication, both of which can be high or low (see Figure 2).

The bold arrows indicate expected significant paths, while the dotted arrows designate expected non-significant paths. In the remainder of this section, we will include construct abbreviations in brackets to make the link between the relationships in the model and the hypothesis development clearer for the reader (see abbreviations in Figure 2).

Insert Figure 2 here

In scenarios A and B, when a supplier has a lower level of functional sophistication, its knowledge connectivity (KC) with the MNE buyer is likely to activate knowledge acquisition (KA) in both low and high trust contexts. In other words, the relationship is likely to be hierarchical, with the MNE supplier as the “teacher”. This KC-KA path serves as the basis on which the supplier’s knowledge integration (KI) occurs. The low functional sophistication of the supplier means that the emphasis is on learning and leveraging the obtained knowledge (more of a “teaching” function) rather than on value co-creation. This militates against the direct path (KC-KI).

However, the two trust contexts differ in terms of the manner in which the MNE buyer handles the knowledge connectivity to knowledge acquisition (KC-KA) path. Low trust (scenario A) implies that the MNE buyer is likely to partition the knowledge it shares with the supplier to limit the extent to which it can be redeployed in other contexts (Zhao, 2006). The supplier’s low functional sophistication has two logical implications. First, the supplier’s capabilities limit the knowledge shared by the MNE buyer to items of lesser value. Second, the MNE buyer has few concerns that the supplier will move up the value chain and become a future competitor. Both these implications mitigate MNE concerns regarding knowledge sharing with the local supplier in spite of the absence of trust.

Nonetheless, the knowledge acquired by the supplier from the MNE is likely to be context-specific and to increase its ability to integrate its innovation efforts with MNE buyer. This supports the path (KA-KI). Both the supplier's newly acquired knowledge as well as its integrated innovation efforts with its buyer are likely to positively impact its new product innovation capability (cf. Nobeoka et al., 2002). However, our arguments suggest that the (KA-NPIC) path is likely to be stronger than the (KI-NPIC) path.

In the high trust context (scenario B) we expect MNE buyers will be more willing to share re-deployable knowledge in addition to relationship specific knowledge (Charterina et al., 2018). Furthermore, when inter-firm trust is high, suppliers will be less constrained in disseminating and leveraging the obtained knowledge through internal mechanisms. This is likely to manifest itself through a similarly strong effect from both knowledge acquisition (KA) and knowledge integration (KI) on their new product innovation capability (NPIC).

Hypothesis 1a: In MNE buyers' low trust relations with local suppliers whose functional sophistication is low, knowledge acquisition is the more significant path to suppliers' new product innovation capability.

Hypothesis 1b: In MNE buyers' high trust relations with local suppliers whose functional sophistication is low, both knowledge acquisition and knowledge integration are equally significant paths to suppliers' new product innovation capability.

In the high functional sophistication category in which suppliers have a wide range of capabilities, the importance of inter-firm trust is even higher as these suppliers may pose a competitive threat to lead firms (cf. Alcacer & Oxley, 2014; Cantwell, 2017). Our expectation is that, in a low inter-firm trust context (scenario C in Figure 2), lead firms will be very careful about what information they share, as well as with whom within the supplier firm they share it.

Knowledge protection mechanisms like these can be expected to hamper the dissemination and leveraging of the acquired knowledge within the supplier organization. In other words, while the acquired knowledge may exist in the heads of specific individuals, they may not be permitted to share it with other employees (KA-KI). They will only be able to apply this knowledge in projects with that specific MNE buyer. As a consequence, we expect their new product innovation capability to stem solely from relationship specific knowledge manifesting as a positive and significant relationship between knowledge acquisition and new product innovation capability (KA-NPIC). The relationship between knowledge integration and new product innovation capability (KI-NPIC) will not be significant.

In scenario D, in which suppliers' functional sophistication is high and the level of inter-firm trust is also high, we expect the impact of knowledge connectivity to be activated directly via knowledge integration in the form of value co-creation (cf. Ballantyne & Varey, 2008; Jean, Kim, Chiou, & Calantone, 2018; Sinkovics et al., 2018b). While additional knowledge acquisition can be expected to occur as a by-product of the value co-creation process, we do not expect the link between knowledge acquisition and new product innovation capability (KA-NPIC) to be significant.

Hypothesis 2a: *In MNE buyers' low trust relations with local suppliers whose functional sophistication is high, knowledge acquisition is the only significant path to suppliers' new product innovation capability.*

Hypothesis 2b: In MNE buyers' high trust relations with local suppliers whose functional sophistication is high, knowledge integration is the only significant path to suppliers' new product innovation capability.

Finally, we compare the outcomes of the two different trust contexts (scenarios A vs. B and C vs. D in Figure 2), i.e., the high inter-firm trust context vs. the low inter-firm trust context. Evidence from previous studies suggests that greater trust is associated with a higher degree of product innovation performance (cf. Charterina et al., 2018; Nardelli & Broumels, 2018) and joint learning (Jean et al., 2012) regardless of whether the supplier’s functional sophistication is high or low. In our model, this appears as in a quantitative form, i.e., knowledge connectivity leads to stronger paths knowledge acquisition and knowledge integration and consequent paths to new product innovation capability. This suggests that suppliers working in high trust relationships with MNE buyers would benefit more in terms of new product innovation capability. These arguments imply the following hypothesis:

> *Hypothesis 3a: Suppliers that are in a high trust relationship with their MNE partners will benefit more from knowledge connectivity in terms of new product innovation capability than their counterparts in a low trust inter-firm relationship.*

However, there may also be a dark side to high trust. When inter-firm trust is high, suppliers may rely more on their lead-firm partners for problem solving than they do when inter-firm trust is low (cf. Lin & Huang, 2013). Secondly, in order to maintain a good relationship, they may be reluctant to engage in constructive conflict (cf. Yang et al., 2017) which is key for effective learning (cf. Williams & Kumar, 2014). Thirdly, the maintenance of trust requires investments of time and resources and these may be diverted away from the actual innovation process (Molina-Morales, Martinez-Fernandez, & Torlo, 2011). Gathering these arguments together, leads to a competing hypothesis:

> *Hypothesis 3b: Suppliers that are in a high trust relationship with their MNE partners will benefit less from knowledge connectivity in terms of new product innovation capability than their counterparts in a low trust inter-firm relationship.*

The horse race between Hypotheses 3a and 3b must be decided empirically.

4 Methods

4.1 Study context

As stated in the introduction, our study context is the Taiwanese electronics and IT hardware industries. Our focus is on hardware products and components, including communication products, systems, peripherals, cards and boards, and semiconductors. This context is particularly suitable for studying the role of knowledge connectivity in supplier new product innovation capability for two reasons. First, the Taiwanese industry arose through a conscious government-facilitated process of connectivity, mainly with Silicon Valley in California, USA (Saxenian & Hsu, 2001). Second, because this industry represents a phenomenal upgrading story in the global electronics value chain. For example, by 2008 92% of worldwide shipments of notebook PCs were being produced by Taiwanese manufacturers (Kawakami, 2011). Similarly, Taiwan's semiconductor sector occupies a prominent position in the global industry (Lu & Hung, 2010).

Pietrobelli and Rabellotti (2011) demonstrate how the state of a country's national innovation system can support or hinder supplier upgrading. The government's investments into the Taiwanese innovation system created an inviting environment for lead firms' outsourcing activities ranging from strategic to transformational global sourcing (cf. Jensen & Petersen, 2013). As a consequence, this context offers a selection of pipeline conditions that allow us to make comparisons of how our concept of interest, namely knowledge connectivity, shapes suppliers' ability to enhance their product innovation capabilities.

4.2 Research design

In the first stage, we carried out several preliminary on-site interviews. We applied a theoretical sampling method to identify firms that fit our four scenarios. Furthermore, we looked at the size of the firm and its experience in the chain. A large firm will generally have more experience, contribute to different projects, possibly act as lead firm in the chain and thus exhibit in-house expertise, providing in-depth information for our study. Five companies in the Top 500 manufacturing list agreed to take part in the case interviews after we made several enquiries through high-level entry points (Director or Vice President with more than ten years of experience). The objective of the case interviews in our research was to aid the theorizing and hypotheses development process (cf. Alvesson & Karreman, 2007; Teddie & Tashakkori, 2009) as well as to ensure that the constructs in our survey instrument are appropriately operationalized (cf. van Teijlingen & Hundley, 2002). In Appendix 1, we provide quotes for each scenario that further strengthened our theoretical reasoning outlined in the hypothesis development section.

4.2.1 Population and unit of analysis

Three criteria were used to define the population of our research. First, our unit of analysis was defined as cooperative relationships between local Taiwanese manufacturing suppliers and their international MNE partners. Second, the selected firms were taken from the electronics/IT manufacturing GVC. Third, the Taiwanese GVC partners in our research needed to exhibit strong relational structures and connectivity, supporting the flow of resources between these firms (Cano-Kollmann et al., 2016; Parkhe, 1991). According to the definition of the Ministry of Economic Affairs (MOEA) in Taiwan, the IT GVC includes the following component manufacturers: card/board, communication products, components, peripherals, systems, software and information services, and semiconductors. Since software and services companies in Taiwan primarily engage in domestic clusters and are not directly connected with MNE partners, such companies were excluded from the sampling frame. The final population included 935 firms.

4.2.2 Sampling frame and data collection

Our sampling frame was chosen from several sources, including the Taiwan Computer Association, the Taiwan Electronics and Appliance Manufacturers Associates, and the Top 1000 Taiwanese Manufacturing Firms in the database of the China Credit Information Service (CCIS). The following three criteria were used to select firms from these databases: (1) capital of more than US$3 million, (2) ongoing relationships with their MNE partners, and (3) belonging to the electronics/IT manufacturing GVC. Most of the sample firms were large Taiwanese IT firms with varying degrees of experience of international relationships. We verified these sample firms using secondary data to confirm that these relationships were still active and met the criteria of our survey. We also tried to obtain contact information for potential informants to clarify the importance and purpose of our study through several phone calls. In the end, a total of 609 firms were identified and included in the final sample.

We developed our questionnaire based on previous literature further informed by the preliminary interviews. We also conducted pilot tests with senior managers who had extensive experience of working with MNE partners in the sector. After the pilot tests, the wording and format of the questionnaire items were modified to avoid misunderstandings. All the items were initially developed in English and translated into Chinese. We applied back translation to ensure concept equivalence (Salzberger & Sinkovics, 2006). Following the tailored design method of Dillman, Smyth, and Leah (2014), we sent out our questionnaires in both paper and digital formats, accompanied by a cover letter highlighting the contemporary relevance of the research to encourage responses. For firms with multiple MNE relationships, respondents were asked to complete the survey by thinking of their strategically most important project. Senior managers in charge of relationship management were selected as key informants in our study. Most of the respondents were top executives (i.e. CEOs, general managers, presidents, vice presidents, directors or senior managers) and the rest were functional or project managers.

4.2.3 Respondents and firm profiles

In order to increase the response rate, we sent reminders to those companies that had not yet returned their questionnaires two weeks after the first mailing. Following this, the total number of questionnaires received was 183. We removed 23 questionnaires which were insufficiently completed, leaving 160 effective responses. The effective response rate (26.27%) was considered adequate, given that many firms are not allowed to disclose partner information (Hitt, Dacin, Levitas, Arregle, & Borza, 2000).

The completed questionnaires were returned to us by post (60.7%) and e-mail (39.3%). This could cause some concern over method bias. Therefore, we ran t-tests for some variables, such as number of employees, firm age, and revenue. No significant differences emerged for these variables between the post and e-mail groups. Additional t-tests between these two groups were conducted on four of the main constructs. The results again showed no significant differences.

Insert Table 1 about here

The sample firms represented six major segments of the electronics/IT manufacturing GVC: communication products (15.8%), systems (18.3%), peripherals (19.3%), card/board

(13.2%), semiconductors (16.2%) and components (17.2%). In terms of relationship duration, more than 28% of the companies had collaborated with their partners for more than five years and some firms for more than ten. More than 43.8% of the responding firms reported annual sales volumes of more than US$15 million. More than 65% of the firms had more than 500 employees. In our sample of 160 firms, 125 firms reported that they not only manufactured but also designed products for their MNE partners, which suggested that fine slicing of the value chain and geographic separation from their MNE partners had not limited their innovation capabilities, but indeed been beneficial and facilitated their upgrading from OEM to ODM (Chen & Xue, 2010). Quite a few of the Taiwanese suppliers in our sample have already strengthened their design capabilities for their MNE buyers. In addition to manufacturing or designing products for them, 84 of the sample firms have also started to develop products with their own brand, thus qualifying as OBMs.

4.2.4 Measures

The main dependent variable is new product innovation capability (NPIC). It was measured via three items: (1) capability in product differentiation (adapted from Knudsen, 2007), (2) speed of introducing new products (taken from Subramaniam & Venkatraman, 2001), and (3) capability for perceiving new technological developments/market trends (Thomas, 1993).

A consequent dependent variable is GVC status enhancement (GVCS), as the only path to it in our model specification is through NPIC. This measure was adapted from previous studies by Saxton (1997) and Ritter and Gemünden (2003). The four-item scale included better opportunities for forming relationships with prominent global partners, strengthening bargaining power with MNE partners, the penetration of important growth markets, and the enhancement of the firm’s reputation in the value chain.

Knowledge acquisition (KA) was measured using four scales adapted from Lyles and Salk (1996) and Norman (2004). The scales captured different aspects of knowledge acquired from the MNE partner: (1) expertise in R&D, (2) new product development, (3) knowledge related to the manufacturing process, and (4) managerial practices.

The measurement items used to capture knowledge integration (KI) were drawn from Gold, Malhotra, and Segars (2001), Crossan, Lane, and White (1999); Pak, Ra, and Park (2009).

The measures for the knowledge connectivity construct (KC) were based on items from Inkpen (1996) and Subramaniam and Venkatraman (2001). The four-item scale consisted of interactions by means of on-site visits and face-to-face communication, technology sharing, joint new product design, and joint problem solving.

Original equipment manufacturers (OEM) mainly focus on production related activities. Original design manufacturers (ODM) additionally perform functions related to product design including research and development (R&D). Original brand manufacturers (OBM) extend their functional range to include branding and distribution activities. Operationally, if a supplier in our sample has OEM status plus ODM status, we place it into the “low” functional sophistication category. If, on the other hand, a supplier holds OBM status or both ODM and OBM status in addition to their OEM status, we place them into the “high” functional sophistication category.

Lastly, we measured inter-firm trust with a construct comprising of five measurement items adapted from Cullen, Johnson, and Sakano (2000); Inkpen (2000); Smith and Barclay (1997): (1) the existence of a good faith relationship with the partner, (2) the existence of a good understanding between the partners, (3) the feeling of the supplier of never having been misled by the partner, (4) the trustworthiness of the partner and its employees, (5) the ability of the supplier to foresee how the partner will behave. We calculated the aggregated mean value of the construct and categorized firms as low versus high inter-firm trust accordingly.

5 Analysis

5.1 Data analysis process

We used the partial least squares structural equation modeling (PLS-SEM) method and the statistical software SmartPLS3 (Ringle, Wende, & Becker, 2015) to estimate the model and conduct multi-group analysis (MGA). PLS is a composite-based approach to SEM that relaxes the strong assumption that a common factor explains all the covariation between a block of indicators. The method imposes no restrictions on the covariances between the same construct indicators but instead forms composites as linear combinations of their respective indicators. These linear combinations then serve as proxies for the conceptual variables under investigation (Henseler et al., 2014; Schlägel & Sarstedt, 2016). Researchers have argued that modeling constructs as composites is a more realistic approach to measurement, since it explicitly considers the proxy nature of construct measures (Henseler et al., 2014; Rigdon, 2012; Sarstedt, Hair, Ringle, Thiele, & Gudergan, 2016). Furthermore, PLS-SEM is ideally suited to being used in situations where the goal is theory development, or predicting target constructs, and it supports the carrying out of MGA (Henseler, Ringle, & Sinkovics, 2009; Richter, Sinkovics, Ringle, & Schlägel, 2016).

With previous studies having identified a sampling threshold for PLS-SEM in the order of 100 observations, the current sample size of 160 (full sample) would generally be seen as adequate for PLS-SEM (Reinartz, Haenlein, & Henseler, 2009). We employed an MGA by examining combinations of functional sophistication (low/high) and trust (low/high), which resulted in relatively homogeneous subgroup sizes of 33, 43, 46 and 38. We reverted to the restrictive minimum sample size recommendations based on a statistical power of 80% (Hair, Hult, Ringle, & Sarstedt, 2017, p.26). With the maximum number of arrows pointing at a construct (i.e. the number of independent variables) being two, a significance level of 5% and a minimum R^2 of 0.25, all of the subgroups in the study satisfied the acceptable sample size of 33.

5.2 Measurement model evaluation

Assessment of the reflective measurement model entails the evaluation of its reliability and validity with respect to the latent variables (LVs) (Chin, 1998; Hair, Sarstedt, Ringle, & Mena, 2012). *Internal consistency reliability:* The assessment of the internal reliability yielded Cronbach's alpha values of above 0.7 (ranging from 0.796 to 0.938) for the full model and all the subgroups, suggesting a high level of internal reliability (Fornell & Larcker, 1981). With Cronbach's alpha being considered the lower bound and the composite reliability (CR) the upper bound of the true internal consistency reliability, ranging from 0.871 to 0.954, the composite measurement items exhibited sufficient reliability (Hair et al., 2017).

Convergent validity: Except for five items in model D (functional sophistication high and trust high), which were slightly below 0.7, all items exhibited absolute standardized first-order outer loadings above the critical value of 0.7 (Fornell & Larcker, 1981). However, with a minimum cut-off criterion of 0.5 (Henseler et al., 2009), high CR for all the reflective latent variables, and average variance extracted (AVE) for all the latent constructs – for the full sample and all subsamples – beyond the threshold of 0.5, convergent validity was established (see Table 2).

Discriminant validity is the extent to which each latent variable is distinct from other constructs in the model (Chin, 2010; Hair et al., 2017) and this was successfully assessed in two ways. First, we employed the Fornell-Larcker criterion, which compares the square root of the

AVE of each latent variable with the cross-loadings. A square root of AVE higher than the cross-loadings confirms the discriminant validity of the construct in question (Fornell & Larcker, 1981; Hair, Black, Babin, & Anderson, 2014). Second, we analyzed the heterotrait-monotrait (HTMT) ratio of the correlations. This method has recently been established as a superior criterion to that of Fornell-Larcker (Henseler, Ringle, & Sarstedt, 2015) and we used the conservative 0.85 (i.e. $\text{HTMT}_{.85}$) threshold to establish that all results were below the critical value. We furthermore computed 95% bias-corrected and accelerated confidence intervals from 5000 bootstrap samples to check whether the HTMT values were significantly different from 1 (Hair et al., 2017). Neither of the confidence intervals included the value 1, demonstrating that the constructs had discriminant validity and were thus empirically distinct (see Table 3).

Insert Table 2 and Table 3 about here

5.3 Structural model

Our structural model assessment initially checked for collinearity between the constructs. As all the variance inflation factor (VIF) values in all the models were below the threshold of 5, we concluded that collinearity was not an issue. Next, we assessed the structural model. R^2 scores indicate predictive power by showing the amount of variance explained by the independent variables (Peng & Lai, 2012). The results of the structural model are shown in Table 4. Since the objective of PLS is to maximize variance explained, R^2 – as a prediction-oriented measure – is used to evaluate PLS models. Our model explains between 63% and 34% of the variance in GVC status enhancement (in the full model and models A to D) and between 62% and 32% of the variance in new product innovation capability, which can be considered moderate to high levels (Cohen, 1988; Ringle, Sarstedt, & Straub, 2012). Our approach builds on soft modeling and exploratory model evaluation, with prediction in mind rather than the confirmation of results from previous studies (Richter et al., 2016; Wold, 1980). Looking at IB-discipline-specific practices regarding R^2, and even more so when comparing our R^2 values to other areas such as consumer behavior or marketing, where a value of 0.2 is considered high (Hair, Ringle, & Sarstedt, 2011), we hold that our values are indeed very good.

Insert Table 4 and Table 5 about here

In addition to the evaluation of the R^2 values of all endogenous constructs, the change in the R^2 value when a specified exogenous construct is omitted from the model can be used to evaluate whether the omitted construct has a substantive impact on the endogenous construct. This measure is referred to as the effect size (f^2) and is used to examine the impact of an independent latent variable on a dependent latent variable (Chin, 2010). f^2 values of 0.02, 0.15 and 0.35 are used to indicate that a predictor latent variable has a small, medium or large effect size at the structural level (Chin, 2010; Cohen, 1988). We provide effect sizes in Table 4, using different bold and italic font faces to represent strong and medium effect sizes. As can be seen specifically for new product innovation capability and connectivity in the various models, effect sizes are big.

Next, we assessed the PLS path model's predictive relevance by running the blindfolding procedure with an omission distance of 8. This helped us to assess the predictive relevance of the path model with respect to each endogenous construct (Hair et al., 2017). All the resulting crossvalidated redundancy values Q^2, also referred to as Stone-Geisser values, were above zero, supporting the model's predictive accuracy.

6 Results

This section will first provide an overview of the results from the analysis presented in the previous section. Variations across the two low-functional-sophistication groups (scenarios A and B)

Beginning with scenarios A and B in Figure 2, our analysis found support for the expectation that when suppliers' functional sophistication is low and the level of inter-firm trust is low, the impact of knowledge connectivity will be activated via knowledge acquisition (KC-KA) and leveraged through knowledge integration (KA-KI and KI-NPIC). Accordingly, all paths in the model are positive and significant except for, as expected, the direct link between knowledge connectivity and knowledge integration.

We also found support for positing that the effect of knowledge acquisition on new product innovation capability (KA-NPIC) will be stronger than the effect of knowledge integration on new product innovation capability (KI-NPIC). This is supported by the effect sizes f^2 presented in table 4 (KA-NPIC: f^2=0.380; KI-NPIC: f^2=0.279). They indicate that knowledge acquisition is a stronger predictor of new product innovation capability than knowledge integration. This provides support for Hypothesis 1a,

In contrast to Hypothesis 1a, Hypothesis 1b anticipated that when suppliers' level functional sophistication is low and the level of inter-firm trust is high the impact of knowledge acquisition on new product innovation capability (KA-NPIC) will be similar in size as that of knowledge integration (KI-NPIC). The effect sizes in Table 4 (KA-NPIC: f^2=0.347; KI-NPIC: f^2=0.319) seem to confirm this.

6.1 Variations across the two high-functional-sophistication groups (scenarios C and D)

In the high functional sophistication/low inter-firm trust scenario (scenario C in Figure 2), we expected knowledge connectivity to be activated via knowledge acquisition (KC-KA). At the same time we argued that due to the safety measures implemented by MNE buyers, suppliers will not be able to widely disseminate and leverage this knowledge (KA-KI and KI-NPIC). The empirically estimated paths in scenario C confirm this. While the paths between knowledge connectivity and knowledge acquisition (KC-KA), knowledge acquisition and new product innovation capability (KA-NPIC), and knowledge acquisition and knowledge integration (KA-KI) are positive and significant, the paths between knowledge integration and new product innovation capability (KI-NPIC) and knowledge connectivity and knowledge integration (KC-NPIC) are not significant. The non-significance of the KI-NPIC path also confirms Hypothesis 2a which put forward the expectation that only knowledge acquisition will have an effect on new product innovation capability.

We also argued that if suppliers' functional sophistication is high and the level of inter-firm trust is high (scenario D in Figure 2), the impact of knowledge connectivity will be activated via knowledge integration and knowledge acquisition occurs as a by-product of the co-creation process. In our estimation of scenario D, only the paths between knowledge connectivity and knowledge integration (KC-KI), knowledge connectivity and knowledge acquisition (KC-KA) and knowledge integration and new product innovation capability (KI-NPIC) are significant. This also confirms Hypothesis 2b expecting that only knowledge integration will have a positive effect on new product innovation capability.

6.2 Estimating the effect of trust

Finally, we turn our attention to the trust horse race. Based on inferences from one body of literature (e.g. Jean et al., 2010; Liu, 2012), Hypothesis 3a makes the prediction that suppliers in high trust relationships would benefit more than those in low trust relationships regardless of the level of functional sophistication. However, the effect sizes in Table 4 tell a different story. Both in terms of the link between knowledge acquisition and new product innovation capability (KA-NPIC: $f^2_A=0.380$; $f^2_B=0.347$), and in terms of GVC status enhancement (NPIC-GVCS: $f^2_A=1.737$; $f^2_B=0.772$), suppliers under scenario A (low trust) benefit significantly more than their counterparts under scenario B (high trust).

Further, the f^2 values in Table 4 show that both in terms of new product innovation capability (KA-NPIC $f^2_C=0.582$; KI-NPIC $f^2_D=0.250$) and GVC status (NPIC-GVCS $f^2_C=0.579$; $f^2_D=0.518$), suppliers in scenario C (low trust) extract more value from the collaboration than those in scenario D (high trust). These empirical results provide strong evidence in supporting Hypothesis 3b and against Hypothesis 3a.

7 Discussion

7.1 Implications for theory

The findings show how suppliers benefit from knowledge connectivity under different conditions associated with the inter-firm organizational pipeline. Interestingly, in our sample, the effect of knowledge connectivity was strongest in scenario A (KC-KA $f^2=0.959$) and D (KC-KI $f^2=0.587$), followed by scenario C (KC-KA $f^2=0.478$) and lastly scenario B (KC-KA $f^2=0.361$). This is contrary to the expectation that the impact of knowledge connectivity would be strongest when the supplier's level of functional sophistication is high and there is a high degree of inter-firm trust. In fact, the results seem to suggest that suppliers in low inter-firm trust relationships

(f^2_A=1.737 and f^2_C=0.579) reaped more rewards in terms of GVC status regardless of their level of functional sophistication than suppliers in the high inter-firm trust relationships (f^2_B=0.772 and f^2_D=0.518). In terms of new product innovation capability, the implications are more nuanced but overall provide similar insights (NPIC R^2_A=0.623; R^2_B=0.553; R^2_C=0.473; R^2_D=0.325). The effect sizes suggest that suppliers in low inter-firm trust relationships benefit more from direct knowledge transfer (KA-NPIC f^2_A=0.380; f^2_C=0.582) than their counterparts in high inter-firm trust relationships (KA-NPIC f^2_B=0.347; f^2_D=0.116). On the other hand, when it comes to accessing and leveraging the acquired knowledge, suppliers in high inter-firm trust relationships experience a stronger impact on new product innovation capability (KI-NPIC f^2_B=0.319; f^2_D=0.250) than suppliers in low inter-firm trust relationships (KI-NPIC f^2_A=0.279; f^2_C=0.025).

Based on these findings, it seems that suppliers in low inter-firm trust relationships are able to do more with less despite the attempts of their buyers to constrain the acquired knowledge within the supplier organization. Even if they are not fully able to disseminate the knowledge throughout their organization due to buyer restrictions, they seem to have a larger capacity for learning than firms in high inter-firm trust relationships (cf. Argyris, 1976; Argyris & Schön, 2003). A larger capacity for such learning may manifest itself as a dynamic capability that in turn will lead to enhanced innovation capabilities as well as improved GVC status (cf. Schoemaker, Heaton, & Teece, 2018). This raises the question, who benefits more from high inter-firm trust and in what way?

Although we do not measure the benefits accrued to the buyer, past studies suggest that buyers who are in a high-trust relationship with their suppliers benefit from the relationship in terms of innovation (e.g. Revilla & Knoppen, 2015; Williams & Kumar, 2014) and other relationship performance outcomes (e.g. Yang, Gao, Li, Shen, & Zheng, 2017), at least up to a point. There is an emerging body of literature that emphasizes the potential dark side of buyer-supplier relationships (cf. Oliveira & Lumineau, 2019) that includes the dark side of inter-firm trust. However, studies on this topic mostly focus on how the benefits of inter-firm trust decline over time for the buyer (Villena, Choi, & Revilla, 2019; Villena, Revilla, & Choi, 2011). To this end, our results provide complementary evidence highlighting that there is also a dark side of inter-firm trust for suppliers. A supplier's loyalty to its buyers may also explain the lower GVC status compared to suppliers in low inter-firm trust relationships (GVCS $R^2_A=0.635$; $R^2_B=0.436$; $R^2_C=0.367$; $R^2_D=0.341$). This is because suppliers with a long-term relationship orientation will prioritize keeping their current buyers happy over attempting to secure new buyers.

The theoretical implications for the theory of connectivity are the following. High knowledge connectivity in the form of communication and interaction mechanisms can exist independently of the supplier's level of functional sophistication and the degree of inter-firm trust. While different combinations of these two inter-firm pipeline conditions will activate the effects of knowledge connectivity in different ways, suppliers under all four scenarios benefit from knowledge connectivity in terms of new product innovation capability as well as GVC status. Nevertheless, the findings suggest that the effectiveness of knowledge connectivity is highest under two pipeline scenarios. (1) Under scenario A, when suppliers' functional sophistication and the level of inter-firm trust is low and the buyer is able to safeguard its core technology (cf. Buckley, 2009a, 2009b); and (2) under scenario D, when suppliers' functional sophistication and the level of inter-firm trust is high and knowledge connectivity is activated via knowledge integration with the aim to co-create value (cf. Gereffi et al., 2005; Sinkovics et al., 2018b).

7.2 Managerial implications

Our empirical results provide practical insights for managers of local supplier firms as they endeavor to enhance their product innovation capabilities in search of higher profits. First, the results clearly indicate that a firm's new product innovation capability is a precondition for the attainment of GVC status, and by extension the achievement of increased competitive advantage. However, the paths to new product innovation capability can vary depending on the level of suppliers' functional sophistication and the level of trust between the buyer and the supplier. Managers in supplier firms that are in high inter-firm trust relationships need to make sure that they avoid falling prey to organizational inertia and relying too much on their MNE partner. This would hinder the level of their new product innovation capability over time. Another potential pitfall in high trust relationships is the avoidance of challenging the status quo for fear of alienating the buyer. Of course, in order to reap the benefits of constructive conflicts employees from both buyer and supplier organizations need to have the tools of engaging in effective learning and decision making (Argyris, 1976; Argyris & Schön, 2003). These tools and capabilities can be consciously cultivated. Should the buyer organization not wish to engage in such processes, the supplier organization can still benefit from effective learning without challenging the buyer. This then will happen solely among supplier employees via the knowledge integration process.

Our findings also have implications for managers in buyer firms. They need to be aware of the strategic intent of their suppliers. Specifically, whether their goal is to break out of, or step up their role within their current relationships with buyers (Sinkovics et al., 2019). If it is to step up, they are more likely to be loyal and attempt to build trust. To reap the benefits from such high trust relationships, managers in buyer firms need to make sure that there are mechanisms in place that allow constructive conflict (Yang et al., 2017). They will also need to maintain the effectiveness of performance monitoring systems (Villena et al., 2019; Villena et al., 2011).

On the other hand, if a supplier's strategic intent is to leverage the learning to eventually break out of the relationship, managers in buyer firms will need to evaluate whether it would be more cost-effective for them to invest in retaining the supplier rather than to search for new suppliers. If managers conclude that retaining the supplier would be the better option, they will need to invest in the relationship to build inter-firm trust (Sinkovics et al., 2019), more specifically goodwill trust (Sako, 1992). This can be done by increasing the intensity of knowledge connectivity through, for example, geographical proximity, co-location, team building events and gift exchange (Jensen & Petersen, 2013; Sako, 1992).

8 Conclusion and limitations and future research

This paper examined the role of knowledge connectivity in suppliers' new product innovation capability under different inter-firm pipeline conditions. We used the Taiwanese electronics and IT manufacturing industry (i.e., excluding software) to carve out a contribution to the emerging bodies of literature on knowledge connectivity and the dark side of high inter-firm trust. Our results demonstrate that although suppliers' new product innovation capability may be larger under low inter-firm trust conditions, they will also be more likely to use the ensuing GVC status to pursue new, better paying buyers than their counterparts in high inter-firm trust relationships. As a consequence, if buyer firms in low trust relationships would like to benefit more from their suppliers' enhanced innovation capabilities, they may need to invest more in building inter-firm goodwill trust.

However, while the overarching model and the pipeline conditions are generic and can be tested in different industries, the results are likely to be specific to industries that are knowledge intensive and in which product life cycles are short. In such industries, buyers are often forced to share knowledge even if they do not fully trust the supplier. This is to take advantage of quicker design and manufacturing times. As a consequence, future research may test this model across a range of different industries.

Future research could also unpack the two pipeline conditions further as well as identify additional ones. Using a micro-foundational lens to do so may be especially useful (Felin, Foss, Heimeriks, & Madsen, 2012; Felin, Foss, & Ployhart, 2015). Furthermore, future studies will need to measure the relationship benefits for both partners over time. In this paper we only focused on the benefits accrued to the suppliers. Moreover, panel data could be used to examine whether the level of inter-firm trust changes over time in the presence of varying levels of connectivity. Drawing on panel data would also offset the limitations ensuing from the cross-sectional nature of our study. Lastly, further studies could include a number of control variables. Although we made sure that factors such as relationship duration, firm size, and national innovation distance did not interfere with the results, we excluded these controls from the analysis, (1) because the main focus of this paper was on the pipeline conditions and (2) due to space limitations.

9 References

Alcacer, J., & Oxley, J. E. (2014). Learning by supplying. *Strategic Management Journal, 35*(2), 204-223. doi: 10.1002/smj.2134

Alvesson, M., & Karreman, D. (2007). Constructing mystery: Empirical matters in theory development. *The Academy of Management Review, 32*(4), 1265-1281. doi: 10.2307/20159366

Argyris, C. (1976). Single-loop and double-loop models in research on decision making. *Administrative Science Quarterly, 21*(3), 363-375. doi: 10.2307/2391848

Argyris, C., & Schön, D. A. (2003). *Theory in practice : Increasing professional effectiveness*. San Francisco, Calif.: Jossey-Bass.

Armstrong, S. J., & Overton, T. S. (1977). Estimating nonresponse bias in mail surveys. *Journal of Marketing Research, 14*(3), 396-402. doi: 10.2307/3150783

Ballantyne, D., & Varey, R. J. (2008). The service-dominant logic and the future of marketing. *Journal of the Academy of Marketing Science, 36*(1), 11-14. doi: 10.1007/s11747-007-0075-8

Bilgili, T. V., Kedia, B. L., & Bilgili, H. (2016). Exploring the influence of resource environments on absorptive capacity development: The case of emerging market firms. *Journal of World Business, 51*(5), 700-712. doi: 10.1016/j.jwb.2016.07.008

Birdsall, N. M., Campos, J. E. L., Kim, C.-S., Corden, W. M., Pack, H., Page, J., . . . Stiglitz, J. E. (1993). The east asian miracle : Economic growth and public policy : Main report (english). In L. MacDonald (Ed.), *A World Bank policy research report*. New York, New York: Oxford University Press.

Buckley, P. J. (2009a). The impact of the global factory on economic development. *Journal of World Business, 44*(2), 131-143. doi: 10.1016/j.jwb.2008.05.003

Buckley, P. J. (2009b). Internalisation thinking: From the multinational enterprise to the global factory. *International Business Review, 18*(3), 224-235. doi: 10.1016/j.ibusrev.2009.01.006

Cano-Kollmann, M., Cantwell, J., Hannigan, T. J., Mudambi, R., & Song, J. (2016). Knowledge connectivity: An agenda for innovation research in international business. *Journal of International Business Studies, 47*(3), 255-262. doi: 10.1057/jibs.2016.8

Cantwell, J. (2017). Innovation and international business. *Industry and Innovation, 24*(1), 41-60. doi: 10.1080/13662716.2016.1257422

Cassiman, B., & Veugelers, R. (2006). In search of complementarity in innovation strategy: Internal R&D and external knowledge acquisition. *Management Science, 52*(1), 68-82. doi: 10.1287/mnsc.1050.0470

Chang, W., & Taylor, S. A. (2016). The effectiveness of customer participation in new product development: A meta-analysis. *Journal of Marketing, 80*(1), 47-64. doi: 10.1509/jm.14.0057

Charterina, J., Landeta, J., & Basterretxea, I. (2018). Mediation effects of trust and contracts on knowledge-sharing and product innovation evidence from the european machine tool industry. *European Journal of Innovation Management, 21*(2), 274-293. doi: 10.1108/ejim-03-2017-0030

Chen, L., & Xue, L. (2010). Global production network and the upgrading of China's integrated circuit industry. *China & World Economy, 18*(6), 109-126. doi: 10.1111/j.1749-124X.2010.01223.x

Chin, W. W. (1998). The partial least squares approach to structural equation modeling. In G. A. Marcoulides (Ed.), *Modern methods for business research* (pp. 295-336). New York: Taylor & Francis Group

Chin, W. W. (2010). How to write up and report PLS analyses. In V. Esposito Vinzi, W. W. Chin, J. Henseler & H. Wang (Eds.), *Handbook of partial least squares: Concepts, methods and applications* (pp. 655-690). Berlin, Heidelberg: Springer. doi:10.1007/978-3-540-32827-8_29

Choksy, U. S., Sinkovics, N., & Sinkovics, R. R. (2017). Exploring the relationship between upgrading and capturing profits from GVC participation for disadvantaged suppliers in developing countries. *Canadian Journal of Administrative Sciences, 34*(4), 356-386. doi: 10.1002/cjas.1455

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum.

Crossan, M. M., Lane, H. W., & White, R. E. (1999). An organizational learning framework: From intuition to institution. *Academy of Management Review, 24*(3), 522-537. doi: 10.5465/amr.1999.2202135

Cuervo-Cazurra, A., & Rui, H. (2017). Barriers to absorptive capacity in emerging market firms. *Journal of World Business, 52*(6), 727-742. doi: 10.1016/j.jwb.2017.06.004

Cullen, J. B., Johnson, J. L., & Sakano, T. (2000). Success through commitment and trust: The soft side of strategic alliance management. *Journal of World Business, 35*(3), 223-240.

Dedrick, J., Kraemer, K. L., & Linden, G. (2010). Who profits from innovation in global value chains?: A study of the ipod and notebook pcs. *Industrial and Corporate Change, 19*(1), 81-116. doi: 10.1093/icc/dtp032

Dillman, D. A., Smyth, J. D., & Leah, C. M. (2014). *Internet, phone, mail, and mixed-mode surveys: The tailored design method* (4th ed.). Hoboken: Wiley.

Dunlap, D., McDonough III, E. F., Mudambi, R., & Swift, T. (2016). Making up is hard to do: Knowledge acquisition strategies and the nature of new product innovation. *Journal of Product Innovation Management, 33*(4), 472-491. doi: 10.1111/jpim.12298

Felin, T., Foss, N. J., Heimeriks, K. H., & Madsen, T. L. (2012). Microfoundations of routines and capabilities: Individuals, processes, and structure. *Journal of Management Studies, 49*(8), 1351-1374. doi: 10.1111/j.1467-6486.2012.01052.x

Felin, T., Foss, N. J., & Ployhart, R. E. (2015). The microfoundations movement in strategy and organization theory. *Academy of Management Annals, 9*(1), 575-632. doi: 10.1080/19416520.2015.1007651

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research, 18*(1), 39-50. doi: 10.2307/3151312

Fujita, M. (2011). Value chain dynamics and local suppliers' capability building: An analysis of the vietnamese motorcycle industry. In M. Kawakami & T. J. Sturgeon (Eds.), *The dynamics of local learning in global value chains: Experiences from East Asia* (pp. 68-99). Houndmills, Basingstoke, Hampshire: Palgrave Macmillan. doi:10.1057/9780230281783

Gereffi, G., Humphrey, J., & Sturgeon, T. (2005). The governance of global value chains. *Review of International Political Economy, 12*(1), 78-104. doi: 10.1080/09692290500049805

Gold, A. H., Malhotra, A., & Segars, A. H. (2001). Knowledge management: An organizational capabilities perspective. *Journal of Management Information Systems, 18*(1), 185-214. doi: 10.1080/07421222.2001.11045669

Hair, J., Sarstedt, M., Ringle, C., & Mena, J. (2012). An assessment of the use of partial least squares structural equation modeling in marketing research. *Journal of the Academy of Marketing Science, 40*(3), 414-433. doi: 10.1007/s11747-011-0261-6

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2014). *Multivariate data analysis* (7th ed.). Upper Saddle River, NJ: Pearson.

Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2017). *A primer on partial least squares structural equation modeling (PLS-SEM)* (2nd ed.). Thousand Oaks, CA: Sage Publications.

Hair, J. F., Ringle, C. M., & Sarstedt, M. (2011). PLS-SEM: Indeed a silver bullet. *Journal of Marketing Theory and Practice, 19*(2), 139-152. doi: 10.2753/mtp1069-6679190202

Henseler, J., Dijkstra, T. K., Sarstedt, M., Ringle, C. M., Diamantopoulos, A., Straub, D. W., . . . Calantone, R. J. (2014). Common beliefs and reality about partial least squares: Comments on Rönkkö & Evermann (2013). *Organizational Research Methods, 17*(2), 182-209. doi: 10.1177/1094428114526928

Henseler, J., Ringle, C. M., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the Academy of Marketing Science, 43*(1), 115-135. doi: 10.1007/s11747-014-0403-8

Henseler, J., Ringle, C. M., & Sinkovics, R. R. (2009). The use of partial least squares path modeling in international marketing. In R. R. Sinkovics & P. N. Ghauri (Eds.), *Advances in international marketing* (Vol. 20, pp. 277-320). Bingley: Emerald doi:10.1108/S1474-7979(2009)0000020014

Hitt, M. A., Dacin, M. T., Levitas, E., Arregle, J.-L., & Borza, A. (2000). Partner selection in emerging and developed market contexts: Resource-based and organizational learning perspectives. *Academy of Management Journal, 43*(3), 449-467. doi: 10.5465/1556404

Huang, Y. T., & Chu, W. (2010). Enhancement of product development capabilities of OEM suppliers: Inter- and intra-organisational learning. *Journal of Business & Industrial Marketing, 25*(2), 147-158. doi: 10.1108/08858621011017769

Inkpen, A. C. (1996). Creating knowledge through collaboration. *California Management Review, 39*(1), 123-140. doi: 10.2307/41165879

Inkpen, A. C. (2000). Learning through joint ventures: A framework of knowledge acquisition. *Journal of Management Studies, 37*(7), 1019-1044. doi: 10.1111/1467-6486.00215

Jean, R. J., Chiou, J. S., & Sinkovics, R. R. (2016). Interpartner learning, dependence asymmetry and radical innovation in customer-supplier relationships. *Journal of Business and Industrial Marketing, 31*(6), 732-742. doi: 10.1108/JBIM-10-2012-0185

Jean, R. J., Kim, D., Chiou, J. S., & Calantone, R. (2018). Strategic orientations, joint learning, and innovation generation in international customer-supplier relationships. *International Business Review, 27*(4), 838-851. doi: 10.1016/j.ibusrev.2018.01.007

Jean, R. J., Kim, D., & Sinkovics, R. R. (2012). Drivers and performance outcomes of supplier innovation generation in customer–supplier relationships: The role of power-dependence. *Decision Sciences, 43*(6), 1003-1038. doi: 10.1111/j.1540-5915.2012.00380.x

Jean, R. J., Sinkovics, R. R., & Kim, D. (2010). Drivers and performance outcomes of relationship learning for suppliers in cross-border customer–supplier relationships: The role of communication culture. *Journal of International Marketing, 18*(1), 63-85. doi: 10.1509/jimk.18.1.63

Jensen, P. D. Ø., & Petersen, B. (2013). Global sourcing of services: Risk, process, and collaborative architecture. *Global Strategy Journal, 3*(1), 67-87. doi: 10.1111/j.2042-5805.2012.01049.x

Kawakami, M. (2007). Competing for complementarity: Growth of Taiwanese notebook PC manufacturers as odm suppliers. In Y. Sato, M. Kawakami & K. Ajia Keizai (Eds.), *Competition and cooperation among asian enterprises in China* (pp. 91-118). Chiba-shi, Japan: Institute of Developing Economics, JETRO

Kawakami, M. (2009). Learning from customers: Growth of Taiwanese notebook PC manufacturers as original design manufacturing suppliers. *China Information, 23*(1), 103-128. doi: 10.1177/0920203x08100949

Kawakami, M. (2011). Inter-firm dynamics in notebook PC value chains and the rise of Taiwanese original design manufacturing firms. In M. Kawakami & T. J. Sturgeon

(Eds.), *The dynamics of local learning in global value chains: Experiences from East Asia* (pp. 16-42). Houndmills, Basingstoke, Hampshire: Palgrave Macmillan. doi:10.1057/9780230281783

Knudsen, M. P. (2007). The relative importance of interfirm relationships and knowledge transfer for new product development success. *Journal of Product Innovation Management, 24*(2), 117-138. doi: 10.1111/j.1540-5885.2007.00238.x

Kunin, M., Julliard, K. N., & Rodriguez, T. E. (2014). Comparing face-to-face, synchronous, and asynchronous learning: Postgraduate dental resident preferences. *Journal of Dental Education, 78*(6), 856-866.

Liang, H., Saraf, N., Hu, Q., & Xue, Y. (2007). Assimilation of enterprise systems: The effect of institutional pressures and the mediating role of top management. *MIS Quarterly, 31*(1), 59-87. doi: 10.2307/25148781

Lin, M. J. J., & Huang, C. H. (2013). The impact of customer participation on NPD performance: The mediating role of inter-organisation relationship. *Journal of Business & Industrial Marketing, 28*(1), 3-15. doi: 10.1108/08858621311285679

Liu, C. L. E. (2012). An investigation of relationship learning in cross-border buyer-supplier relationships: The role of trust. *International Business Review, 21*(3), 311-327. doi: 10.1016/j.ibusrev.2011.05.005

Lu, W. M., & Hung, S. W. (2010). Assessing the performance of a vertically disintegrated chain by the DEA approach - a case study of Taiwanese semiconductor firms. *International Journal of Production Research, 48*(4), 1155-1170. doi: 10.1080/00207540802484929

Lyles, M. A., & Salk, J. E. (1996). Knowledge acquisition from foreign parents in international joint ventures: An empirical examination in the Hungarian context. *Journal of International Business Studies, 27*(5), 877-903. doi: 10.1057/palgrave.jibs.8490155

Mah, J. S. (2015). R&D policies and development of technology-intensive industries of Taiwan. *Progress in Development Studies, 15*(2), 125-138. doi: 10.1177/1464993414565532

Menguc, B., Auh, S., & Yannopoulos, P. (2014). Customer and supplier involvement in design: The moderating role of incremental and radical innovation capability. *Journal of Product Innovation Management, 31*(2), 313-328. doi: 10.1111/jpim.12097

Metraux, D. (1992). *Taiwan's political and economic growth in the late twentieth century*. New York, NY: Edwin Mellen Press.

Molina-Morales, F., Martinez-Fernandez, M.T., & Torlo, V. (2011). The dark side of trust: the benefits, costs, and optimal levels of trust for innovation performance. *Long Range Planning*, **44**(2): 118-133.

Mudambi, R. (2008). Location, control and innovation in knowledge-intensive industries. *Journal of Economic Geography, 8*(5), 699-725. doi: 10.1093/jeg/lbn024

Najafi-Tavani, S., Najafi-Tavani, Z., Naudé, P., Oghazi, P., & Zeynaloo, E. (2018). How collaborative innovation networks affect new product performance: Product innovation capability, process innovation capability, and absorptive capacity. *Industrial Marketing Management, 73*, 193-205. doi: 10.1016/j.indmarman.2018.02.009

Nardelli, G., & Broumels, M. (2018). Managing innovation processes through value co-creation: A process case from business-to-business service practise. *International Journal of Innovation Management, 22*(3). doi: 10.1142/s1363919618500305

Nevis, E. C., DiBella, A. J., & Gould, J. M. (1995). Understanding organizations as learning systems. *Sloan Management Review, 36*(2), 73-85.

Nobeoka, K., Dyer, J. H., & Madhok, A. (2002). The influence of customer scope on supplier learning and performance in the Japanese automobile industry. *Journal of International Business Studies, 33*(4), 717-736. doi: 10.1057/palgrave.jibs.8491041

Norman, P. M. (2004). Knowledge acquisition, knowledge loss, and satisfaction in high technology alliances. *Journal of Business Research, 57*(6), 610-619. doi: 10.1016/S0148-2963(02)00395-8

Oliveira, N., & Lumineau, F. (2019). The dark side of interorganizational relationships: An integrative review and research agenda. *Journal of Management, 45*(1), 231-261. doi: 10.1177/0149206318804027

Pak, Y. S., Ra, W., & Park, Y.-R. (2009). Understanding ijv performance in a learning and conflict mediated context. *International Business Review, 18*(5), 470-480. doi: 10.1016/j.ibusrev.2009.07.006

Parkhe, A. (1991). Interfirm diversity, organizational learning, and longevity in global strategic alliances. *Journal of International Business Studies, 22*(4), 579-601. doi: 10.1057/palgrave.jibs.8490315

Peng, D. X., & Lai, F. (2012). Using partial least squares in operations management research: A practical guideline and summary of past research. *Journal of Operations Management, 30*(6), 467-480. doi: 10.1016/j.jom.2012.06.002

Pietrobelli, C., & Rabellotti, R. (2011). Global value chains meet innovation systems: Are there learning opportunities for developing countries? *World Development, 39*(7), 1261-1269. doi: 10.1016/j.worlddev.2010.05.013

Podsakoff, P. M., MacKenzie, S. B., & Podsakoff, N. P. (2012). Sources of method bias in social science research and recommendations on how to control it. *Annual Review of Psychology, 63*, 539-569. doi: 10.1146/annurev-psych-120710-100452

Podsakoff, P. M., & Organ, D. W. (1986). Self-reports in organizational research: Problems and prospects. *Journal of Management, 12*(4), 531-544. doi: 10.1177/014920638601200408

Ponte, S., & Ewert, J. (2009). Which way is "up" in upgrading? Trajectories of change in the value chain for south African wine. *World Development, 37*(10), 1637-1650. doi: 10.1016/j.worlddev.2009.03.008

Primo, M. A. M., & Amundson, S. D. (2002). An exploratory study of the effects of supplier relationships on new product development outcomes. *Journal of Operations Management, 20*(1), 33-52. doi: 10.1016/S0272-6963(01)00080-8

Ranjan, K. R., & Read, S. (2016). Value co-creation: Concept and measurement. *Journal of the Academy of Marketing Science, 44*(3), 290-315. doi: 10.1007/s11747-014-0397-2

Reinartz, W., Haenlein, M., & Henseler, J. (2009). An empirical comparison of the efficacy of covariance-based and variance-based SEM. *International Journal of Research in Marketing, 26*(4), 332-344. doi: 10.1016/j.ijresmar.2009.08.001

Revilla, E., & Knoppen, D. (2015). Building knowledge integration in buyer-supplier relationships the critical role of strategic supply management and trust. *International Journal of Operations & Production Management, 35*(10), 1408-1436. doi: 10.1108/ijopm-01-2014-0030

Richter, N. F., Sinkovics, R. R., Ringle, C. M., & Schlägel, C. (2016). A critical look at the use of SEM in international business research. *International Marketing Review, 33*(3), 376-404. doi: 10.1108/IMR-04-2014-0148

Rigdon, E. E. (2012). Rethinking partial least squares path modeling: In praise of simple methods. *Long Range Planning, 45*(5), 341-358. doi: 10.1016/j.lrp.2012.09.010

Ringle, C. M., Sarstedt, M., & Straub, D. (2012). Editor's comments: A critical look at the use of PLS-SEM in MIS quarterly. *MIS Quarterly, 36*(1), iii-xiv.

Ringle, C. M., Wende, S., & Becker, J.-M. (2015). *Smartpls 3*. Boenningstedt, Germany: SmartPLS GmbH.

Ritter, T., & Gemünden, H. G. (2003). Network competence: Its impact on innovation success and its antecedents *Journal of Business Research, 56*(9), 745-755. doi: 10.1016/S0148-2963(01)00259-4

Roath, A. S., & Sinkovics, R. R. (2006). Utilizing relational governance in export relationships: Leveraging learning and improving flexibility and satisfaction. In C. A. Solberg (Ed.), *Advances in international marketing - relationship between exporters and their foreign sales and marketing intermediaries* (Vol. 16, pp. 157-185). Amsterdam: Elsevier - JAI. doi:10.1016/S1474-7979(05)16007-4

Robson, M. J., Katsikeas, C. S., & Bello, D. C. (2008). Drivers and performance outcomes of trust in international strategic alliances: The role of organizational complexity. *Organization Science, 19*(4), 647-665.

Sako, M. (1992). Trust and organisational efficiency. In M. Sako (Ed.), *Price, quality and trust: Inter-firm relations in Britain and Japan* (pp. 30-48). Cambridge: Cambridge University Press. doi:Doi: 10.1017/cbo9780511520723.003

Sako, M. (1996). Supplier relationships and innovation. In M. Dodgson (Ed.), *Handbook of industrial innovation* (pp. 268-274). Cheltenham: Edward Elgar

Sako, M. (1998). Does trust improve business performance? In C. Lane & R. Bachmann (Eds.), *Trust within and between organizations* (pp. 88-117). Oxford: Oxford University Press

Salzberger, T., & Sinkovics, R. R. (2006). Reconsidering the problem of data equivalence in international marketing research: Contrasting approaches based on CFA and the Rasch model for measurement. *International Marketing Review, 23*(4), 390-417. doi: 10.1108/02651330610678976

Sarstedt, M., Hair, J. F., Ringle, C. M., Thiele, K. O., & Gudergan, S. P. (2016). Estimation issues with PLS and cbsem: Where the bias lies! *Journal of Business Research, 69*(10), 3998-4010. doi: 10.1016/j.jbusres.2016.06.007

Sato, Y., & Fujita, M. (2009). *Capability matrix: A framework for analyzing capabilities in value chains*. IDE Discussion Paper. IDE. Chiba.

Saxenian, A. (2002). Transnational communities and the evolution of global production networks: The cases of Taiwan, China and India. *Industry and Innovation, 9*(3), 183-202. doi: 10.1080/1366271022000034453

Saxenian, A., & Hsu, J. Y. (2001). The silicon valley–hsinchu connection: Technical communities and industrial upgrading. *Industrial and Corporate Change, 10*(4), 893-920. doi: 10.1093/icc/10.4.893

Saxton, T. (1997). The effects of partner and relationship characteristics on alliance outcomes. *Academy of Management Journal, 40*(2), 443-461. doi: 10.5465/256890

Schlägel, C., & Sarstedt, M. (2016). Assessing the measurement invariance of the four-dimensional cultural intelligence scale across countries: A composite model approach. *European Management Journal, 34*(6), 633-649. doi: 10.1016/j.emj.2016.06.002

Schoemaker, P. J. H., Heaton, S., & Teece, D. (2018). Innovation, dynamic capabilities, and leadership. *California Management Review, 61*(1), 15-42. doi: 10.1177/0008125618790246

Shane, S. A. (2007). *A general theory of entrepreneurship : The individual-opportunity nexus*. Cheltenham, UK; Northampton, MA: Edward Elgar.

Simonin, B. L. (1999). Ambiguity and the process of knowledge transfer in strategic alliances. *Strategic Management Journal, 20*(7), 595-623. doi: 10.1002/(SICI)1097-0266(199907)20:7%3C595::AID-SMJ47%3E3.0.CO;2-5

Sinkovics, N., Choksy, U. S., Sinkovics, R. R., & Mudambi, R. (2019). Knowledge connectivity in an adverse context: Global value chains and Pakistani offshore service providers. *Management International Review, 59*(1), 131-170. doi: 10.1007/s11575-018-0372-0

Sinkovics, N., Hoque, S. F., & Sinkovics, R. R. (2018a). Supplier strategies and routines for capability development: Implications for upgrading. *Journal of International Management, 24*(4), 348-368. doi: 10.1016/j.intman.2018.04.005

Sinkovics, R. R., Kuivalainen, O., & Roath, A. S. (2018b). Value co-creation in an outsourcing arrangement between manufacturers and third party logistics providers: Resource commitment, innovation and collaboration. *Journal of Business & Industrial Marketing, 33*(4), 563-573. doi: 10.1108/JBIM-03-2017-0082

Smith, B. J., & Barclay, D. W. (1997). The effects of organizational differences and trust on the effectiveness of selling partner relationships. *Journal of Marketing, 61*(1), 3-21. doi: 10.1177/002224299706100102

Smith, H. (2000). *Industry policy in Taiwan and Korea in the 1980s: Winning with the market*. Northampton, MA: Edward Elgar Pub.

Subramaniam, M., & Venkatraman, N. (2001). Determinants of transnational new product development capability: Testing the influence of transferring and deploying tacit overseas knowledge. *Strategic Management Journal, 22*(4), 359-378. doi: 10.1002/smj.163

Takeishi, A. (2002). Knowledge partitioning in the interfirm division of labor: The case of automotive product development. *Organization Science, 13*(3), 321-338. doi: 10.1287/orsc.13.3.321.2779

Teddie, C., & Tashakkori, A. (2009). *Foundations of mixed methods research : Integrating quantitative and qualitative approaches in the social and behavioral sciences*. Thousand Oaks: Sage Publications.

Thomas, R. J. (1993). *New product development: Managing and forecasting for strategic success*. New York: John Wiley & Sons.

van Teijlingen, E., & Hundley, V. (2002). The importance of pilot studies. *Nursing Standard (through 2013), 16*(40), 33-36.

Veugelers, R. (1997). Internal r & d expenditures and external technology sourcing. *Research Policy, 26*(3), 303-315. doi: 10.1016/S0048-7333(97)00019-X

Villena, V. H., Choi, T. Y., & Revilla, E. (2019). Revisiting interorganizational trust: Is more always better or could more be worse? *Journal of Management, 45*(2), 752-785. doi: 10.1177/0149206316680031

Villena, V. H., Revilla, E., & Choi, T. Y. (2011). The dark side of buyer-supplier relationships: A social capital perspective. *Journal of Operations Management, 29*(6), 561-576. doi: 10.1016/j.jom.2010.09.001

Williams, C., & Kumar, M. (2014). Experiential learning and innovation in offshore outsourcing transitions. In T. Pedersen, M. Venzin, T. M. Devinney & L. Tihanyi (Eds.), *Orchestration of the global network organization* (Vol. 27, pp. 433-461). doi:10.1108/s1571-502720140000027005

Williams, L. J., Edwards, J. R., & Vandenberg, R. J. (2003). Recent advances in causal modeling methods for organizational and management research. *Journal of Management, 29*(6), 903-936. doi: 10.1016/s0149-2063_03_00084-9

Wold, H. (1980). Model construction and evaluation when theoretical knowledge is scarce. In J. Kmenta & J. B. Ramsey (Eds.), *Evaluation of econometric models* (pp. 47-74). New York: Academic Press

Yang, W., Gao, Y., Li, Y., Shen, H., & Zheng, S. Y. (2017). Different roles of control mechanisms in buyer-supplier conflict: An empirical study from China. *Industrial Marketing Management, 65*, 144-156. doi: 10.1016/j.indmarman.2017.04.002

Zhang, C., Cavusgil, S. T., & Roath, A. S. (2003). Manufacturer governance of foreign distributor relationships: Do relational norms enhance competitiveness in the export market? *Journal of International Business Studies, 34*(6), 550-566. doi: 10.1057/palgrave.jibs.8400051

Zhang, J., Jiang, Y., Shabbir, R., & Du, M. (2015). Building industrial brand equity by leveraging firm capabilities and co-creating value with customers. *Industrial Marketing Management, 51*, 47-58. doi: 10.1016/j.indmarman.2015.05.016

Zhao, M. (2006). Conducting R&D in countries with weak intellectual property rights protection. *Management Science, 52*(8), 1185-1199. doi: 10.1287/mnsc.1060.0516

10 Figures and Tables

Figure 1: Main model of suppliers' learning from MNE partners

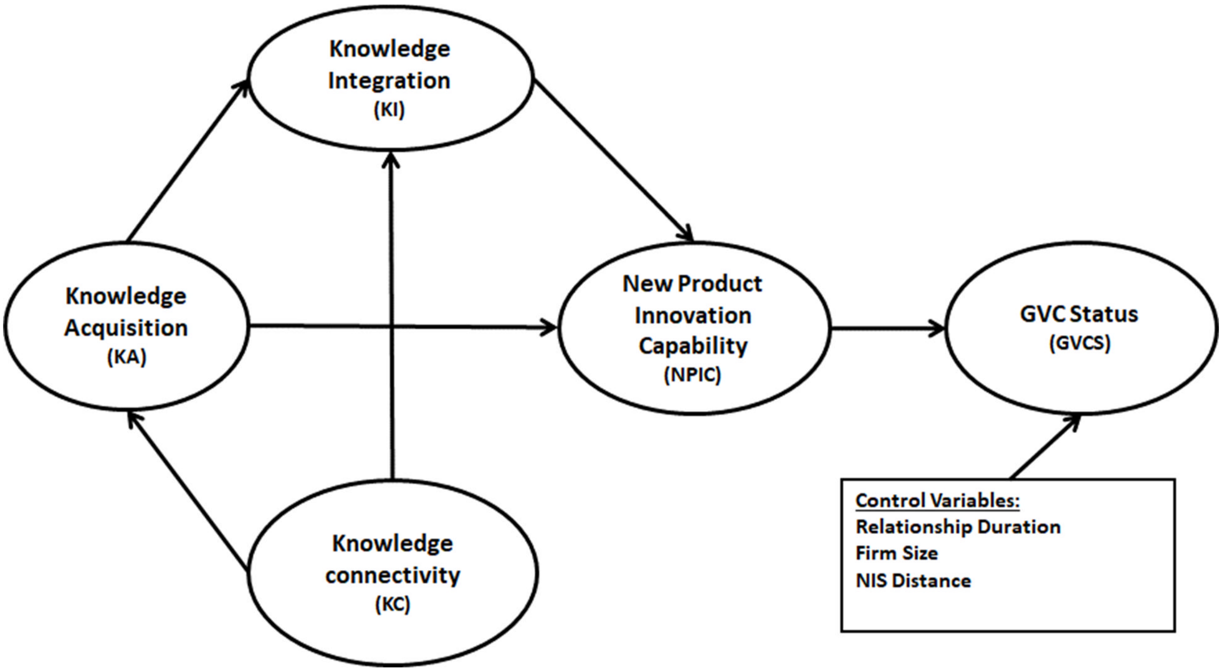
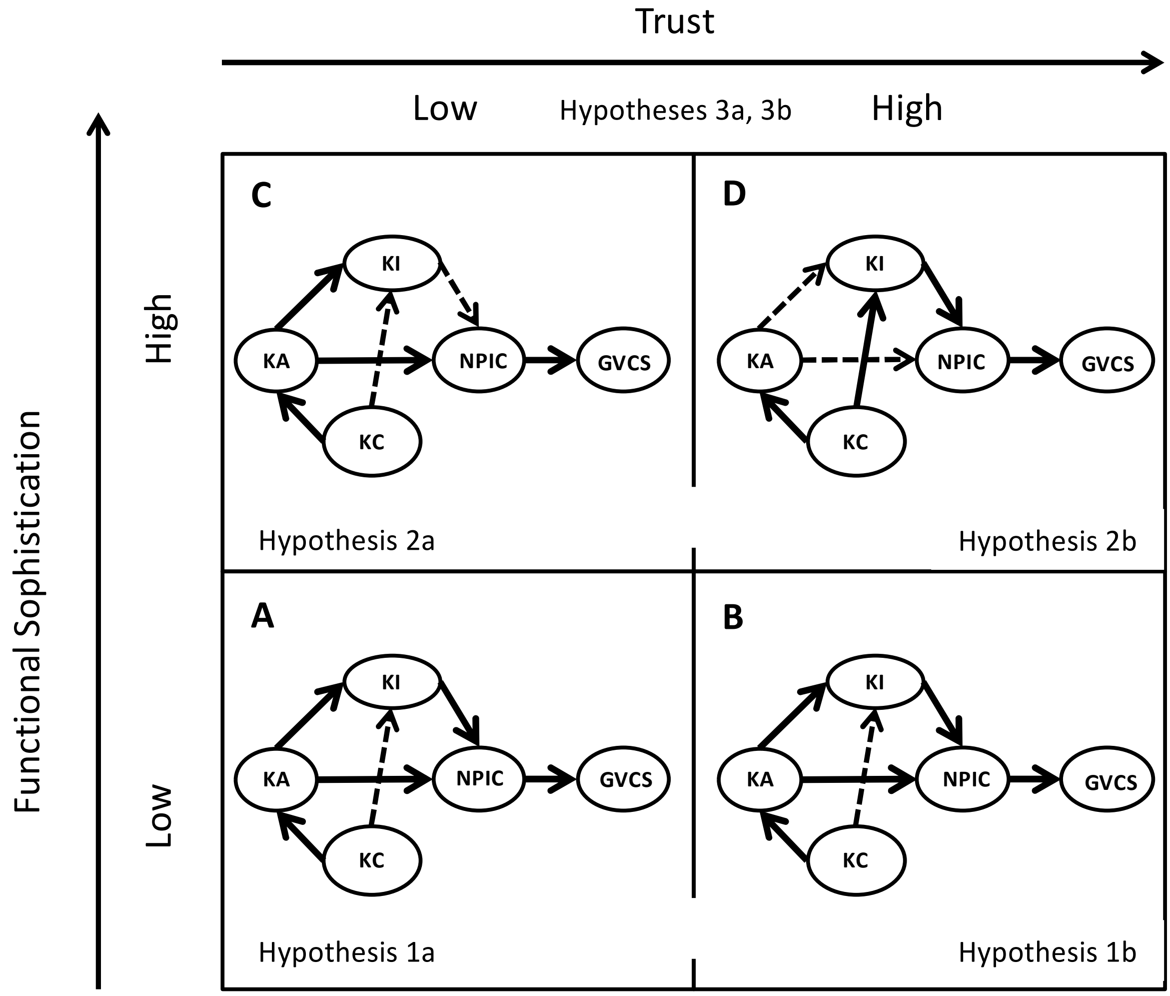


Figure 2: Variations in the impact of knowledge connectivity under different pipeline conditions



Note: Bold arrows represent hypothesized significant path relationships; dotted arrows represent hypothesized non-significant paths

Table 1: Descriptive information

Product Distribution	Percentage	Alliance Type	Percentage
Communication Products	15.8%	OEM	21.9%
Systems	18.3%	ODM	78.1%
Peripherals	19.3%	**Own Brand Product**	**Percentage**
Card/ Board	7.9%	No Own Brand Product	47.5%
Semiconductors	10.9%	Own Brand Product	52.5%
Components	11.9%	**Sales Revenue**	**Percentage**
Other	15.9%	NT100M (US$3M)< Revenue < NT500M	10.0%
Alliance Duration	**Percentage**	NT500M < Revenue < NT1B	13.2%
Less than 1 year	9.4%	NT1B < Revenue < NT5B	32.7%
1-2 years	15.0%	NT5B < Revenue < NT10B	10.1%
3-5 years	46.9%	More than NT10B (US$300M)	34.0%
6-10 years	20.0%		
More than 10 years	8.7%		
Employee Numbers	**Percentage**		
Less than 100	5.6%		
101-500	29.4%		
501-1000	15.6%		
1001-5000	25.6%		
5001-10000	11.3%		
More than 10000	12.5%		

Table 2: Constructs and associated items

		Full model			*Model A (FS-l/T-l)*			*Model B (FS-l/T-h)*			*Model C (FS-h/T-l)*			*Model D (FS-h/T-h)*		
	Items	*Mean*	*SD*	*OL*	*Mean*	*SD*	*OL*	*Mean*	*SD*	*OL*	*Mean*	*SD*	*OL*	*Mean*	*SD*	*OL*
	Knowledge acquisition (KA), adapted from Lyles and Salk (1996) and Norman (2004)	A=0.875 CR=0.915 AVE=0.786			A=0.887 CR=0.923 AVE=0.749			A=0.909 CR=0.935 AVE=0,784			A=0.856 CR=0.903 AVE=0.726			A=0.827 CR=0.889 AVE=0.673		
ka1	We have learned new R&D expertise from our foreign partner.	4.981	1.343	0.915	4.636	1.245	0.919	5.209	1.552	0.962	4.587	1.222	0.863	5.500	1.109	0.802
ka2	We have learned new product development from our foreign partner.	4.981	1.348	0.916	4.545	1.277	0.911	5.116	1.546	0.938	4.761	1.268	0.878	5.474	1.109	0.885
ka3	We have learned new manufacturing processes from our foreign partner.	4.750	1.550	0.856	4.788	1.166	0.826	4.651	1.863	0.843	4.326	1.461	0.869	5.342	1.419	0.941
ka4	We have learned managerial practice from our foreign partner.	4.625	1.512	0.718	4.212	1.317	0.800	4.953	1.632	0.786	4.522	1.312	0.731	4.737	1.703	0.615
	Knowledge integration (KI), adapted from Gold et al. (2001) and Pak et al. (2009)	A=0.870 CR=0.906 AVE=0.658			A=0.902 CR=0.927 AVE=0.717			A=0.823 CR=0.874 AVE=0.582			A=0.878 CR=0.909 AVE=0.666			A=0.796 CR=0.861 AVE=0.555		
ki1	The firm makes efforts to establish formal policies such as documentation, standard operation procedure (S.O.P.), a knowledge bank and expert systems to facilitate the utilization of knowledge.	5.200	1.175	0.830	5.000	1.173	0.900	5.442	1.119	0.817	4.717	1.129	0.846	5.684	1.068	0.688
ki2	The firm offers on-job training.	5.706	1.136	0.777	5.394	1.116	0.722	6.140	1.037	0.780	5.196	1.025	0.792	6.105	1.085	0.665
ki3	The firm encourages job rotation between different project teams.	5.069	1.332	0.864	4.818	1.286	0.912	5.651	1.152	0.788	4.500	1.295	0.832	5.316	1.317	0.869
ki4	The firm is able to locate and apply knowledge to change competitive conditions.	4.538	1.500	0.770	4.364	1.454	0.808	4.814	1.516	0.702	4.087	1.411	0.798	4.921	1.514	0.692
ki5	The firm has processes for distributing knowledge from business partners into the organization.	5.163	1.341	0.811	5.030	1.132	0.877	5.488	1.279	0.722	4.674	1.351	0.814	5.500	1.409	0.791
	New product innovation capability (NPIC), adapted from Thomas (1993) and Subramaniam and Venkatraman (2001)	A=903 CR=0.939 AVE=0.837			A=0.928 CR=0.954 AVE=0.875			A=0.905 CR=0.940 AVE=0.840			A=0.829 CR=0.896 AVE=0.743			A=0.920 CR=0.949 AVE=0.862		
npc1	We improved our R&D capability in terms of product differentiation and functionality after collaborating with our foreign MNE partner.	5.181	1.223	0.899	4.818	1.380	0.900	5.37	1.176	0.894	4.913	1.189	0.870	5.605	1.028	0.915

npc2	We improved our speed of introducing new products after collaborating with our MNE partner.	5.056	1.167	0.925	4.848	1.302	0.962	5.12	1.219	0.933	4.826	1.060	0.860	5.447	1.032	0.934
npc3	We improved our capability to perceive new technology developments/market trends after collaborating with our MNE partner.	5.194	1.163	0.921	4.848	1.395	0.942	5.47	1.222	0.922	4.870	0.806	0.855	5.579	1.081	0.937
	GVC status (GVCS), adapted from Saxton (1997) and Ritter and Gemünden (2003) Since forming the relationship with this partner, the firm…	A=0.909 CR=0.936 AVE=0.786			A=0.938 CR=0.956 AVE=0.844			A=0.914 CR=0.940 AVE=0.796			A=0.879 CR=0.913 AVE=0.726			A=0.880 CR=0.917 AVE=0.736		
gvc1	… has gained more opportunities to form relationships with other prominent global partners.	5.731	1.086	0.897	5.515	1.064	0.914	6.047	0.950	0.913	5.326	1.136	0.911	6.053	1.012	0.854
gvc2	… has strengthened its bargaining power with key partners in the global industry.	5.462	1.075	0.863	5.030	1.159	0.895	5.674	1.149	0.812	5.261	0.828	0.904	5.842	1.027	0.808
gvc3	… has superior technology for product development.	5.500	1.133	0.884	5.182	1.103	0.912	5.884	1.005	0.897	5.087	1.071	0.757	5.842	1.151	0.910
gvc4	… has enhanced its reputation in the global value chain.	5.788	1.078	0.901	5.424	1.146	0.953	5.977	0.886	0.942	5.500	1.049	0.826	6.237	1.076	0.856
	Knowledge Connectivity (KC), adapted from Inkpen (1996) and Subramaniam and Venkatraman (2001) My company has frequent…	A=0.884 CR=0.920 AVE=0.743			A=0.851 CR=0.900 AVE=0.692			A=0.932 CR=0.951 AVE=0.829			A=0.828 CR=0.883 AVE=0.656			A=0.801 CR=0.871 AVE=0.631		
kc1	… on-site visits and face-to-face communication with our partner	5.575	1.315	0.857	5.091	1.487	0.806	5.977	1.439	0.939	5.087	1.092	0.712	6.132	.844	0.784
kc2	… interactions with our partner for technology sharing	5.538	1.192	0.912	5.212	1.139	0.893	5.977	1.300	0.929	4.957	1.010	0.832	6.026	.915	0.903
kc3	… interactions with our partner for joint new product design	5.381	1.453	0.840	5.121	1.219	0.819	5.674	1.742	0.880	4.978	1.145	0.855	5.763	1.497	0.803
kc4	… interactions with our partner for joint problem solving	5.850	1.245	0.836	5.606	1.197	0.806	6.395	1.137	0.892	5.174	1.161	0.831	6.263	1.083	0.671

Note: Mean=mean value; SD=standard deviation; OL=outer loading; CA=Cronbach's alpha; CR=composite reliability; AVE=average variance extracted; Model A=functional sophistication (FS)-low (l) / trust (T)-high (h), Model B=FS-l / T-h, Model C=FS-h / T-l, Model D=FS-h / T-h. Recommended criteria for reflective measurement model: Loadings (OL) > 0.70, AVE > 0.50, Cronbach's alpha 0.60-0.90, CR 0.60-0.90.

Table 3: Discriminant validity assessment results (HTMT.85 criterion)

		GVCS	KA	KI	NPIC
KA	Model full	0.608 [0.464; 0.723]			
	Model A	0.712 [0.493; 0.895]			
	Model B	0.459 [0.193; 0.722]			
	Model C	0.684 [0.470; 0.822]			
	Model D	0.461 [0.246; 0.744]			
KI	Model full	0.614 [0.441; 0.769]	0.518 [0.353; 0.665]		
	Model A	0.535 [0.274; 0.779]	0.629 [0.363; 0.813]		
	Model B	0.341 [0.142; 0.587]	0.488 [0.267; 0.671]		
	Model C	0.616 [0.306; 0.872]	0.492 [0.263; 0.810]		
	Model D	0.763 [0.556; 0.928]	0.398 [0.202; 0.497]		
NPIC	Model full	0.750 [0.609; 0.839]	0.705 [0.581; 0.807]	0.645 [0.489; 0.782]	
	Model A	0.850 [0.697; 0.954]	0.789 [0.512; 0.953]	0.716 [0.443; 0.873]	
	Model B	0.724 [0.244; 0.931]	0.685 [0.468; 0.842]	0.710 [0.490; 0.934]	
	Model C	0.636 [0.392; 0.755]	0.796 [0.499; 0.950]	0.429 [0.207; 0.770]	
	Model D	0.637 [0.332; 0.868]	0.442 [0.196; 0.747]	0.568 [0.250; 0.889]	
KC	Model full	0.696 [0.581; 0.792]	0.627 [0.447; 0.757]	0.503 [0.317; 0.659]	0.527 [0.352; 0.674]
	Model A	0.811 [0.575; 0.921]	0.804 [0.565; 0.947]	0.385 [0.151; 0.661]	0.680 [0.345; 0.887]
	Model B	0.540 [0.262; 0.677]	0.507 [0.214; 0.725]	0.356 [0.144; 0.605]	0.423 [0.169; 0.653]
	Model C	0.585 [0.256; 0.813]	0.655 [0.391; 0.839]	0.273 [0.103; 0.372]	0.394 [0.164; 0.713]
	Model D	0.732 [0.474; 0.890]	0.443 [0.163; 0.812]	0.784 [0.566; 0.951]	0.333 [0.095; 0.635]

Note: The numbers in brackets are the 95% bias-corrected and accelerated confidence intervals of the HTMT statistic (Henseler et al., 2015). Confidence intervals were derived from bootstrapping 5000 samples, using the "no sign changes" option.

Table 4: Coefficient of determination (R^2), effect sizes f^2 and Stone-Geisser Q^2 of predictive relevance

			f^2 *(effect size) on…*				*Stone Geisser Q^2*
		R^2	GVCS	KA	KI	NPIC	Q^2
GVCS	Model full	0.469					0.340
	Model A	0.635					0.444
	Model B	0.436					0.245
	Model C	0.367					0.158
	Model D	0.341					0.224
KA	Model full	0.313			0.091	*0.342*	0.212
	Model A	0.490			**0.387**	**0.380**	0.325
	Model B	0.265			0.149	*0.347*	0.172
	Model C	0.323			*0.180*	**0.582**	0.193
	Model D	0.138			0.000	0.116	0.076
KI	Model full	0.268				*0.216*	0.153
	Model A	0.371				*0.279*	0.211
	Model B	0.225				*0.319*	0.101
	Model C	0.204				0.025	0.088
	Model D	0.409				*0.250*	0.168
NPIC	Model full	0.508	**0.883**				0.393
	Model A	0.623	**1.737**				0.470
	Model B	0.553	**0.772**				0.414
	Model C	0.473	**0.579**				0.282
	Model D	0.325	**0.518**				0.226
KC	Model full			**0.456**	0.07		
	Model A			**0.959**	0.013		
	Model B			**0.361**	0.015		
	Model C			**0.478**	0.000		
	Model D			*0.160*	**0.587**		

Note: f^2 values of 0.02, 0.15 and 0.35 are considered small, medium and large at the structural level. We indicate this in normal font (small), italics (medium) and bold (large).

Table 5: Results of the structural model testing

Rel	*Model*	*Path coefficient*	*t values*	*CIS (95% bias-corrected)*	*p values*	*Sig*
KA -> KI	Model full	0.311	3.637	[0.136, 0.474]	0.000	yes
	Model A	0.691	3.460	[0.161, 0.981]	0.001	yes
	Model B	0.397	2.393	[0.022, 0.689]	0.017	yes
	Model C	0.460	2.999	[0.010, 0.683]	0.003	yes
	Model D	0.015	0.100	[-0.371, 0.259]	0.920	no
KA -> NPIC	Model full	0.463	5.506	[0.296, 0.617]	0.000	yes
	Model A	0.474	3.135	[0.197, 0.787]	0.002	yes
	Model B	0.444	3.220	[0.144, 0.658]	0.001	yes
	Model C	0.620	3.675	[0.214, 0.832]	0.000	yes
	Model D	0.289	1.366	[-0.147, 0.647]	0.172	no
KI -> NPIC	Model full	0.368	4.439	[0.202, 0.528]	0.000	yes
	Model A	0.407	2.394	[0.023, 0.685]	0.017	yes
	Model B	0.426	3.252	[0.218, 0.697]	0.001	yes
	Model C	0.129	0.722	[-0.242, 0.460]	0.470	no
	Model D	0.424	1.970	[-0.055, 0.795]	0.049	yes
NPIC -> GVCS	Model full	0.685	12.476	[0.555, 0.774]	0.000	yes
	Model A	0.797	13.080	[0.639, 0.892]	0.000	yes
	Model B	0.660	3.574	[0.234, 0.881]	0.000	yes
	Model C	0.606	7.592	[0.303, 0.706]	0.000	yes
	Model D	0.584	4.836	[0.312, 0.787]	0.000	yes
KC -> KA	Model full	0.560	8.148	[0.402, 0.676]	0.000	yes
	Model A	0.700	7.262	[0.440, 0.835]	0.000	yes
	Model B	0.515	3.596	[0.133, 0.718]	0.000	yes
	Model C	0.569	4.985	[0.187, 0.717]	0.000	yes
	Model D	0.371	2.013	[-0.111, 0.675]	0.044	yes
KC -> KI	Model full	0.274	2.782	[0.064, 0.459]	0.005	yes
	Model A	-0.127	0.513	[-0.543, 0.397]	0.608	no
	Model B	0.127	0.683	[-0.254, 0.468]	0.495	no
	Model C	-0.016	0.063	[-0.550, 0.410]	0.950	no
	Model D	0.634	6.360	[0.331, 0.778]	0.000	yes

Note: Rel=(path) relationships, CIS=95% (bias-corrected) confidence intervals, Sig=significant at 5% level (yes/no)