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Adaptation, bridging and firm upgrading: How non-market institutions and MNCs facilitate knowledge recombination in emerging markets

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Abstract

How do multinational corporation (MNC) subsidiaries and local institutions help or hinder emerging market suppliers to upgrade their capabilities? Drawing on insights from economic sociology and comparative capitalism, we posit that in these contexts of scarce resources and inferior technologies upgrading depends on the ways in which organizational and institutional networks enable firms to integrate imported advanced knowledge with local applied knowledge. Using a combination of field work and unique survey data of Argentine auto parts suppliers, we show that process upgrading improves significantly when suppliers have ties to seemingly resource-weak non-market institutions that improve access to a variety of experiential knowledge. These institutions act as knowledge bridges, helping local firms tap into diverse applied knowledge embedded in isolated industrial districts and adapt frontier advanced practices to their local conditions. Moreover, suppliers appear to benefit from ties to MNC subsidiaries only when they simultaneously collaborate with certain non-market institutions that help them recombine experiential knowledge with the standards gained from the subsidiaries.

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INTRODUCTION

Over the past 20 years, international business scholars have increasingly debated how emerging market firms might benefit from competing in global value chains and from foreign direct investment (FDI) in their home countries (Alcacer & Oxley, 2014; Meyer & Sinani, 2009). The negative and positive spillover effects onto these firms can significantly impact the ability of multinational corporations (MNCs) from advanced countries to sustain firm-specific advantages, the global competitiveness of emerging market industries and the future policies toward MNCs themselves (Dunning & Lundan, 2008; Moran, Graham, & Blomström, 2005). A key part of this debate has been to identify the factors that can enable emerging market suppliers to MNC subsidiaries to upgrade – shifting from lower to higher value-added activities via constant improvements in products and processes

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(Blalock & Simon, 2009; Spencer, 2008). Drawing on evolutionary and knowledge-based views of the firm, much of this work views upgrading as contingent on a firm accessing a variety of knowledge resources (Giuliani, Pietrobelli, & Rabellotti, 2005; Moran & Ghoshal, 1999; Song, 2002). Although the extant literature has stressed that a competitive advantage of the MNC is its ability to transfer proprietary knowledge to its subsidiaries (Buckley & Casson, 2009; Kogut & Zander, 1993), it is less clear how the broad base of local suppliers, especially with antiquated technologies and limited resources, might benefit from this knowledge and improve its capabilities.

Beyond the effects of competitive pressures, research on this issue has focused mainly on the strategies of MNCs and the responses of suppliers. Through their demands for international standards and their assistance programs, MNCs can expose upstream local suppliers to superior technologies and new practices. Suppliers with relatively strong resources and absorptive capacities will be more likely to learn from the MNCs and upgrade their capabilities (Blalock & Simon, 2009; Kumaraswamy, Mudambi, Saranga, & Tripathy, 2012; Moran et al., 2005). However, the focus on firm-level factors specific to the value chain can obscure how the organizational and institutional context in emerging markets can impede or enable broad base supplier upgrading in critical ways. For instance, while it is unlikely many local suppliers can enter into learning relationships with MNCs (Dyer & Hatch, 2006; MacDuffie & Helper, 2006; Spencer, 2008), the legacies of weak collaboration between firms and backward institutions (Henisz & Zelner, 2005; Mesquita, Lazzarini, & Cronin, 2007) greatly constrain suppliers in accessing alternative knowledge resources.

By integrating recent insights about firm learning from the economic sociology and comparative capitalism literatures, this article attempts to fill this analytical gap. It shows how emerging market suppliers can overcome these hurdles by accessing a variety of applied knowledge through non-market institutions. Viewing institutions as *resources* for strategic coordination allows one to identify a broader range of organizational forms that can shape firm capabilities (Deeg & Jackson, 2008; Dutt, Hawn, Vidal, Chatterji, McGahan, & Mitchell, 2012; Mair, Marti, & Ventresca, 2012; Perez-Aleman, 2011). In stressing the composition of knowledge networks, scholars have shown how civic and industry associations as well as government support institutions (GSIs), such as public research institutes and training centers,[1] facilitate firm access to new knowledge by creating linkages between groups of firms from different geographic and technological orientations (McEvily & Zaheer, 1999; Powell, Whittington, & Packalen, 2012; Safford, 2009; Zuckerman & Sgourev, 2006).

In extending these approaches to emerging market countries, we posit that the upgrading of local firm capabilities depends less on access to frontier technologies or resource rich institutions *per se* and more on the ways in which the organizational and institutional networks help firms integrate imported advanced practices with a variety of experiential knowledge. We show in particular how emerging market suppliers to MNC subsidiaries can improve their process capabilities through ties to seemingly resource-weak local industry associations and GSIs in two ways. First, we show how higher levels of process upgrading depends on the supplier being tied to those associations and GSIs that facilitate access to a variety of experiential knowledge embedded in previously isolated industrial districts and to the tutelage in adapting technology to local contexts. Second, we show that ties to lead MNCs are beneficial for suppliers when combined with learning ties to the aforementioned GSIs.

These results suggest that emerging market suppliers may optimally learn when they can access new knowledge from the MNCs in combination with non-market services affording a variety of applied knowledge in adapting standards and technologies to local conditions. Such findings open up the variety of institutional configurations in emerging markets that MNCs might identify as contexts contributing to their own value and, conversely, that host government and industry leaders might consider as policy alternatives.

We advance this argument by analyzing the transformation of the automotive supplier sector in Argentina. Like many emerging market countries, it attempted to improve competitiveness since 1989 through market liberalization and attracting FDI (Giuliani et al., 2005; Kumaraswamy et al., 2012), but is also noted for its dysfunctional institutions and social capital (Levitsky & Murillo, 2005). This is an apt setting for two key reasons. First, while the policies facilitated the MNCs in investing and reorganizing the industry, government and industry leaders did not create a concerted policy to improve local technological capabilities. Second, like other manufacturing value chains in emerging markets, the suppliers relied heavily on the strategies of the MNCs for knowledge flows but also remained embedded in fragmented industrial districts, each with its own manufacturing traditions, networks and institutions.

Reflecting the literatures we combine, we employ both qualitative and quantitative analyses. After a brief discussion of the industry in Argentina, we build our hypotheses about upgrading process capabilities. The third section describes our unique cross-sectional survey data set of auto suppliers from seven distinct industrial districts.[2] In discussing our results, we then offer qualitative evidence from our field work that helps specify the mechanisms underpinning the roles of key associations and GSIs in facilitating new types of supplier learning and process upgrading. While these non-market institutions lack the governance rules and joint investments from industry and the government as reported by McDermott, Corredoira, and Kruse (2009), they still are able to help suppliers access diverse local experiential knowledge and recombine it with the advanced knowledge from MNCs.

MNCs, WEAK INSTITUTIONS AND REGIONAL FRAGMENTATION IN THE ARGENTINE AUTOMOTIVE INDUSTRY

Similar to other emerging market countries in the 1990s, Argentina implemented broad pro-market policies and used tax and trade incentives to attract FDI and revive its automotive industry, which had existed since the 1930s (Humphrey & Memedovic, 2003; Kosacoff, 1999; Sturgeon & Florida, 2004). The MNCs (i.e., international assemblers and allied top-tier suppliers) took charge of reorganizing the value chain, in which MNCs dominated the first tier, and domestic firms dominated the second and third tiers (subsystems and components). Suppliers had strong incentives to improve quality and reduce costs by incorporating such practices as Just in Time, Total Quality Management (TQM), statistical process control and six sigma. Argentine suppliers also had to regularly adapt their products to feed a variety of models and platforms (Kosacoff, 1999).

During the 1990s, Argentina witnessed substantial increases in auto sales, production and investment in the industry. The automotive industry increased production capacity by almost 300%, with over US $7.3 billion of investments, $1.75 billion coming from auto parts suppliers. Seven international assemblers renovated existing plants or opened new ones, including General Motors, Ford, Chrysler, Fiat, Peugeot, VW and Renault.[3] The auto parts suppliers alone grew to account for about 3.5% of output and 38,000 employees or about 4% of manufacturing employment (Kosacoff, 1999). By 1998 half of the original 500 auto parts suppliers in 1992 had survived, including 30% of firms foreign-owned, 30% domestic, 21% minority foreign joint ventures and 19% under international license (Kosacoff, 1999). Almost half of active suppliers had ISO certification. Productivity of the sector as a whole increased by 157% between 1994 and 1999 (Español, Lugones, Porta, & Sierra, 2000). The Argentine default of 2001 caused significant short-term contractions in production and investment. Nonetheless, in 2004–2005, the auto parts sector invested over $400 million, and employment was at 45,000 (5.6% of industrial employment) as sales and exports rebounded (Lopez et al., 2008).

However, two longer-term concerns about the innovative capacities of the suppliers remained. First, government and MNCs did little to support technological and capabilities upgrading for suppliers (Kosacoff, 1999; Yoguel, Moori Koenig, & Angelelli, 1999). Similar to trends in Mexico, Brazil and East Europe (Humphrey & Memedovic, 2003), foreign owners of suppliers significantly limited investments into R&D and engineering capacities, viewing product designs and processes as "coming off the shelf" from abroad (Kosacoff, 1999). The industry lost local production of many high value-added subsystems and was passed over for investments in major R&D centers (Lopez et al., 2008). When the government created its auto investment policies, it notably left out representatives of the auto parts sector, which would later create a new sectoral association, AFAC, for lobbying. This lack of support was part of a broader trend throughout Latin America – already weak science, technology, and training institutions watched their budgets and employment decline in real terms (Sutz, 2000). In Argentina overall expenditure in these programs (public and private) barely grew in the 1990s, while key public institutions, like the national industrial technology institute (INTI), saw its employment cut by over 60% between 1992 and 2002 (Baruj, Kosacoff, & Ramos, 2009). The 1996 reorganization consolidated regional centers and laboratories, and forced INTI to increase revenues via the private sector but at the expense of small- and medium-sized firms (SMEs). Industry leaders continually criticized INTI for its backward technological capabilities, and resources remained weak through the 2000s (Baruj et al., 2009; Lopez & Ruffolo, 2001). During this period, no automotive MNC created a joint program with INTI or the standards certification institution, IRAM. Provincial governments also drastically reduced their programs in training and technology upgrading for SMEs (Ferraro, Costamagna, Mirabella, & Carmona, 2006).

Second, the auto parts sector in particular, and manufacturing in general, suffered from fragmentation and weak collaborative relationships. Studies of the automotive value chain note the sparseness of inter-firm networks and an environment of weak joint-action (Albornoz & Yoguel, 2004; McDermott & Corredoira, 2010). Similar to Brazil and Mexico, the industry remained rather fragmented, as firms were embedded in many local, isolated industrial districts scattered across the three dominant industrial provinces of Buenos Aires, Santa Fe and Cordoba that varied in terms of wealth, technological profile, competitiveness, education and public policies (Lopez et al., 2008; Yoguel et al., 1999). A relatively strong district, such as Rafaela in the province of Santa Fe, was host to auto parts, metalworking and dairy firms. It was noted for its long history of vibrant networks and local public–private institutions, such as technology and SME training centers and an external promotion agency (CEPAL, 2000). But most districts were patchworks of SMEs from a range of manufacturing sectors, often with their own local association, poor infrastructure and a spattering of public training programs. Survey and case studies of manufacturing SMEs and auto parts suppliers in the highly dense industrial districts in the northern and southern zones of Buenos Aires and the metropolitan area of Rosario (the largest in Santa Fe) found that a typical district was home to about 15–20 different manufacturing sectors (2-digit SIC), with firms reporting very few productive ties, most of which were to local and national business associations and the municipal government (Ferraro et al., 2006; Fritzsche & Vio, 2000; Sabate, 2002).

In sum, the Argentine auto parts sector presents an attractive setting for investigating the upgrading of emerging market suppliers in the face of MNC entry and a relatively weak domestic innovation system. As in other Latin American countries, the Argentine policies allowed market forces and the MNCs to substantially reorganize the value chain, increase investment and introduce modern production practices. But the industry also has lacked a coherent technology support strategy, while suppliers remain embedded in a variety of isolated industrial districts. We now examine what types of networks and institutional forms could help firms overcome these legacies to upgrade their capabilities.

UPGRADING AND ACCESS TO APPLIED KNOWLEDGE VIA TIES TO THE MNC

Following Schumpeter (1934), the development and management literatures have increasingly viewed process upgrading as a particular form of innovation, in which firms focus on creating new processes to improve efficiencies, quality and value-added by incrementally experimenting with new combinations of material, human and knowledge inputs (Giuliani et al., 2005; Kumaraswamy et al., 2012). Such capabilities are indicative of the firm's ability to adapt and compete in subsequent periods (Moran & Ghoshal, 1999; Zollo & Winter, 2002). The traditional view on supplier upgrading is that market liberalization and the entry of FDI allows the combination of competition and MNC customer demands for international production standards to create powerful incentives for suppliers to invest in required upgrading capabilities (Moran et al., 2005). Variation would largely be due to differences in supplier-level traits and resources, like ownership, size and absorptive capacities (Blalock & Simon, 2009).

An alternative view points to two related factors shaping capabilities development and knowledge diffusion for suppliers – (1) the types of knowledge needed when adapting standards or practices to new contexts and (2) the types of organizational and institutional networks in which a firm is embedded. A key assumption in the work in emerging markets about spillover effects from FDI is that because MNCs tend to bring more mature, modularized production systems, with discrete packages of technologies and interfaces, then the relevant knowledge and practices are highly standardized and can be "bought off the shelf" (Gereffi, Humphrey, & Sturgeon, 2005). However, the work on complex, apparently highly modularized manufacturing sectors such as automotives, aircraft and energy equipment has shown increasingly how the diffusion of capabilities for lean production, TQM and continuous process improvements depends on the tacit knowledge of translating the codified practices from one context to another (Camuffo & Cabigiosu, 2012; Sako, 2004). In contexts as varied as Brazil, China, the United States and Korea, ethnographic studies reveal how the emergence of new production capabilities is very much a process of adaptation, combining old and new routines and techniques (Herrigel, Wittke, & Voskamp, 2013; Kotabe, Dunlap-Hinkler, Parente, & Mishra, 2007; MacDuffie, 2013).

This research also views such processes as relational, integrating recent work on strategic networks that seeks to show not simply the accumulated value of organizational ties but particularly the relative impact of a firm's network composition (Gulati, Nohria, & Zaheer, 2000). As Fleming (2001) has argued, the process of recombination underpinning

capabilities creation demands that firms gain a variety of raw and applied knowledge not only from in-house resources but especially from the organizational and institutional network in which they are embedded. Lin (2001) has argued that an individual's or firm's network is composed of different types of organizations, which in turn, provide different types of resources and information that can shape the actor's performance in different ways. Rather than focus on an actor's total number of overall ties or an actor's location in a network, one should focus on the composition of the network resources, which are embedded in an actor's ego-networks. In turn, we focus on whether the focal firm has ties to certain types of organizations and institutions that can provide access to knowledge of value for the task at hand.

In considering the heterogeneous benefits of a firm's network composition, the recent work on the spillover benefits from MNCs in emerging markets and the automotive industry emphasizes the relative importance of strong professional ties a local supplier has with the MNCs in the value chain as opposed to ties with other market actors, such as peer firms, consultants and banks. The research in emerging markets suggests that multiple strong professional relationships with customers and assemblers, namely, MNCs, would allow domestic suppliers to directly access key, sometimes tacit information about new products, processes and superior technologies (Blalock & Gertler, 2004; Javorcik & Spatareanu, 2005; McDermott & Corredoira, 2010; Spencer, 2008). Researchers on the automotive industry have shown that these customer–supplier relationships emerge as firms jointly invest in specific routines and interactions that "permit the transfer, recombination or creation of specialized knowledge" (Dyer & Singh, 1998: 665). New knowledge and capabilities emerge for suppliers when they engage in regular, disciplined discussions with customers about adapting product designs and processes that yield joint experiments and routinized collective problem solving (Dyer & Hatch, 2006; MacDuffie & Helper, 2006). In contrast, ties to peer firms and consultants may be better at conveying well-codified knowledge than new, tacit knowledge (Spencer, 2008). For instance, research on the automotive industry in even the United States and Japan argues that the quick fix assistance common to dyadic firm relationships and consultants often does not provide the tacit knowledge and problem-solving underpinning capabilities creation in complex manufacturing systems (Helper & Kiehl, 2004; Herrigel, 2004; Sako, 2004).

In our case, MNCs have unique advanced knowledge, developed internally and transferred to their subsidiaries (Kogut & Zander, 1993). An auto part supplier can access this knowledge via ties to the MNCs in the value chain.[4] This increases the variety of knowledge available to supplier, which in turn facilitates recombination and improving its process capabilities. Hence, we hypothesize:

Hypothesis 1: The greater the number of ties the focal supplier firm has to MNCs in the value chain, the higher will be its level of process upgrading.

Alternative Channels for Access to a Variety of Applied Knowledge: Associations and GSIs

Management and development scholars, however, note that many suppliers may not benefit from the above relationships because of resource constraints and MNC strategies. Automotive researchers in advanced countries argue that deverticalization is often viewed by the MNC assemblers as the opportunity to externalize costs but not necessarily to co-invest in multiple firms throughout the value chain (Dyer & Hatch, 2006; MacDuffie & Helper, 2006). Recent work on complex manufacturing in emerging markets amplifies this view (McDermott & Corredoira, 2010; Pietrobelli & Rabellotti, 2011; Spencer, 2008). Even if local firms know "what" they are to produce for the MNC customer, they do not really know "how" or "why." Learning the latter aspects comes from practice, iterative experiments and practical examples (White, 2002). These translation problems are reinforced when the firms are far from the technological frontier and lack key resources, as adaptation of the standards demands combining them with complementary inputs, like skills and know-how, which are not readily available (Perez-Aleman, 2011). MNC subsidiaries have a limited interest in guiding such detailed, continuous training of lower tiered firms, preferring to work with a select few that made significant *ex ante* investments in their own systems (Gereffi et al., 2005; Giuliani et al., 2005; Kumaraswamy et al., 2012; Quadros, 2004).

What then might be the alternative ways in which local firms can access new applied knowledge to improve their capabilities? Integrating recent work on network resources and comparative capitalism may prove useful here in considering the impact of the different institutional configurations in which a firm is embedded (Granovetter, 2002; Padgett & Powell, 2012). Much of the research in international business stresses the view of institutions as sets of *rules* that limit opportunism and protect private

property rights (Peng, 2003). A complementary, often overlooked, view from the work on comparative capitalism understands institutions as combinations of public and private *resources* for strategic coordination and collective action that shape the capabilities of firms (Deeg & Jackson, 2008; Spencer, 2008). Societies vary often in how they create institutional resources, not simply in a rank order manner but especially in addressing similar needs but with different types of configurations. To the extent that meeting international standards needs complementary inputs, these inputs are often drawn from collective resources. This opens analysis to the diverse constellations of institutions providing knowledge and industry support (Dutt et al., 2012; Perez-Aleman, 2011).

In advanced countries, network scholars overlap with this view, highlighting how firms can benefit from ties to certain GSIs and associations with strong resources, stature and pioneering technologies (Baum & Oliver, 1991; Owen-Smith & Powell, 2004). The growing research in emerging markets, however, increasingly emphasizes that these types of institutional templates and knowledge resources are not directly applicable in less advanced countries (Perez-Aleman, 2011; Pietrobelli & Rabellotti, 2011; Thun, 2006). While advice from advanced countries stresses R&D and frontier technologies, innovation in emerging markets mostly focuses on incremental changes to absorb and apply existing practices and technologies. Moreover, science and technology institutions tend to have weak capacities, while the linkages among them and local firms are limited (Baruj et al., 2009; Sutz, 2000).

This stream of research instead places greater emphasis on non-market institutions that provide low-cost access to technology application and extension services, such as in metrology, standards, testing and quality (Pietrobelli & Rabellotti, 2011). These types of services draw on knowledge of production systems through practical examples within the resource and organizational legacies at hand. It seeks to recombine old habits and practices into new process capabilities that can meet needed performance standards (Perez-Aleman, 2011). The management literature has taken note of this evidence as well, arguing that the emergence of markets depends on the co-development of firm capabilities and the institutions facilitating such services (Dutt et al., 2012), and that positive spillover effects from FDI to developing country firms depend in part from the availability of basic skill and SME training programs (Moran et al., 2005; Spencer, 2008). This view stresses that the relevant economic institutions in emerging markets may not have the same characteristics as Western models but arise with the old institutional fragments of the past system (Dutt et al., 2012; Mair et al., 2012).

Consistent with the recombinatory view of innovation (Fleming, 2001), this line of research suggests that to improve their capabilities suppliers from developing countries may not need to access pioneering R&D as much as gain access a diversity of applied, experiential knowledge via the constellation of the evolving non-market institutions, such as schools, business associations and GSIs. As Breznitz (2005) has noted, the distinguishing traits of these institutions to support innovation are that they provide reliable channels for collective learning and knowledge diffusion as well as create forums and programs that infuse the system with trust and cooperation. Recent research in manufacturing and agriculture shows how certain industry associations and GSIs, though lacking in substantial material resources, facilitate upgrading of firm capabilities (especially in SMEs) because their services can act as repositories of diverse applied knowledge drawn from the local contexts, provide mentoring relationships and foster collaborative inter-firm relationships (Lengyel & Bottino, 2011; McDermott et al., 2009; Mesquita et al., 2007; Perez-Aleman, 2011).[5] In a highly resource constrained and volatile environment, like Argentina, this discussion opens analysis to a greater variety of institutional configurations for firms to improve their process capabilities. The diffusion of diverse knowledge may occur through training programs, applied practice sharing or repeated demonstration experiments via collective actors like industry associations and GSIs. While such activities are not trivial, they do not necessarily demand the financial, organizational and human resources associated with the collective provision of pioneering technologies.

The foregoing suggests that domestic suppliers in emerging markets are more likely to gain access to a variety of applied knowledge relevant to upgrading process capabilities by having ties to industry associations and GSIs that provide problem-solving services and venues.[6] This reasoning yields our second set of hypotheses:

Hypothesis 2a: The greater number of ties the focal supplier firm has to associations, the higher will be its level of process upgrading.

Hypothesis 2b: The greater number of ties the focal supplier firm has to GSI, the higher will be its level of process upgrading.

Accessing Diverse Knowledge via Bridging Organizations and Institutions

To the extent that linkages to MNCs and non-market institutions can facilitate firm upgrading, it is less clear what the underlying mechanisms are that improve firm access to a variety of applied, experiential knowledge. Studies on manufacturing value chains in Latin America and Asia (Giuliani et al., 2005; Herrigel et al., 2013; Kumaraswamy et al., 2012) reveal that the potential "raw material" lies in the different industrial districts, in which suppliers are embedded. Research in emerging markets often views suppliers of global value chains and MNC subsidiaries at an advantage if embedded in dense clusters of inter-firm networks and support institutions (McDermott & Corredoira, 2010; Spencer, 2008). However, recent work on innovation networks and comparative industrial upgrading has also emphasized the constraining nature of local embeddedness (Locke, 1995; McEvily & Zaheer, 1999; Safford, 2009; Uzzi, 1996). The collaborative ties and production traditions promoted by the firms and institutions of an industrial district can just as easily restrict access or blind firms to new knowledge and contacts. By drawing from too small and potentially homogenous pool of knowledge, even resource rich local associations and GSIs might not be able to sustain firm-level upgrading.

In this subsection, we offer two sets of hypotheses about the composition of network resources that can help a supplier to overcome these constraints. The research just cited above has increasingly shown how firms can access a variety of new knowledge by being tied to mediating organizations and institutions that act as social and knowledge bridges between previously isolated networks (Bell & Zaheer, 2007; Burt, 2000). For instance, Powell et al. (2012) have demonstrated that firms from the most successful high-tech regions of the United States benefit mostly from being tied to those firms and GSIs that anchor different organizational and knowledge networks. Zhang and Li (2010) show how service firms in China bridge communities of knowledge and help new ventures improve their product innovation rates. Safford (2009) and Zuckerman and Sgourev (2006) have shown how both civic and industry associations can create assistance programs in such ways that foster cross-cutting ties across isolated networks and regions and help firms learn new processes from one another's experiences. McEvily and Zaheer (1999, 2004) have shown how public technology centers helped firms from different geographic locations integrate the different applied knowledge and also build new professional relationships. Our point here is to stress how organizations can act as social and knowledge bridges in different forms but are not dependent on certain governance rules and joint investments from government and industry, as specified by McDermott et al. (2009).

These insights resonate strongly in the context of our study. As described in the section "MNCs, weak institutions and regional fragmentation in the Argentine automotive industry," the Argentine auto suppliers are historically embedded in different, often isolated industrial districts. They have ties to several associations and GSIs, yet most are geographically constrained. Moreover, inter-firm networks often constrained the supplier's access to new knowledge and professional ties because of the technological focus of the specific community and because of an over-reliance on one or two MNCs as their sources of revenue (Kosacoff, 1999). Given the path-dependent nature of network relationships, ties to firms, associations and GSIs within its industrial district can reinforce old practices or limit the suppliers from accessing new knowledge or learning processes (Gulati et al., 2000; Uzzi, 1996).

Conversely, following the above discussion, Argentine suppliers could overcome these constraints and access diverse applied knowledge resources by being tied to those organizations and institutions with diverse geographic reach across the different Argentine industrial districts. For instance, several lead MNCs in the automotive industry, such as the assemblers and their Tier 1 allies, have built supplier networks throughout the country. While a key competitive advantage of MNCs is their ability to transfer knowledge across countries (Dhanaraj, Lyles, Steensma, & Tihanyi, 2004; Kogut & Zander, 1993), here we assume that this capability can extend to different regions within a country. To the extent that the downstream MNCs use suppliers from different industrial districts in Argentina, they then might be exposed to different learning dynamics for adaptation and be able to transfer this local knowledge to suppliers across districts. Herrigel et al. (2013) have found this to be a growing trend for manufacturing MNCs using suppliers in different regions of China. Similarly, the section "MNCs, weak institutions and regional fragmentation in the Argentine automotive industry" highlighted that a few Argentine GSIs and associations, though weak in resources, were recently created or renovated in order to reach firms in a variety of geographic areas.[7] In their work on Argentine agricultural sectors, Lengyel and Bottino (2011) and McDermott et al.

(2009) suggest that this geographic reach has enabled some GSIs and associations to recombine diverse knowledge on production practices and transfer it to firms in different subnational regions.

Grounded in a learning view, the foregoing suggests that domestic suppliers are more likely to gain access to a variety of applied knowledge relevant to upgrading process capabilities by having formal and informal ties to the MNCs, associations and GSIs with high geographically diverse reach across industrial districts in Argentina. This reasoning yields our third set of hypotheses:

Hypothesis 3a: The greater number of ties a focal supplier firm has to MNCs in the value chain with high geographic diversity, the higher will be its level of process upgrading.

Hypothesis 3b: The greater number of ties a focal supplier firm has to associations with high geographic diversity, the higher will be its level of process upgrading.

Hypothesis 3c: The greater number of ties a focal supplier firm has to GSIs with high geographic diversity, the higher will be its level of process upgrading.

Much of the logic driving the theorizing for the preceding sets of hypotheses has considered ties to different alters or mediating organizations and institutions, namely, the ties to the MNCs in the value chain and those to the non-market institutions, as substitutes. An alternative approach to theorizing how suppliers can maximize access to a variety of applied knowledge would be to consider the aforementioned alters as combinatory complements. To the extent that improving production capabilities in suppliers is a process of combining new and old knowledge, then an optimal path for upgrading process capabilities would be for the supplier to combine the superior technologies and practices with the experiential knowledge and guidance found via the non-market institutions discussed above.

A critical value-added of MNCs is their ability to transfer proprietary knowledge about its production systems to its subsidiaries (Dhanaraj et al., 2004; Grant, 1996; Kogut & Zander, 1993). As noted above, the reasoning behind this advantage also suggests that the MNCs would be reluctant to adapt in any extensive manner its technological package to local conditions. While this behavior might limit the MNCs to build intensive learning relationships with suppliers throughout the host-country value chain, it would not constrain necessarily their interest or ability to expose these suppliers to advanced standards and processes. That is, strong ties to the MNCs in the value chain can still afford the supplier an understanding of key benchmarks and production systems. At the same time, the aforementioned associations and GSIs offer the supplier knowledge resources that can compensate for the limitations of the ties with the MNCs. In particular, the top bridging associations and GSIs can provide the supplier access to diverse experiential knowledge about adapting the international standard and practices to local conditions and potentially valuable tutelage about how to combine the different types of knowledge.

Hence, this approach suggests that suppliers can optimize their learning from access to a variety of applied knowledge and improve their process capabilities by having strong ties to MNCs when they simultaneously hold ties to the associations and GSIs with high geographically diverse reach. That is, the value of ties to the MNCs increases as the supplier learns via these associations and GSIs how to integrate the standards of the MNCs into their existing practices. The reasoning behind these interaction effects yields our fourth set of hypotheses:

Hypothesis 4a: The greater number of ties a focal supplier firm has to associations with high geographic diversity, the more the firm's level of process upgrading will increase by its ties to MNCs in the value chain.

Hypothesis 4b: The greater number of ties a focal supplier firm has to GSIs with high geographic diversity, the more the firm's level of process upgrading will increase by its ties to MNCs in the value chain.

DATA AND METHODOLOGY

Our data comes from a survey of Argentine auto parts suppliers that we developed and implemented in 2004–2005 in collaboration with AFAC. The universe of focal firms includes suppliers from seven different industrial districts that are historically unique in terms of their technologies and institutional features and that cut across different provinces (Cordoba, Santa Fe, San Luis and Buenos Aires). We constructed network variables that measure the degree to which the focal firm (supplier) regularly collaborates or gains key information from other firms, schools, banks, GSIs and associations. To capture the claim that firms gain access to diverse knowledge particularly via mediating alters, which themselves are tied to firms from a variety of

locations, we decomposed the most salient of the above ties (e.g., Ties to GSIs, Ties to Associations, Ties to Firms) into those that were the most central and had the highest levels of network geographic diversity and those that did not. We then ran regressions of these variables with a dependent variable of *Process Upgrading*, which our survey yielded to measure the extent to which a firm implemented practices associated with the continuous improvement of efficiencies, adaptation and quality control. (All regressions included the relevant control variables.)

Sample

The survey questionnaire was developed and adjusted based on our interviews with experts and managers in the auto parts sector, and pre-tested by submitting it to 15 auto part manufacturers in Buenos Aires. The final sample was drawn from the list of the auto part manufacturers from Buenos Aires utilized by McDermott and Corredoira (2010), and a list of auto part manufacturers from Cordoba, San Luis and Santa Fe. This resulted in a list of 154 firms that was comprehensive and included members and non-members of AFAC. We invited 115 firms to participate in the survey, and 27 declined. This resulted in a total of 88 firms that received the survey of which 62 responded. Due to inconsistencies and missing data the sample was reduced to 59 firms (response rate of 67%). In our sample, the average number of employees is 130, with a median of 90 and ranging from 6 to 516. The average number of employees with college degrees is 11, with a median of 7 and ranging from 0 to 47. Forty five percent of the firms have received FDI, with an average stake of 44%. According to industry data and experts, these demographics were representative.

Dependent Variable

Process upgrading captures innovation that focuses on implementation of new processes to achieve efficiencies, adaptation and improved quality control (Fleming, 2001; Giuliani et al., 2005). We measured it by asking respondents to assess the extent to which their firms implemented several practices associated with process upgrading in this context using a 5-point scale (e.g., 5 indicating total agreement), a procedure utilized in extant literature (MacDuffie, 1995; Zollo & Winter, 2002). Our interviews with auto part manufacturers yielded the practices, which were confirmed by a team of experts from AFAC, and included: regular employee training, improvement in quality control, promotion of employee innovation, and re-organization and improvement of manufacturing systems. For example, we asked informants to indicate the degree of agreement (in a 5-point scale from totally agree to totally disagree) with statements like: "The quality department has increased its effectiveness in improving the quality of our products" or "Our company has made important improvements in manufacturing processes." (For a full list of questions, see the Appendix.)

Explanatory Variables

Network data was generated following the approach in McDermott et al. (2009). Respondents were asked to identify firms (up to five) and non-firm entities (up to five)[8] with which they regularly interacted, collaborated or exchanged information regarding specific strategic areas, such as product development, production methods, technology acquisition, training, marketing and exports (see Appendix). We validated and classified responses into five categories: associations (trade, peak level, etc.); banks; firms (auto part manufacturers, assemblers, technology suppliers, etc.); GSIs; and schools (universities, technical schools, etc.). We also decomposed alter firms into MNC firms in the value chain and all other firms.[9]

We constructed a two-mode network (focal firms as egos and firms, and non-firms organizations as alters) where ties were defined by a relationship between a focal firm and an alter that provided the firm with relevant information in a series of areas. Our measures reflect multiplex characteristics of the relationship (Cross, Borgatti, & Parker, 2001) by counting all the mentions to the same alter across all the types of information received. By adopting this approach we account for the strength of the ties (McDermott et al., 2009), a relevant aspect since multiplex relationships provide the repeated interactions that facilitate knowledge transfer (Hansen, 1999). We apply a log transformation to all the ties variables to correct the distribution skewness.

In order to capture the exposure to an alter's knowledge and influence, we utilize the count of ties to the organizations and institutions (Borgatti, 2005). We decomposed the different types of organizations and institutions following McDermott et al.'s (2009) approach and based on field interviews. First, we assumed homogeneity of all the alters and generated *Ties to all alters* as the count of all the mentions by the focal firm to any alter. Second, we relaxed the homogeneity assumption and generated variables following standard methods (Lin, 2001; McDermott et al., 2009; Owen-Smith & Powell, 2004). This approach captured the composition and structure of the focal

firm's ego network. This generated six variables as the counts of ties to MNC, non-MNC firms, associations, banks, GSIs and schools. Third and in order to capture the exposure of the focal firm to MNCs, associations and GSIs with access to more diverse knowledge, we further decomposed variables for MNCs, associations and GSIs into *Ties to high geographically diverse alter* and *Ties to not high geographically diverse alter*. We calculated the diversity of geographic zones reached by the alter (MNCs, associations and GSIs) by examining an alter's direct ties to firms in seven different zones or industrial districts.[10] Following our above discussion, the geographic diversity is a proxy for the diversity of the bodies of knowledge accessed through network ties. The experiential knowledge and resources embedded in these districts differ since they emerged relatively independently during different phases of industrialization policies, and thus also vary in their organizational and institutional composition. Though we lacked information about the complete network, our random sample of firms provided adequate information to generate unbiased estimations of such a measure (Frank, 2005). For each alter, we counted the total number of ties to firms in our sample and assigned the ties to districts according to the geographic location of the surveyed firm identified in the relationship. These district counts were then used to derive a Herfindahl index score for each alter based on the number of ties to each district. Alters were ranked from highest to lowest on the basis of their diversity scores, and the top decile was selected. We generated three variables by counting the number of ties that a focal firm had to these geographically most diversified alters (i.e., for MNCs, associations and GSIs) and another three counting the number of ties that a focal firm had to those alters not in that group.

Control Variables

Indicator variables for region capture location fixed effects (e.g., local resources and natural endowments) and systematic error in the measurement of our perceptual dependent variable. Since respondents might have used the performance of their neighbors as anchors, we could not infer upgrading differences between regions by comparing the coefficients of different districts. Due to the limited degrees of freedom and to control systematic differences in the anchoring of upgrading perceptual measures, we report models that control for three regions (Buenos Aires, San Luis-Cordoba and Santa Fe). As robustness check of our assumption, we ran ANOVA for the seven industrial districts, and then when grouping the districts grouped into five and three zones. There were no significant differences in Process Upgrading.

Following extant research in emerging markets and in the automotive industry (Giuliani & Bell, 2005; McDermott & Corredoira, 2010), we utilize two variables to control for differences in absorptive capacity (Cohen & Levinthal, 1990) and learning capabilities: *Foreign ownership*, a bounded variable between 0 and 1.0 that measures the percentage of foreign ownership in the focal firm and controls for access to superior resources and capabilities, and *Knowledge stock*, the natural log of the count of professionals in the firm. To capture privileged access to knowledge from assemblers, we use a dummy variable for whether a firm is located in *Tier1*. We control for firm age, a well-established driver of inertia. To capture the effects (positive or negative) of the different final assembler in the value chain, we use a dummy variable (*Assemblers*) if the supplier focused production on assemblers with above average effect on process upgrading.[11]

In order to control for the effects of a firm's demand structure and positioning choice, we introduced *Sophistication Intent*, a 2-item perceptual index that shows the firm's choice to allocate resources to increase the sophistication of their products (Cronbach's α coefficient of 0.68). We asked informants to indicate the degree of agreement (in a 5-point scale from totally agree to totally disagree) with the engaging in product design and assembly of complex components (for questions see the Appendix). Although we controlled for capabilities, the inclusion of *sophistication intent* (inferred from firm actions) added an additional control for unobserved differences in cognition (e.g., managers' ability to understand the benefits of upgrading) and incentives (e.g., market demand faced by the firm), both drivers of firm actions (Kaplan, 2008). Our field work shows that firms were under pressure from MNCs to improve their efficiency, but MNCs were not imposing demands for product design or increased product complexity. Given the relatively small size of our suppliers, the questions in this measure revealed allocation of limited resources in a way that was consistent with acting on a perceived lack of demand for process upgrading. For this reason, we expect a negative relationship between the *sophistication intent* and process upgrading variables.

Methodological Issues and Statistical Inference

As with every survey data, our data collection is exposed to non-response bias and common method

variance. In order to increase participation and minimize non-response bias we followed well-established procedures, including gaining the enthusiastic approval of the project by the relevant sectorial association and inviting firm owners/directors by mail and telephone to participate in the survey (Buse, 1973; Hansen & Robinson, 1980). In order to minimize the common method variance we followed procedural remedies proposed by Podsakoff, MacKenzie, Lee, and Podsakoff (2003). The survey from where we extracted the data includes more than 80 questions. As confirmed in follow up interviews, it took between 90–120 min to respond and its comprehensiveness demanded the participation of several firm members to collect all the information required. The length and comprehensiveness allowed us to create psychological separation between our dependent and independent variables, while the multiple respondents also created physical separation. For these reasons, we pose that common variance bias, which inflates the correlations between dependent and independent variables, is not a serious problem in our case.

To test our hypotheses, we ran robust regressions (PROC ROBUSTREG, SAS version 9.3) with least trimmed squared (LTS) estimation (Rousseeuw, 1984), which generates Ordinary Least Squares estimates robust to the presence of outliers. Our models regress *Process Upgrading* on our variables of interest.[12] We first introduce Model A as the baseline including our control variables and the total count of ties to all alters. Models B, C, D and E proceed to four different decompositions of the *Ties to All* variable in Model A. The decomposition strategy followed for *Ties to All* allows us to study the effect of ties to different alters but also precludes us to enter variables from one model into another when it causes a repeated count of the same ties. In other words, when a type of tie is decomposed, we cannot simultaneously enter decomposed and non-decomposed variables in the same model. For instance, we test Hypotheses 3b and 3c in Models C and D, using different way to account for Ties to MNCs. Also, in Models B, C, D and E, we always account for ties to all different types of alters, but we decompose or group them differently to include proper controls and manage limited degrees of freedom.[13]

Table 1 presents a summary description and Table 2 the correlation matrix and descriptive statistics for our variables. Some correlations are moderately high; nevertheless, collinearity between variables is not a problem according to Variance Inflation Factor and tolerance tests (SAS v. 9.2).

RESULTS

Table 3 presents the results of our regressions. Our models' unit of analysis is the auto part supplier firm, and the dependent variable is the firm's level of process upgrading. In general, the directions of our control variables behave as expected, yet they often do not reach significance. We found significant differences between assemblers that promote and those that hinder upgrading as well as inertia effects in Models B, C and D (effect of age is negative and significant). We did not find significant effects for location. As expected, sophistication intent is negative and significant across models. The effects of knowledge stock and FDI are often not significant across the models.

Hypothesis 1 does not receive support in Model B. The estimate for ties to MNC is negative and marginally significant, but, as discussed below, Model E estimation qualifies this result. Hypotheses 2a and 2b are supported by positive and significant estimates for ties to associations and GSIs ($\beta = 0.57$ and 0.65, p-value <0.05 and 0.01, respectively). In Model C, Hypothesis 3a does not find support, as Ties to High GeoDiversity MNCs (measured as MNC subsidiaries reach to the seven Argentine districts) is not significant, but Hypotheses 3b and 3c are supported. The estimates for ties to High GeoDiversity Associations and GSIs are positive and significant across Models C, D and E (β range from 0.54 to 0.66 and from 0.50 to 0.58 with p-value <0.05, respectively). In Model E, Hypothesis 4a is not supported, but Hypothesis 4b is supported ($\beta = 0.21$, p-value <0.05).[14]

To further explore the significant interaction supporting Hypothesis 4b, we plot Process Upgrading on Ties to MNCs for different levels of Ties to High GeoDiversity GSIs with all the remaining covariates at average levels (see Figure 1). This plot is done for the relevant ranges of Ties to MNCs and Ties to High GeoDiversity GSIs. The Ties to MNCs increase the level of Process Upgrading as the number of Ties to High GeoDiversity GSIs increases. The plot also shows that Ties to MNCs in the absence of Ties to High GeoDiversity GSIs can have a detrimental effect on the level of Process Upgrading of the focal firm. Overall, Figure 1 confirms and qualifies the lack of support for Hypothesis 1 from Model B: the effect of Ties to MNCs is negative only in the absence of Ties to High GeoDiversity GSIs. The positive effect of an additional Tie to MNCs increases as the firm has more Ties to High GeoDiversity GSIs.

While Model B presents a test of the effect of embeddeness in networks of different organizations

Table 1 Variable summary

Variable	Variable type	Description
Process Upgrading	Continuous	7-item index capturing the extent in which focal firm implemented several practices associated with the upgrading of processes leading to higher value
Log(Age)	Continuous	Natural log of the age of the firm
Log(Knowledge Stock)	Continuous	Natural log of the count of employees with professional degrees
Foreign Ownership	Bounded (1–100)	Percentage of foreign ownership
San Luis-Cordoba	Dichotomous	Firm located in San Luis or Cordoba provinces
Santa Fe	Dichotomous	Firm located in Santa Fe province
First Tier	Dichotomous	Position of the firm in automotive value chain (direct supplier of OEM)
Assemblers	Dichotomous	Position of the firm in automotive value chain (significant supplier of one of the top OEMs promoting supplier upgrading of capabilities)
Sophistication Intent	Continuous	Index derived from questions that capture the intention of the engaging in sophisticated manufacturing
Log(Ties to All)	Continuous	Natural log of the count of ties to associations, banks, firms, GSIs and schools
Log(Ties to Banks)	Continuous	Natural log of the count of ties to banks
Log(Ties to Schools)	Continuous	Natural log of the count of ties to schools
Log(Ties to Associations)	Continuous	Natural log of the count of ties to associations
Log(Ties to GSIs)	Continuous	Natural log of the count of ties to GSIs
Log(Ties to MNCs)	Continuous	Natural log of the count of ties to MNCs
Log(Ties to Not-MNCs)	Continuous	Natural log of the count of ties to firms that are not MNCs
Log(Ties to not-MNC, Banks, and Schools)	Continuous	Natural log of the count of ties to not MNCs, banks and schools
Log(Ties to High Centrality Associations)	Continuous	Natural log of the count of ties to associations in the top-centrality decile
Log(Ties to NOT-High Centrality Associations)	Continuous	Natural log of the count of ties to associations not in the top-centrality decile
Log(Ties to High Centrality GSIs)	Continuous	Natural log of the count of ties to GSIs in the top-centrality decile
Log(Ties to NOT-High Centrality GSIs)	Continuous	Natural log of the count of ties to GSIs not in the top-Geo. Diversity Reach decile
Log(Ties to High GeoDiversity Associations)	Continuous	Natural log of the count of ties to associations in the top-Geo. Diversity Reach decile
Log(Ties to NOT-High GeoDiversity Associations)	Continuous	Natural log of the count of ties to associations not in the top-Geo. Diversity Reach decile
Log(Ties to High GeoDiversity GSIs)	Continuous	Natural log of the count of ties to GSIs in the top-Geo. Diversity Reach decile
Log(Ties to NOT-High GeoDiversity GSIs)	Continuous	Natural log of the count of ties to GSIs not in the top-Geo. Diversity Reach decile
Log(Ties to High GeoDiversity MNCs)	Continuous	Natural log of the count of ties to MNCs in the top-Geo. Diversity Reach decile
Log(Ties to NOT-MNCs, Banks, Schools, and not-High GeoDiversity MNCs)	Continuous	Natural log of the count of ties to Banks, Schools, not MNCs and MNCs not in the top-Geo. Diversity Reach decile

and distinguishes the positive effects of non-market actors – such as associations and GSIs – Models C, D and E test hypotheses based on a learning perspective under conditions that favor a more incremental adaptation of existing technology. The motivation behind Hypotheses 3 and 4 was essentially that if access to diverse knowledge is key, then higher levels of upgrading should be associated with ties to alters that have the highest bridging traits but not with ties to alters that lack these traits. The results broadly confirm our claim. As we discuss in the next section, the lack of significant effects for Ties to High GeoDiversity MNCs can be attributed to MNC characteristics and strategic choices. The significant estimate

Table 2 Correlation matrix and descriptive statistics

		v1	v2	v3	v4	v5	v6	v7	v8	v9	v10	v11
v1	*Process Upgrading*	1										
v2	*Log(Age)*	0.13	1									
v3	*Log(Knowledge Stock)*	0.02	0.28	1								
v4	*Foreign Ownership*	−0.07	0.04	0.40	1							
v5	*San Luis-Cordoba*	0.00	−0.11	0.06	−0.15	1						
v6	*Santa Fe*	0.17	0.13	−0.04	−0.12	−0.24	1					
v7	*First Tier*	−0.07	−0.05	0.14	0.16	0.2	−0.28	1				
v8	*Assemblers*	−0.29	0.10	0.14	−0.04	0.02	−0.19	0.11	1			
v9	*Sophistication Intent*	−0.05	−0.11	−0.08	−0.05	0.00	0.03	−0.13	−0.12	1		
v10	*Log(Ties to All)*	0.03	0.11	0.27	0.06	0.17	0.11	0.12	−0.26	−0.16	1	
v11	*Log(Ties to Banks)*	−0.22	0.12	0.14	0.02	0.01	0.06	−0.01	−0.17	−0.01	0.48	1
v12	*Log(Ties to Schools)*	−0.21	−0.16	0.09	−0.05	0.36	−0.03	0.16	0.13	0.06	0.23	−0.22
v13	*Log(Ties to Associations)*	0.23	0.30	0.31	−0.04	0.19	0.19	−0.07	−0.16	−0.09	0.49	0.16
v14	*Log(Ties to GSIs)*	0.12	0.18	0.00	−0.26	−0.03	0.53	−0.22	−0.17	−0.09	0.23	0.14
v15	*Log(Ties to MNCs)*	0.01	0.07	0.16	0.25	0.02	−0.12	0.15	−0.27	−0.28	0.46	0.33
v16	*Log(Ties to Not-MNCs)*	0.10	−0.02	0.09	−0.03	0.06	−0.04	0.13	−0.22	−0.06	0.84	0.35
v17	*Log(Ties to not MNC, Banks, and Schools)*	0.03	−0.03	0.09	−0.07	0.13	−0.02	0.14	−0.19	−0.06	0.85	0.40
v18	*Log(Ties to High GeoDiversity Associations)*	0.03	0.17	0.19	0.17	−0.21	−0.01	0.11	0.07	−0.08	0.19	−0.03
v19	*Log(Ties to Not-High GeoDiversity Associations)*	0.28	0.22	0.34	−0.04	0.40	0.20	−0.10	−0.26	−0.08	0.52	0.27
v20	*Log(Ties to High GeoDiversity GSIs)*	0.04	−0.05	0.10	0.01	0.11	0.24	−0.08	0.05	−0.03	0.12	0.02
v21	*Log(Ties to Not-High GeoDiversity GSIs)*	0.20	0.28	−0.06	−0.36	−0.06	0.56	−0.34	−0.20	0.01	0.26	0.23
v22	*Log(Ties to High GeoDiversity MNCs)*	−0.05	0.11	0.28	0.19	0.03	−0.27	0.29	−0.08	−0.19	0.47	0.19
v23	*Log(Ties to not MNC, Banks, Schools, and Not-High GeoDiv GSIs)*	−0.10	−0.09	0.17	0.13	0.12	−0.11	0.19	−0.21	−0.14	0.86	0.45
Average		16.39	3.04	1.92	0.44	0.20	0.19	0.64	0.64	5.85	2.70	−1.35
Standard error		5.19	0.95	1.15	0.46	0.41	0.39	0.48	0.48	2.46	0.67	2.16

		v12	v13	v14	v15	v16	v17	v18	v19	v20	v21	v22	v23
v12	*Log(Ties to Schools)*	1											
v13	*Log(Ties to Associations)*	0.16	1										
v14	*Log(Ties to GSIs)*	0.09	0.24	1									
v15	*Log(Ties to MNCs)*	−0.15	0.10	−0.09	1								
v16	*Log(Ties to Not-MNCs)*	0.17	0.22	0.04	0.21	1							
v17	*Log(Ties to not MNC, Banks, and Schools)*	0.28	0.25	0.09	0.17	0.98	1						
v18	*Log(Ties to High GeoDiversity Associations)*	0.08	0.61	−0.01	0.04	0.10	0.08	1					
v19	*Log(Ties to Not-High GeoDiversity Associations)*	0.17	0.70	0.27	0.13	0.25	0.29	0.08	1				
v20	*Log(Ties to High GeoDiversity GSIs)*	0.21	0.08	0.65	−0.16	−0.04	0.04	−0.10	0.16	1			
v21	*Log(Ties to Not-High GeoDiversity GSIs)*	−0.03	0.31	0.79	0.03	0.10	0.10	0.04	0.31	0.19	1		
v22	*Log(Ties to High GeoDiversity MNCs)*	−0.12	0.23	−0.21	0.63	0.31	0.26	0.18	0.22	−0.25	−0.09	1	
v23	*Log(Ties to not MNC, Banks, Schools, and Not-High GeoDiv GSIs)*	0.26	0.17	0.04	0.43	0.86	0.87	0.04	0.21	0.01	0.05	0.28	1
Average		−1.35	−0.13	−1.18	−0.26	1.73	2.02	−1.27	−1.27	−2.27	−1.87	−1.23	2.24
Standard error		2.18	1.89	2.22	2.34	1.27	1.27	1.97	2.12	1.84	2.11	2.40	0.82

Table 3 Results of robust regression analysis with process upgrading as dependent variable

Parameter		Model A estimate	Model B estimate	Model C estimate	Model D estimate	Model E estimate
Intercept		25.08(3.17)***	23.87(2.72)***	30.39(2.96)***	30.92(3.00)***	26.74(2.78)***
Log(Age)		–0.65(0.49)	–1.49(0.48)***	–1.19(0.51)**	–1.19(0.52)**	–0.56(0.52)
Log(Knowledge Stock)		0.35(0.44)	0.20(0.37)	0.55(0.43)	0.49(0.44)	0.22(0.41)
Foreign Ownership		0.21(1.12)	2.06(0.99)**	–0.37(1.07)	–0.23(1.10)	–0.11(1.07)
San Luis-Cordoba		–0.84(1.10)	–1.45(1.04)	–1.27(1.24)	–1.16(1.26)	–0.69(1.18)
Santa Fe		2.22(1.30)*	0.77(1.20)	0.24(1.55)	0.82(1.51)	1.21(1.40)
First Tier		–1.72(1.01)*	–1.35(0.84)	–0.62(0.95)	–0.67(0.96)	–1.85(0.94)
Assemblers		–0.15(0.18)	–0.21(0.16)	–0.35(0.17)	–0.34(0.18)	–0.26(0.17)
Sophistication Intent		–2.33(0.95)**	–1.41(0.87)	–3.23(0.93)***	–3.10(0.98)***	–2.88(0.92)***
Log(Ties to All)		–0.98(0.77)				
Log(Ties to Banks)			–0.44(0.21)**			
Log(Ties to Schools)			–0.43(0.21)**			
Log(Ties to MNCs)	*(H1)*		–0.33(0.18)*		–0.12(0.20)	0.26(0.32)
Log(Ties to Not-MNCs)			–0.09(0.40)			
Log(Ties to Associations)	*(H2a)*		0.57(0.23)**			
Log(Ties to GSIs)	*(H2b)*		0.65(0.20)***			
Log(Ties to not MNC, Banks, and Schools)					–1.52(0.61)**	–0.43(0.38)
Log(Ties to High GeoDiversity MNCs)	*(H3a)*			–0.32(0.20)		
Log(Ties to Not-MNCs, Banks, Schools, and Not-High GeoDiversity MNCs)				–1.22(0.55)**		
Log(Ties to High GeoDiversity Associations)	*(H3b)*			0.66(0.21)***	0.60(0.22)***	0.54(0.21)**
Log(Ties to Not-High GeoDiversity Associations)				0.05(0.27)	0.05(0.28)	–0.15(0.26)
Log(Ties to High GeoDiversity GSIs)				0.51(0.24)**	0.50(0.24)**	0.58(0.23)**
Log(Ties to Not-High GeoDiversity GSIs)	*(H3c)*			0.29(0.28)	0.26(0.28)	0.08(0.27)
*Log(Ties to MNCs)*Log(Ties to High GeoDiversity Associations)*	*(H4a)*					0.06(0.09)
*Log(Ties to MNCs)*Log(ties to High GeoDiversity GSIs)*	*(H4b)*					0.21(0.10)**
R^2		0.51	0.60	0.61	0.65	0.64

*p-value <0.10, **p-value <0.05, ***p-value <0.01.
Notes: Results for Robust Regression with LTS estimation. Standard errors in parenthesis, Buenos Aires Zone is the omitted location.

for the interaction between Ties to MNC and Ties to High GeoDiversity GSIs further supports the thesis of these GSIs developing the firm's ability to learn from external knowledge.

As noted in the previous section, the statistical analysis can suffer from problems of endogeneity because of its cross-sectional nature. For instance, given the lack of longitudinal statistical evidence, one could still argue that upgrading is driven by unobserved inter-firm relationships or that the most prominent GSIs and associations mainly work with firms with superior capabilities. To partially overcome these limitations, we offer below additional qualitative analysis about why certain types of alters appear to be contributing to process upgrading in suppliers. As we will discuss in the next section, the qualitative analysis suggests that self-selection is not a major empirical problem – firms of all pedigrees have ties to the relevant GSIs and associations and, conversely, the relevant GSIs and associations not only have limited capacities but also their bridging qualities were in many ways the by-product of other objectives. The combination of qualitative and quantitative the analyses, in turn, reveals less a definitive theory of upgrading and more a plausible explanation about how institutional resources can improve firm access to a variety of applied knowledge (O'Mahony & Ferraro, 2007; Uzzi, 1996).

DISCUSSION

Our analysis has aimed to reassess how the institutional and organizational embeddedness of emerging market suppliers, in the face of MNC entry and market liberalization, shapes their abilities to access

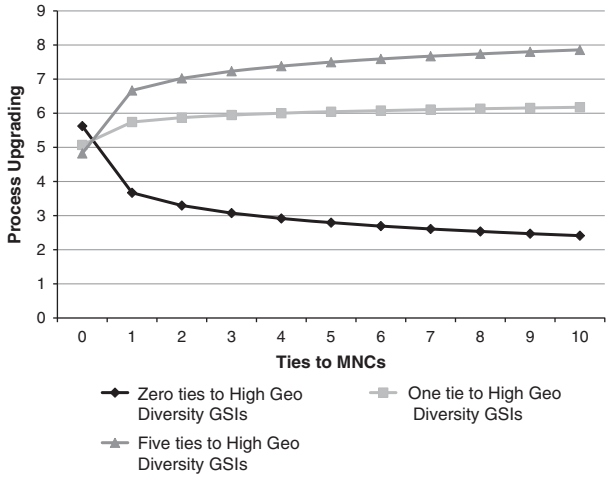


Figure 1 Effect of ties to MNCs on Process Upgrading for three levels of Ties to High GeoDiversity GSIs.

a variety of applied knowledge and improve their process capabilities. Suppliers must learn not just what international standards and practices they must satisfy but particularly how to translate and integrate them into their local context of more antiquated technologies and systems. Such a process of recombination demands tutelage and access to related local experiential knowledge that can be impeded by the supplier's limited resources and balkanized industry structure. By combining recent work from comparative institutional and network analysis, we first focused on how ties to MNCs in the value chain, associations and GSIs might help a supplier overcome these constraints and upgrade its processes. We then advanced hypotheses examining the underlying recombinatory learning mechanisms.

We found that multiple strong ties to associations and GSIs, especially to the top bridging ones, had a consistently positive impact on supplier process upgrading. Previous research on innovation and strategy in advanced countries has increasingly revealed the benefits firms gain from ties to non-market institutions. This work largely emphasizes ties to resource rich, prominent organizations and institutions that offer firms robust material resources, pioneering knowledge and technology, and increased legitimacy (Baum & Oliver, 1991; Owen-Smith & Powell, 2004). But in the context of emerging markets like Argentina, the suppliers appear to be in greater need of applied, experiential, local knowledge for adaptation and recombination that can be obtained from non-market institutions that are weak in resources and stature. Management scholars have indeed increasingly shown this to be the case in other developing countries (Dutt et al., 2012; Mair et al., 2012; Perez-Aleman, 2011). In particular, they emphasize institutional constellations that provide efficient channels for collective learning and knowledge diffusion and infuse the relevant actors with a sense of collaboration via forums for debate on common problems (Breznitz, 2005; McDermott et al., 2009; Zuckerman & Sgourev, 2006).

Our field work in Argentina found that rather basic, intuitive efforts in training and relationship building reinforced the abilities of a few non-market institutions to take advantage of their bridging traits and provide firms with improved access to a variety of applied knowledge. What is particularly relevant here is that neither the governments (federal or provincial) nor the MNCs had undertaken notable coordinated, coherent efforts to build new institutions or services for the suppliers.

For instance, two of the GSIs with the highest measures of bridging were the previously mentioned INTI and IRAM. Despite having long histories and national reach, these GSIs have been the object of continued criticism for the last two decades for their declining budgets and personnel, fragmented internal organization, and relatively backward technological and R&D capacities (Baruj et al., 2009; Lopez & Ruffolo, 2001). A change in their relationship with the suppliers emerged from a new 1998 transportation law, requiring, among other things, the testing of all new or altered auto parts to meet certain safety standards. INTI and IRAM were the designated certifiers. From this experience, a few engineers in both GSIs began speaking with auto parts suppliers to learn of other needs that perhaps they could meet. A major complaint was that the MNCs could tell them what the standard was, but were not willing to spend time or resources explaining the underlying logic or problem-solving with the suppliers about how to reorganize the relevant capabilities. In turn, two of the most common requests were related to basic testing services – the aforementioned safety certification and testing components to meet the standards of the MNCs (done by INTI, rather than having them sent back to the MNCs headquarters as was common practice). These services not only saved time and costs, but also accelerated firm upgrading since the supplier learned from the engineers where the defects were occurring and how to remedy them. Indeed, a case study of component suppliers showed that INTI was one of the only institutions with

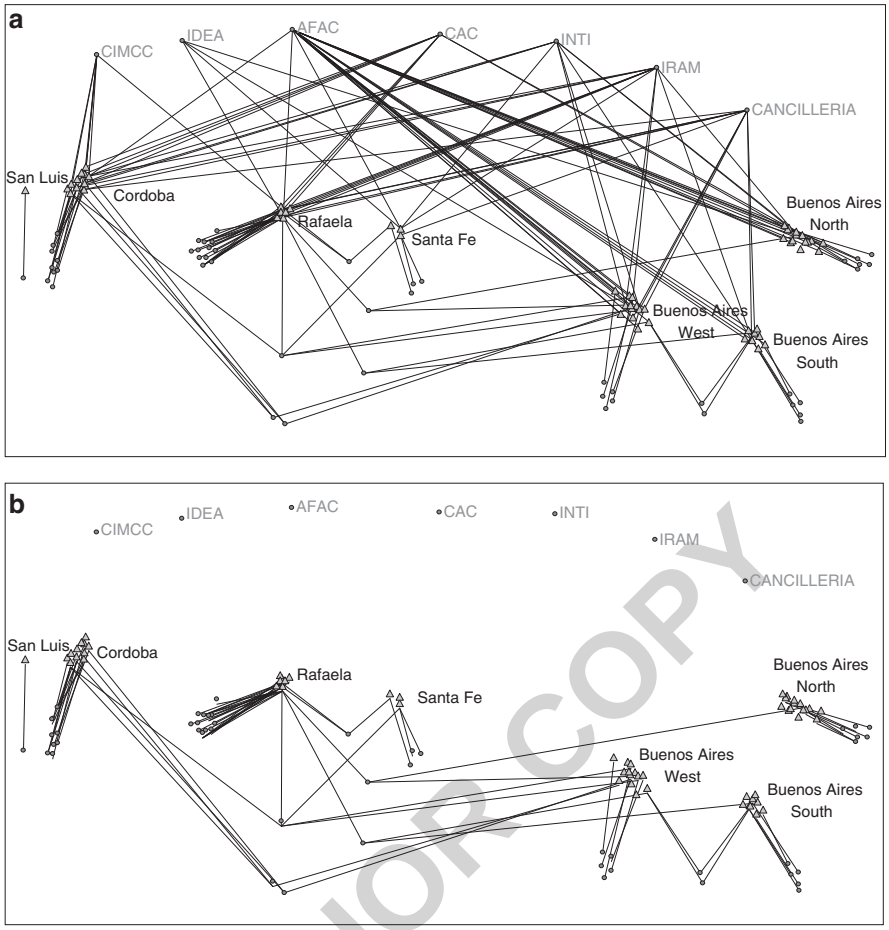
reliable assistance programs for helping firms improve basic process capabilities (Motta & Morero, 2008). In our case, firms and engineers noted that INTI and IRAM helped suppliers overcome the gaps in "knowing how" and "knowing why" because they could integrate different experiences and practical examples they gained from aiding clients in diverse organizational contexts. In this sense, the GSIs became repositories of diverse experiential knowledge via their testing and extension services for firms in different industrial districts (McDermott et al., 2009; McEvily & Zaheer, 1999; Perez-Aleman, 2011).

A common view of the benefits of associations, even in emerging markets, is that they can help members forge professional relationships and coordinate investments, and in turn provide direct material support via lobbying and advanced training services (Mesquita et al., 2007). In our case, the benefits appear less directly material and more in advancing learning via access to a variety of applied knowledge. As mentioned in the section "MNCs, weak institutions and regional fragmentation in the Argentine automotive industry," Argentina, like many Latin American countries, is home to a plethora of business associations, with both local and industry-wide profiles. But these organizations tend to focus on basic lobbying or can fragment coordination within an industry (Schneider, 2004). In contrast, the most bridging associations in our data gradually created programs, which in many ways reflect the mechanisms for establishing new cross-cutting ties that were emphasized by other scholars in different contexts (McEvily & Zaheer, 2004; Safford, 2009; Zuckerman & Sgourev, 2006). The case in point is AFAC. Recall from the section "MNCs, weak institutions and regional fragmentation in the Argentine automotive industry" that AFAC was created in 1994 to provide collective voice because the auto parts suppliers were excluded from government negotiations with the MNCs. But what was distinct from other trade associations was that AFAC gradually made consistent efforts to provide their member firms with domestic and international information that was difficult to gain on their own. AFAC built up a small group of experts to collect and organize key industry data on a regular basis. It also created regular forums in which the members from different industrial districts learned about major trends and standards in the industry, debated their key priorities and activities, and especially learned directly from one another about their respective strategies, practices and results. In turn, these activities not only provide members with unique benchmarking and practical information, but especially create forums that could act as "network facilitators," with firms from different districts building relationships and sharing critical experiential knowledge (McEvily & Zaheer, 2004; Safford, 2009).

It appears that organizations like INTI and AFAC, despite their limited resources, became vital conduits of new knowledge for suppliers because they acted as social and knowledge bridges in two ways. They became repositories of diverse and important standards and practices with the capabilities to transfer them to the firms themselves. They also helped firms learn directly from one another and build new professional ties. The evidence suggests that the institutional constellations that help firms access a variety of knowledge resources can emerge not from being blessed *ex ante* with endowments of large material resources or a coherent industry network, but rather from creating mechanisms fostering a broader learning community that can penetrate isolated producer communities.

We illustrate this point in Figures 2a and b. Using NetDraw (Borgatti, 2005), we show in Figure 2a the aggregate ego network of the 59 firms in the sample and their ties to associations and GSIs. Focal firms are represented by triangles and clustered according to one of the seven industrial districts mentioned above. Associations and GSI's are represented by circles, and the ties to firms are simply binary counts. At the top of Figure 2a are the associations and GSIs with the most geographic diverse reach. As can be seen, the density of connections and the redundancy of ties across districts is supported by the associations, AFAC, CAC and IDEA, and by the GSIs, INTI, IRAM and CANCILLERIA.[15] Figure 2b shows the same ego networks after deleting the ties to these associations and GSIs. Ties to the other GSIs and associations remain, but the different industrial districts become mostly isolated.

The results from our models with the interaction variables also give greater insight into the different roles played by MNCs, associations and GSIs in contributing to supplier upgrading. Although ties to MNCs alone may not help process upgrading in suppliers, they do appear to have added value when combined with ties to GSIs with high geographic diversity. For instance, the evidence from Model E and Figure 1 suggests that for suppliers without ties to geographically diverse GSIs (68% of our sample), the increase of ties to MNCs may not improve their process upgrading. However, when suppliers have ties to these GSIs, ties to MNCs can increase the level of supplier process upgrading.



Figures 2a and 2b Two-mode network of relationships in the Argentine auto parts sector.

There are two complementary explanations for these results. On the one hand, suppliers may be maximizing their access to different types of knowledge when combining their exposure to both advanced technologies and practices via the MNCs and diverse experiential knowledge from different industrial districts via the GSIs. Moreover, the most geographically diverse GSIs help the suppliers learn from and catalyze the knowledge from MNCs. GSIs through the training and testing programs discussed above may be proactively helping suppliers integrate the two types of knowledge, which coincides with studies on the benefits of basic training programs in advanced and developing countries (Herrigel, 2004; McEvily & Zaheer, 1999; Perez-Aleman, 2011).

On the other hand, these results indicate the flipside of the competitive advantage of MNCs found in the management literature. The very competitive advantage that MNCs derive from transferring proprietary knowledge and key technologies to their subsidiaries can act as a deterrent to adapt them to different contexts for the benefit of local suppliers. Similar to the behavior of automotive assemblers in advanced countries, the MNC subsidiaries may give a higher priority to pushing the adoption of their "technological packages" and focusing on cost reductions than working closely with suppliers to combine local and new knowledge or co-invest in new capabilities (Herrigel, 2004; MacDuffie & Helper, 2006). This behavior strongly limits the number of collaborative relationships between customers and suppliers, particularly to those that already have strong process capabilities (Dyer & Hatch, 2006; Sako, 2004). Our own interviews with Argentine suppliers revealed that given their resource constraints pure adoption without adaptation becomes unhelpful. Moreover, they note that while the assembler MNCs offer little experiential knowledge, Tier 1 MNCs resist problem-solving relationships with lower tier supplier because of cost pressures from above.

These contrasting results about the value of ties to MNCs may also help reconcile the different views in

the literature about the effect of MNCs in promoting supplier upgrading in emerging market countries. The empirical inconsistencies in extant studies may be driven by the absence or presence of institutions like the aforementioned GSIs that facilitate the learning from adapting the knowledge brought by MNCs to more backward and volatile settings. Conversely, the results suggest that learning through these combinatory mechanisms is possible even if the MNCs are reluctant to lead the adaptation of their technologies to these contexts.

The importance of suppliers learning how to combine advanced and experiential knowledge may also help explain the different roles of the associations and GSIs, as well as the marginal results for the interaction effects of ties to MNCs and the associations with high geographic diversity. This result could be due to the associations lacking the aforementioned training programs for integrating different types of knowledge. But it could also be due to the participation of MNCs in the associations, which Spencer (2008) argues can facilitate knowledge diffusion. As revealed in our interviews, with the participation of the MNCs in the associations, the suppliers already receive redundant knowledge through direct ties to the MNCs, and therefore the interaction of the two ties does not necessarily increase the variety of applied knowledge available to the supplier. In sum, the evidence from the interaction variables and the field work supports the thesis that the suppliers upgrade their process capabilities through simultaneous ties to certain non-market institutions and the MNCs because of the recombination of advanced and experiential knowledge.

CONCLUDING REMARKS

Research in international business is increasingly concerned with the ways in which the institutional and organizational embeddedness of emerging market firms in general, and suppliers in particular, can shape their ability to upgrade their capabilities to meet international standards (Kumaraswamy et al., 2012; Spencer, 2008). This article contributes to this debate by analyzing how suppliers, in this case the auto parts firms of Argentina, can upgrade their process capabilities despite the legacies of backward technologies, limited resources, weak institutions and dysfunctional social capital. The case was chosen not because of its unequivocal success. To be sure, the sector and the regions remain burdened by the uneven patterns of development that plague most emerging market countries (Doner, 2009). Rather, the unforeseen, sustained gains in process upgrading by the suppliers provided an apt context for generating lessons about the recombination of applied knowledge via non-market institutions and MNC subsidiaries that can be applied elsewhere.

Beyond the effects of firm factors, much of the research on MNC spillovers and embeddedness stresses the value a local firm gains from ties to MNC subsidiaries and other organizations rich in material resources, stature and pioneering technology (Baum & Oliver, 1991; Powell et al., 2012; Spencer, 2008). In contrast, this article has advanced a view of capabilities creation for emerging market suppliers as one of gaining access not simply to frontier knowledge on international standards and practices but especially to diverse, local experiential knowledge for adaptation. By combining views of institutions as resources with views stressing the structure and composition of networks, we argued that firm access to a variety of applied knowledge, in turn improved process capabilities, depends on being tied to non-market institutions that bridged the historical social and knowledge divides between different industrial districts. Moreover, although direct ties to MNCs in the value chain alone may not benefit supplier process upgrading, they bring value when the supplier combines that advanced knowledge with diverse experiential knowledge and tutelage found via top bridging non-market institutions.

These results have important implications for MNCs in their search for reliable suppliers and institutional partners and, conversely, for host-country industry leaders in overcoming significant resources and technology constraints. To the extent that access to a variety of knowledge resources is vital for firm upgrading, the qualitative and quantitative evidence here reframes our notion about which types of alters may facilitate such access and help suppliers integrate knowledge from MNC customers. First, prior research on innovation has emphasized the importance of firms and associations providing cross-cutting relationships between previously isolated knowledge bases (Fleming, 2001; Safford, 2009; Zuckerman & Sgourev, 2006) and the role of GSIs in diffusing knowledge via their collective resources and public mission (Breznitz, 2005; Owen-Smith & Powell, 2004). The evidence here supports a blending of the two views in that the effectiveness of GSIs and associations are rooted in the ways in which their network qualities facilitate access to a variety of experiential knowledge. The innovations at INTI and AFAC, for instance, were not in their overwhelming resources, cutting edge technical knowledge or ideal governance design (McDermott et al., 2009). Rather,

in a setting with few interactive relationships and where government and industry leaders did not promote policies of technological upgrading, the key GSIs and associations created value for firms by grounding themselves into different industrial districts and providing a few basic services for collective learning and relationship building.

Second, suppliers can catalyze MNC spillovers when they recombine it with dispersed but crucial experiential knowledge facilitated by the bridging and mentoring traits of these non-market institutions. The competitive advantage MNCs gain from transferring proprietary knowledge to their subsidiaries may constrain their interest and ability to adapt it for the needs of local, more backward suppliers. Nonetheless, these suppliers can optimize their learning, and thus process upgrading, via ties to MNCs when they simultaneously collaborate with non-market institutions that provide mechanisms that help them integrate the new standards with diverse local applied knowledge.

Hence, this research suggests that firms can improve their access to a variety of knowledge resources and their attendant "combinatory capacities" (Moran & Ghoshal, 1999: 409) if they participate in structures that are constituted with the aforementioned institutional and network qualities. These insights do not mean to exclude other types of organizations, such as other types of firms or schools, from playing important learning roles, but rather they can help us explain why these alters may be less effective in helping firms upgrade in this context. Our argument presupposes that experiential knowledge is heterogeneously distributed across relatively isolated industrial districts. The weak roles of organizations other than certain associations and GSIs, alone and in combination with MNCs, may simply indicate that in this context their organizational strategies constrain their program content and network relationships (Giuliani & Bell, 2005; Herrigel, 2004; Powell et al., 2012).

The analysis in this article opens two avenues for research. First, many of the arguments here were conditioned on the constraints of local firms supplying MNCs in a quasi-hierarchical value chain, like in automotives. While this was an ideal case for our inquiry, further network research is needed in other types of industries and technologies in emerging markets. Second, we only started to scratch the surface of key issues of emergence. A major advance in research would be further analysis of how MNCs and domestic business and government leaders in emerging market countries can forge new types of organizations and institutions that facilitate the recombination of imported, frontier knowledge with local experiential knowledge.

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NOTES

[1]This article focuses on the heterogeneity of organizations and institutions in a country. For the sake of simplicity, we refer to a GSI as any institution that receives at least partial government funding, has government actors participating in its governance and program evaluation, and provides firms with specific services. This definition follows research on government support of industries (Knoke, 2001; Powell et al., 2012; Thelen, 2003). Below, we distinguish further between different types of GSIs, schools and associations.

[2]Recent efforts to statistically analyze network variables and upgrading in developing countries include Giuliani and Bell (2005), Kumaraswamy et al. (2012) and McDermott et al. (2009). We also draw on our field interviews with 35 managers and policymakers.

[3]Toyota invested in Argentina in 2003, but would not develop a local supplier system until after 2005.

[4]Following the literature on network analysis about learning and innovation, we consider a tie to be both formal and informal, for example, through a formal alliance, formal participation in a program or informal relations with an organization (Powell et al., 2012; Zuckerman & Sgourev, 2006).

[5]In contrast, this research has also highlighted how local educational institutions often lack both the capacities and industry linkages to engage in firm training, relying instead on rote teaching of students.

[6]As explained above and below, ties to other firms, schools or banks would not provide access to the

needed applied knowledge, but we include control variables for these organizations in our models.

[7]Our theorizing about bridging organizations that facilitate knowledge flows does not assume they have strong and sophisticated resources, common to similar work in advanced countries (e.g., Powell et al., 2012). As per the section "MNCs, weak institutions and regional fragmentation in the Argentine automotive industry," Argentine associations and GSI are weak and poorly endowed, but the long history of the industry justifies assuming that Argentine auto part manufacturers possess learning capabilities to process the diverse experiential knowledge. We will revisit this point in our discussion section.

[8]While the limit of five entities may censor the number of ties, in our case, the median number of ties reported by firms in any question is 1, and the maximum number of mentions was reached for about 10% of the cases (never for the same firm across all questions capturing ties).

[9]To capture the influence of ties to MNCs on supplier upgrading, we followed the literature on manufacturing and automotive supply chain vertical spillovers (Blalock & Simon, 2009; Dyer & Hatch, 2006; Giuliani et al., 2005) to include only the 63 foreign-owned firms within the automotive value chain, as opposed to MNCs in other industries.

[10]To capture the geographic diversity of the alters, we grouped focal firms into seven industrial districts: Buenos Aires-South, Buenos Aires-North, Buenos Aires-West, Rosario, Santa Fe-Rafaela, Cordoba and San Luis. Historical records and interviews indicated that this division is justified because of the relative provincial sizes and patterns of geographic clustering of firms. See also the section "MNCs, weak institutions and regional fragmentation in the Argentine automotive industry."

[11]Because of the limited degrees of freedom, we could not use individual controls for every assembler. Instead, we first measured the influence of the assembler on the supplier by determining the top two assembler value chains for each supplier. Second, we then regressed Process Upgrading on a model of firm demographics and a dummy for the assemblers. Finally, we grouped them into those who had above and below average effects on upgrading.

[12]Due to the small size of the auto part sector and the relatively high survey response rate, we were unable to increase the number of observations for our quantitative study. As a result, our model estimations have a limited d.f., which leaves our analysis with a relatively small statistical power.

[13]In Model B, we decompose *Ties to All* into the variables that count the ties to each of the six types of alters described above. In Model C, to study the effect of ties to High GeoDiversity alters, we further decompose *Ties to All* into ties each MNCs, associations and GSIs into ties to each of those with top-10% and bottom-90% of geographic diversity. We then aggregate together Ties to Not-MNCs, Banks, Schools and Not-High GeoDiversity MNCs. For this reason, and since these decomposed variables account for all the ties in the six different types of alters, we do not include *Ties to All* and the other ties to the six different alters in Model C. In Model D, we present the baseline for the interaction between ties to MNCs and top geographically diverse associations and GSIs. We decompose *Ties to All* into Ties to MNCs, Ties to Associations and GSIs in each category with top-10% and bottom-90% geographic diversity reach, and we aggregate the rest of ties to not-MNC with ties to banks and school. Finally, Model E adds to Model D the interaction between ties to MNCs and ties to top geographically diverse associations and institutions.

[14]Our results presented here and in other models available show that ties to alter firms in general and even ones with high geographic diversity have negative or insignificant effects on the process of upgrading.

[15]The Cancilleria is a GSI for promoting exports, created in the late 1990s. But its main benefit for suppliers was similar to that of AFAC – providing industry information and creating forums for firms.

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APPENDIX

Sample of questions from survey

Questions capturing Process Upgrading (Cronbach's $\alpha = 0.78$)

Could you indicate the degree of agreement or disagreement with each one of the following statements about your company? (1 = totally agree, 2 = agree, 3 = nor agree or disagree, 4 = disagree, 5 = totally disagree)	
1	Our firm has taken important measures to improve the skills of our labor force
2	Our firm has made important investments in machinery and equipment
3	The quality department has increased its effectiveness in improving the quality of our products
4	The training and education of our employees have been a priority
5	The personnel of my firm were encouraged to innovate and try new and better ways to do the job
6	Our company made a substantive reorganization of the productive systems
7	Our company has made important improvements in manufacturing processes

Questions capturing Sophistication Intent (Cronbach's $\alpha = 0.68$)

Could you indicate the degree of agreement or disagreement with each one of the following statements about your company? (1 = totally agree, 2 = agree, 3 = nor agree or disagree, 4 = disagree, 5 = totally disagree)	
1	Our company increased the percentage products sold that involved complex assembly of components
2	Our company began to design products that it did not previously offer

Questions capturing ties to Firms

Please, identify (up to five) firms with which you had significant access to information or collaboration on the following areas:	
1	Product design and improvement
2	Process improvement and technology
3	Quality
4	Marketing and sales
5	Regulatory aspects

Questions capturing Ties to Associations, GSIs, Banks and Schools

Please indicate the institutions and main programs (up to five) with which your firm has been related (associations, banks, cooperatives, public programs, government institutions, schools) in the following areas the following areas:	
1	Training of administrative personnel and plant workers
2	Training of managerial, professional and executive staff
3	Financing
4	Technology, techniques and innovation
5	Commercialization and marketing

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