

Chapter 3

Governance Architectures for Learning and Self-Recomposition in Chinese Industrial Upgrading¹

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For most of its post-1992 rapid industrialization, Chinese manufacturing excelled in global markets as a platform for high volume and low cost export oriented production.² Since China's accession to the World Trade Organization (WTO) in 2001, however, the fruits of rapid industrialization have been creating home market conditions for very different manufacturing strategies. Successful export-led industrialization has created more sophisticated domestic Chinese demand for a broad array of manufactured goods. In an effort to capture this emergent demand, Chinese producers are shifting their focus toward more advanced production and away from what was traditionally needed (or possible) within the framework of export processing relationships. In particular, they are seeking to leverage their volume production expertise (which involves remarkable flexibility) to move up the value chain into designing and developing their own (increasingly sophisticated) products.³

Developed country MNCs from Asia, Europe and the US have responded to the same emergent opportunities in China as the indigenous producers. In order to be competitive, however, MNCs need to enhance and deepen their commitments in China.⁴ Global firms need to augment production, engineering and design capability in China to adapt their products to the technical, regulatory and cultural characteristics of the Chinese

market. They must also train and rely on Chinese workers, engineers, managers and indigenous suppliers to drive the localization process.

The new Chinese and MNC dynamics interpenetrate: An indicator of success for increasingly sophisticated Chinese suppliers is to be able to participate in the localizing production networks being established by foreign manufacturing MNCs, while the pressures for localization in China are leading MNC component suppliers and capital good manufacturers to seek access to indigenous Chinese networks and system consortia. For its part, the Chinese state, mostly at local and regional levels, often supports actors pursuing both upgrading strategies.⁵ The result is a complex game of cooperation and competition between foreign and domestic producers, suppliers, customers and public authorities.

This chapter suggests that this new game is driven by a surprisingly formalized, multi-directional form of organizational and social learning. Industrial players on all sides are constructing formal architectures that aim to systematically disrupt and reconstitute multidimensional communities of manufacturing practice by inducing joint reflection, experimentation and creativity. These interdependent processes give rise to mutual learning and upgrading all around.

At the least, this is good news for the Chinese. It suggests that doubts about whether Chinese manufacturing can escape the low value and profitability niches of manufacturing value chains are misplaced.⁶ The new arrangements aim to cultivate and presuppose the capacity of Chinese producers to collaborate on design, new product development and increasingly higher value manufacture.

We also suggest (though will not fully develop here) that MNCs are driving the upgrading process in China in ways that are good for MNC operations generally, including their home markets.⁷ MNCs generate recursive effects by globalizing formal learning systems. In section three we suggest that formalized Corporate Production Systems (CPSs) are emblematic of such formal systems. Originally developed to facilitate innovation and continuous optimization in MNC operations within competitive developed markets, CPS principles are now being extended and adapted to Chinese (and other global) operations.⁸ Global CPSs create governance architectures that generate reflection, deliberation and experimentation, which have multi-directional (recursive) consequences for all participants.

The analysis here builds on and departs from much of the sociologically oriented literature on upgrading and organizational learning.⁹ We build on this work by emphasizing the significance of producer relations (within supply chains and regional supporting institutions) over technology and other market endowments as pre-conditions for successful upgrading. However, we abandon its understanding of upgrading as the acquisition of technological knowledge and its (relatively static, structuralist) concern for the specific ties that players have to technology and knowledge carrying customers and extra-firm institutions. We reject the divide this literature imposes between actors and the context in which they act.

Instead, we embrace the process oriented organizational learning literature's emphasis on relational learning within communities of practice over time.¹⁰ At the same time, we depart from that literature's focus on stability and reproduction, and present a pragmatism informed perspective on organizational learning that emphasizes the

importance of joint inquiry, experimentation and creativity.¹¹ Rather than unconsciously enacting practices, we show how firms create “revolutionary routines” that systematically disrupt habits in production and design and force players to continuously reflect on and revise their practices.¹²

In this way, our theoretical orientation is very much in line with the spirit of this volume. We frame our problem as a relational and processual one: Chinese and foreign MNC players are understood to be in on-going, meaningful relations that are recomposed through reflective deliberation in response to challenges that disrupt habitual arrangements. Disruptions occur on myriad levels and processes of recomposition at one level (say in export processing relations between Chinese suppliers and foreign MNCs) induce changes at other levels (e.g.: in the kinds of strategies that Chinese producers pursue both internationally and on their home market). In this way, we regard change as continuous (even as there is pervasive continuity in relations—social relations are complex and not all habitual modes are called into question at once).

Following Dewey and Joas, we emphasize that disruptions in habitual practice present occasions for joint inquiry about how to resolve the disruption and produce experimental solutions. We also understand actors to be defined by the social relations in which they act, rather than the other way around. As a consequence, social processes of reflection and experimentation cause interrelated actors to rethink their ends and who they are. For us, then, actor “interests” are continuously constructed and reconstructed through social processes of collective inquiry, reflection and problem solving.¹³

Finally, in what follows we not only apply a pragmatist theoretical perspective to explain the dynamic of Chinese and MNC FDI upgrading, we also claim that actors are

themselves constructing governance systems that embody pragmatist principles. We follow Charles Sabel,¹⁴ who describes such governance systems as “New Pragmatic Disciplines.” Sabel says:

We can think of these new institutions as pragmatist in the sense of the philosophy of Peirce, James, and Dewey: They systematically provoke doubt, in the characteristically pragmatist sense of the urgent suspicion that our routines—our habits gone hard, into dogma—are poor guides to current problems. Or we can think of benchmarking, simultaneous engineering, error detection, and the other disciplines grouped under the anodyne heading of ‘continuous improvement’ as institutionalizing, and so making more practically accessible, the deep pragmatist intuition that we only get at the truth of a thing by trying to change it¹⁵

Our pragmatist commitments also question the idea that rules, institutions or power determine contractual relations. We care less about constraints and opportunities alleged to flow from rule and structural positions than we do about the interactive and recompositional dynamics that mutually dependent players generate through their joint efforts to solve problems. For us, Chinese and developed country MNCs are not interacting from positions leveraged by advantages rooted in comparative endowments. Rather, we show how innovation-producing interactions are transforming the terrain upon which leverage and endowment can be conceived.

Ultimately, we deploy this theoretical perspective to say something new about contemporary dynamics in China. We makes two major points: 1.) In contrast to skeptics, manufacturing upgrading is actively occurring in China;¹⁶ 2.) Chinese upgrading involves mutual learning among interlocutors in Chinese firms, foreign MNCs, and their supply chains. Learning is achieved through intra- and inter-firm governance architectures that aim to disrupt shared practices and foster recursive processes of joint inquiry and experimentation. We show that these arrangements allow Chinese producers

to compete for business in expanding domestic markets through the development of learning capabilities, while enabling foreign MNCs to enhance their own learning abilities in an effort to gain market share in the same emerging Chinese markets. The result is a highly fluid social and political learning process in which actors continuously redefine their ends and the arrangements they use to pursue them.

Our argument proceeds in three steps. First, we compare our perspective to the existing literature on upgrading and organizational learning. The second section describes the emergent Chinese market and the strategies that both indigenous Chinese and foreign MNC producers follow in order to gain positions within it. MNCs are shifting their commitments in China by localizing production, design and even development functions.

Section three shows how efforts to gain position within emergent Chinese markets transforms learning dynamics within the community of competitors, as both MNC home country and Chinese operations are redefined. Home operations are no longer simply teachers, their Chinese counterparts learners. Instead, home operations are interested in learning from the experiments that the operations in China are carrying out with the firm's product palette and know-how. In order to capture potential innovation in Chinese practice, firms deploy formal governance architectures, often embedded in CPSs, to induce learning. Such mechanisms combine jointly determined global (intra-firm) standards and metrics (or product designs) with local discretion over implementation in ways that provoke reflection and foster experimentation for adaptation and improvement. As such, they facilitate the recursive multi-directional transfer, transformation and

invention of technological and organizational knowledge between Chinese and MNC actors, as well as across MNC global operations.

1.) Theoretical framework: Sociological approaches to upgrading and pragmatist approaches to organizational learning

As indicated, our approach builds on the advances that sociological approaches to upgrading have made to our understanding of the development process. This literature moves beyond efforts to explain upgrading processes by incentive alignments¹⁷ and technologically determinist arguments about how the modular characteristics of manufacturing technologies limit possibilities for supplier and emergent firm upgrading.¹⁸ The virtue of the sociological accounts is that they identify specific relations (especially interactive, non-arm's length relations in supply-chains) and environmental conditions (interconnected clusters of regional producers and supporting institutions) as preconditions for successful upgrading that the non-sociological perspectives usually ignore.¹⁹

This literature's limitation is that it reduces learning to the transfer of specific kinds of technological know-how or knowledge about technologies and products. Moreover, even though it emphasizes the crucial role that MNCs play in emergent economy upgrading processes, this literature is guided by structuralist assumptions about power. It assumes that asymmetries in knowledge and capital means that only one-way flows from MNCs to producers in emerging economies are relevant. Consequently, it leaves the possibility that emerging economies have something to teach developed country players under-theorized.

The practice-based organizational learning literature²⁰ better addresses the processes of learning we observe in China. The sociological literature focuses on discreet nuggets of knowledge and technology, because it presupposes a social terrain in which already formed actors with clear boundaries act within a structure of enabling and constraining rules. By focusing instead on formal and tacit interactive practices—communities of practice—that firms engage in, the practice literature expands the terrain and character of learning: Instead of something actors “learn about” or an external “thing” they acquire, learning is an identity and relation creating process. Learning produces actors as it involves complex and meaningful exchanges that define and redefine roles and capabilities among the interactants. In a companion paper,²¹ for example, we show that Chinese firm engagement with foreign customers resulted over the last two decades in their integration into transnational communities of practice. Chinese manufacturers learned how to be reliable and competent exporters through interaction with their customers. Customers apprenticed Chinese suppliers by showing them how to meet ever more exacting manufacturing and commercial standards. This was done iteratively, through myriad contracts, audits, supplier quality assurance encounters, competitor benchmarking and continuous improvement conferences.²²

These interactions were not so much about specific technological or knowledge issues as they were about the development of the Chinese firm’s capacity to learn how to identify the changing production quality and cost needs of foreign customers. Mistakes could be tolerated if a sign was given that corrections were being made. For customers, good will and demonstrable learning trumped technological backwardness or a lack of specific know-how. Both of the latter could be more easily mobilized and transferred to a

reliable and competent, ever-improving supplier, but competency and learning itself could not be imposed. They had to develop through the practice of the relationship itself.²³ Crucially, this historical process of meaningful interaction (learning) not only redefined relations between Chinese players and MNC customers; it also redefined the boundaries, capabilities and self-understandings of the interacting players themselves. Learning involved political, social and economic recomposition.

The practice-based theories of organizational learning help explain the first phase of Chinese manufacturing upgrading.²⁴ By itself, their emphasis on practice and communities of practice integration in organizational learning, by itself, however, can't account for the contemporary upgrading dynamics described in this chapter. Their arguments tend on the whole to focus on routine practices and the way in which apprenticeship relations (what Lave and Wenger call *legitimate peripheral participation*) unfold within stable practice arrangements—such as the asymmetric ties between Chinese exporters and their foreign customers. The latter, more knowledgeable and sophisticated producers, taught less experienced (but lower cost) Chinese manufacturers the ropes and, gradually integrated them in to their global manufacturing practice communities.

Herrigel, Voskamp and Wittke show that the success of this gradual, apprenticeship-based learning process proved self-limiting. Chinese producers found they had competences and ambitions that exceeded their customers' demands. The next two sections of this paper show that awareness of this mismatch between capability and demand in traditional apprenticeship relations has driven both Chinese producers and MNC manufacturers to shift strategy within the Chinese market. Both want market share

in emerging Chinese markets for dynamic “middle range” products. We argue that in order to enter these markets rapidly, firms need to disrupt routines and reflect upon both the formal and tacit ways in which their practices are organized and their know-how deployed. Uncertainty about strategy, unfamiliarity with new forms of production, lack of experience with product development and design, moreover, leads producers to encourage experimentation.

These dynamics are a central concern of the pragmatism informed organizational learning literature . That literature starts with the practice literature’s emphasis on action and community, but it further emphasizes the significance of collective reflection and experimentation within organizations when routine practices are disrupted.²⁵ Although reflection and experimentation contribute to innovation in the community of practice literature, they are not theorized. They are thought to occur randomly -- the result of temporary crises or interruptions in habitual practice -- and the mechanisms at work are unclear.

The pragmatist organizational learning literature provides systematic attention to the link between the disruption of habitual practices, collective inquiry and experimental problem solving. It focuses on how collective deliberation emerges and on the way processes of joint problem solving recompose practices and relations in manufacturing communities. Our empirical claim in what follows is that the current period in China has seen a concerted shift toward the systematic provocation of reflection and experimentation in order to disrupt entrenched routines and generate processes of collective reflection which, in turn, yield recursive learning processes. Interruptions in

routine that give rise to joint inquiry are not random now; they are systematically and intentionally induced through diverse formal mechanisms.

In contemporary China, reflection and experimentation-based learning processes stem from foreign MNC awareness of the limits of their centralized, home-country-developed knowledge, products and practices. Successful Chinese product adaptation and development forces them to rely on local discretion and competence. Moreover, they can't wait for reflection on the limits of the mother company's products in the Chinese market to occur randomly. They urgently need to induce it.

We argue that MNCs accomplish this by deploying formal governance architectures designed to combine joint general goal setting with local discretion. Although there are many variants, we will highlight the way in which CPSs accomplish this. As multi-dimensional and recursive “constitutional processes,”²⁶ such governance architectures have relevant stakeholder teams establish provisional and revisable central metrics, standards and product designs that local players then use discretion in implementing and adapting to their circumstances. In turn, their experimental efforts to meet global metrics and create competitive products on unfamiliar labor, materials quality and regulatory terrain interrogate home country products and production practices in ways that induce the MNC's monitoring home country teams to reflect on the adequacy and optimality of their own routines, both at home and in other global locations. As Sabel points out, this interactive multi-level experimentation and monitoring makes the tacit dimensions of routine explicit to all the practice community players and thereby makes it possible for them to systematically alter, optimize and recompose their practices.²⁷

Crucially, pragmatist learning theorists emphasize that these multi-level joint processes of reflection and experimentation can be creative, yielding innovation and new practice and product ideas.²⁸ To see how these practices fit into our narrative about Chinese upgrading, it is important to notice that what were once more asymmetric relations of apprenticeship or “learning from” relations, where reflection and experimentation were at most random and reactive incidents, are in this way transformed into proactively induced, systematic, multi-directional, recursive, mutual learning or “learning with” relations.

To summarize, our emphasis on process, habitual practice, collective reflection and problem solving in response to disruption are all core dynamics of pragmatist social action theory.²⁹ They make it possible to interpret industrial dynamics in China as recompositional and social learning processes that occur over time. Following Sabel,³⁰ we are not simply interpreting events through a pragmatist lens, we are also claiming that the actors we observe are themselves constructing governance mechanisms that operate according to pragmatist principles: Contemporary CPSs aim to induce reflection and re-examination of practices in the interest of innovation and optimization. Collective self-reflection and monitoring, systematically imposed by formal procedures, leads to social learning (self-transformation), creativity and continuous organizational and strategic recomposition. Section 3 outlines the dynamics of these new forms of learning relations and describes the development of various constitutional mechanisms for the organization and governance of this new kind of learning.

2.: Changing product strategies in a changing Chinese domestic market:

Competition between MNCs and Chinese producers for the “middle” of the market.

New foreign MNC Chinese market engagement is shaped not only by the quantity but also by the changing character of demand. Contemporary Chinese customers demand products with distinctive characteristics. They want either technologically less sophisticated versions of products MNCs offer in developed country markets, or high-end products with specific modifications to accommodate Chinese preferences, regulations, standards, and resource input differences. In the former (more quantitatively significant) case, foreign MNCs can't compete against native Chinese producers by modifying and selling older or outdated versions of their current equipment because Chinese producers easily copy such technologies and under-price foreign producers.³¹

In order to take advantage of the emergent sophistication of Chinese consumers, then, foreign MNCs in the automobile, automobile component and complex machinery sectors that we studied modify and reconceive their current technologies or even develop entirely new products to address the incipient needs of Chinese customers. The aim is to reduce sophistication and narrow product functionality. For German firms, in particular, this means learning both how to design less durable products that can be easily maintained and to manufacture them with simpler production technologies and less skilled labor. These modifications directly address the needs and usage norms of Chinese consumers and make the product more affordable than the versions sold in MNC home markets. The sweet spot for foreign MNCs is a mid-range market above the highest volume, lowest quality commodity segment and yet below the highest quality, most sophisticated technologies typically sold in developed markets. Chinese customer desires

for such products exceed native Chinese producers abilities to produce them, so there is a legitimate market opportunity for foreign firms.

There are countless examples of this sort of mid-market product. Take the case of computer numerical control (CNC) technology for machine tools and other steerable capital goods. Japanese and German producers of CNC units cannot sell their highly complex highest-end controllers to machine tool and other capital equipment producers very widely in China, due to low demand. Instead, they succeed by selling specially designed “simple” CNC controllers widely in China. As a one German manager told us: “There are millions of conventional machine tools in China that can be easily converted to simple CNC machines if they are provided with the right kind of controller.”

Interestingly, neither the Japanese nor German producers could sell older versions of their entry-level controllers in China. Knock-offs of older designs already existed in the market at price points the foreign producers could not match. Instead, they developed entirely new “simple but sophisticated” controllers that integrated new electronics into a simpler delivery unit designed specifically for Chinese customers needs. Indigenous Chinese producers did not have the electronics know how to be able to compete with the new products. Crucially, in order to more quickly and efficiently supply demand at a competitive cost, MNCs produced the new controllers locally in China, using indigenous designers (who cooperated with designers in the home location), less complex production technologies and Chinese suppliers.

One might ask: Why would the Japanese or German companies bother to invest in less than cutting edge business? Interviews with firm representatives reveal that companies need to establish their brand positions in China so that it will be possible to

grow in that market. Foreign producers regard it as inevitable that the current mid-market niche ultimately will be overrun by rapidly improving indigenous producers. But the more sophisticated the technology becomes, they believe, the slower the process of indigenous learning will become. If the MNCs can establish their brand position in this emerging market, they're betting that the market will grow toward their strengths.

In many cases, rather than designing a wholly new machine or component for the Chinese market, firms redesign existing offerings to make their features and prices more appropriate for Chinese customers. Peter Marsh of the Financial Times has been following this phenomenon and he quotes a manager at Mindray, a producer of medical devices and patient monitoring systems:

“We look at what parts we can standardise, where we can reduce the level of technical sophistication without comprising quality, and in what instances we can substitute software for electronic components,” says Joyce Hsu, Mindray’s chief financial officer. The result, she says, is often a low-cost product that may not have so many features as an equivalent piece of equipment made in western Europe or the US but which satisfies requirements in hospitals – in China and elsewhere – that are trying to cut back on costs.”³²

A German automobile supplier who has been part of our *Globale Komponenten* study has followed a similar strategy for the design and delivery of internal frames (front ends, engine cradles, etc.) for its customers in China. Even when the firm wins a bid on a global component that will be built into the same automobile model in Europe, North

America and China, materials, component designs and manufacturing procedures still differ in each market. In China, the company uses a different quality steel and welds the front end with less innovative and high quality techniques than it uses for customers in Europe. The China product is more primitively manufactured and is less complex, durable, or capable of the performance expected in the European variant.

We found producers in many different machinery and automobile component sectors undertaking these sorts of quite substantial product and production modifications (re-conceptualizations), including firms making power drives, turbines, gear units, transmissions, and woodworking machinery. Crucially, modifications like these are most conveniently done in China, even when there is substantial cooperation with home country designers. Chinese engineers understand customer requirements, local regulations and standards, and the quirks of local materials. And, local production managers have an active sense of labor capabilities and the realistic costs of running complex western production machinery in the Chinese context.

Such moves on the part of MNC firms, of course, create opportunities for local Chinese suppliers to become integrated into the newly recast production strategies. MNCs need local suppliers because the volumes for castings or stamped metal frames for a controller or the front end of an automobile or the cab of a construction machine made in China simply overwhelm the operations of suppliers back in the home market. It is not simply that such distant suppliers are already busy with production slated for home region customers, transportation costs make home country components too difficult to justify. This encourages component producing MNCs to invest in China to offer their customers a “global footprint”. But it also provides an opportunity for indigenous

Chinese producers to enter into newly emerging, and more sophisticated, foreign MNC supply chains. In any case, many capable Chinese suppliers have emerged who are chafing at the limits of their old export processing routines and are in a position to take advantage of such business.³³ In cases where capable suppliers were difficult to identify immediately, MNC customers could work with suppliers to improve their production quality.

The VW experience in China illustrates one way this interconnected upgrading process takes place.³⁴ For decades, VW produced only the modest and outdated Santana in China, in organizationally and technologically minimalist production locations. But toward the end of the 20th century, when the company recognized that a market for its luxury brand Audi was emerging with the growth of a wealthy class in China, and that demand growth was too robust to service with German exports, the company erected production and assembly facilities in China that mirrored those in Germany. Their aim was to produce a Chinese Audi A6 identical in quality to the A6 manufactured in Germany.

While working to achieve this goal, Audi recognized that Chinese customers actually wanted an A6 with particular characteristics unwanted by German (and other European and North American) consumers. For example, Chinese consumers wanted limousine-like sedans with significantly more leg-room (30cm) than existed in German versions. Incorporating such design changes within an integral architecture like the A6's entailed corresponding changes in materials quality, component machining, in-house system assembly and in the character of local supplier relations. Audi engineers, planners and purchasing teams could not manage all of these changes from Germany. Therefore,

local Audi engineering, production worker capability and supplier quality assurance had to be developed and maintained to work together with the home country actors to manage the changes..

New and old orientations to the Chinese market can often be seen together, like geological sedimentations, in German MNC factories in China. At our visit to the VW/Audi/FAW JV in Changchun, for example, alongside old equipment still in use for the VW Jetta, were brand new assembly lines with flexible automation and materials handling work-stations that had been specifically designed for Audi's local Chinese assembly needs. The equipment was highly automated, but distinctive in its ability to handle radical variety: different versions of the A6, Golf, Jetta and Bora were assembled there. Although German engineers were involved in the design of this equipment and supervised its implementation, the ramp up process soon revealed that Chinese engineers, maintenance and setup specialists were required to implement, maintain and operate this, quite sophisticated, equipment.

Audi's traditional German suppliers— e.g., Bosch, ZF, Hella, —were also forced to adjust to the design changes introduced into the A6 (and other VW models) in China. Since the changes were China-specific, it made sense for these suppliers to implement those changes locally, in their Chinese operations as well. These changes then forced all of those producers to alter their external sourcing strategies to incorporate more local Chinese suppliers. This process, in turn, led Audi suppliers to implement the kind of modifications in material usage and manufacturing engineering and technology described above in the case of our German front-end supplier. Characteristically, once the expanded Audi China production complex proved successful, it made further innovation

possible. VW used its Chinese competence to transform the Jetta into the Bora, a simple yet sophisticated hybrid model that mimics characteristics of the Jetta and the company's simpler Polo model.

3.) The Organization of *Mutual Learning*: Systematically disrupting routine, and inducing reflection, experimentation and creativity within and among firms

The last section showed that the foreign MNCs and indigenous manufacturers are altering their strategies and commitments in the Chinese market. Rather than simply purchasing component inputs from Chinese suppliers, or running sleepy low-tech operations producing anachronistic technologies, MNCs are developing serious Chinese production and design operations to compete in a dynamic and rapidly changing market. Indigenous producers, for their part, are eagerly casting off their apprentice relations and engaging foreign customers in more collaborative, design intensive, and high value added business.

We argue that these changes have given rise to a new multi-directional learning dynamic within MNCs and between MNCs and their Chinese suppliers. Remarkable about the stories related in section two is that the upgrading processes have a snowball quality: the transfer of capability fosters indigenous competence development that in turn creates additional possibilities that require still more competence transfer and indigenous competence development. We observe that much of this process is not random or an expression of a "natural" development path. Rather MNCs and the indigenous Chinese producers they interact with are systematically inducing and optimizing learning through the procedures they deploy to combine (global) products, standards and metrics with

disciplined local discretion. Continuous adaptability and innovation, driven by experimentation and learning is essential for competitiveness in the Chinese market. Moreover, MNCs view the learning and innovation taking place in their Chinese operations as a source of global advantage that can benefit operations elsewhere. As a result, the formerly one way learning relations characteristic of communities of manufacturing practice in earlier phases of Chinese upgrading are giving way to recursive, multi-directional, mutual learning relations based in joint reflection and experimentation.

The paradigmatic mechanism used to generate these new mutual learning dynamics is the formal CPS that manufacturing firms increasingly deploy throughout their global operations. Examples include the ACE system at United Technologies, Formel ZF at ZF, the Siemens Production System, the VW production system (known as “The Volkswagen Way”) and the Caterpillar Production System, among countless others.³⁵ Some, mostly smaller MNCs like the woodworking machinery producer in our *Globale Komponenten* case studies, stop short of branding their corporate systems but nonetheless self-consciously deploy extensive formal procedures that mimic many aspects of the CPSs in larger MNCs.

Many of the companies we interviewed not only infused all of their operating practices with the formal procedures of a CPS, they also maintained elaborate continuous improvement teams (CITs) that were charged with the responsibility of spreading the CPS gospel throughout the global organization. CITs teach employees lean production, team collaboration, and realistic target setting, while providing consulting services and

re-engineering input to teams, departments and production cells to help them implement new forms of organization and practice. In the German automobile components and complex machinery sectors, CITs were among the most globally active players within the firm.³⁶

CPSs establish group-based goal setting and monitoring procedures that systematically induce collective self-observation, problem diagnosis and problem solving experimentation among all players throughout a firm's value chain. In such systems, internationally composed team negotiations typically establish common MNC-wide product designs, quality standards, cost targets and manufacturing procedures. Crucial in these arrangements is that the targets or standards (or, in cases of simultaneous engineering, the designs) are sufficiently general to allow for considerable local discretion in implementation. Actors in specific markets are encouraged to experiment with adapting the standards, targets and procedures to local conditions. Local players, however, are not given *carte blanche* to deviate from common targets. Rather, they are required to justify their decisions to the central teams and provide elaborate quantitative and organizational evidence for the local superiority of their modifications. The possibility of discretion gives local players incentive to experiment and be innovative, while the requirement of justification (and continuous monitoring and dialogue with skilled and interested teams in other locations) wraps processes of local experimentation with discipline.³⁷

These formal systems of joint goal setting, local discretion and mutual monitoring aim to generate positive learning spirals of local adaptation and global improvement, product optimization and innovation. Product norms and standards and the metrics for

local targets are explicitly, and continuously (re) constructed by relevant stakeholders in production—manufacturing teams, design teams, customer focused teams, purchasing teams, often with the input of CIT players. Teams are constituted at the local level and at the central MNC level and they are interdependent: The success of the local players relies on central actor input while at the same time the success of the central actors depends on local player success. At regular, formally proscribed intervals (and more frequently on an informal basis in-between), central and local actor deliberation generates continuous, mutual self-analysis among production stakeholders .³⁸

In effect, team actors in different locations jointly reflecting on their mutual activities makes practices in each location transparent to all players—the tacit features of local actions are made explicit. Local discretion combined with joint scrutiny induces disruption of routine and causes teams in the plants to experiment with designs, materials, and production organization. The multi-directional learning generated by this process is recursive, in the sense that the output from one application of a procedure or sequence of operations becomes the input for the next, so that iteration of the same process produces changing results.³⁹ Local deviations from central designs and practice made by local teams must be justified to their central counterparts. When the changes are accepted they are then themselves formalized and turned into standard local practice. The new local “standards” are, in turn, benchmarked by higher order teams within the organization against similar practices in other areas. Where appropriate or possible, adjustments are made elsewhere, which then results in the creation of new higher order standards and targets. The dialectical logic of jointly negotiated central standards → local discretion with public-justification (peer review) → recursive adjustment of central standards creates

a continuous process of experimentation and optimization within the firm that globalizes learning across the entire MNC.

Interestingly, although these systems rely heavily on formal procedure—metrics, standards, writing things down—technology plays only a secondary role in the arrangement of the governing relations (facilitating data collection and monitoring, for example). Indeed, in practice, such systems can be surprisingly low tech. For example, *Globale Komponenten* project’s woodworking machinery producer, the firm managed machinery production transfer to its Chinese (and central European) production locations with what it called a “cookbook” system. German production teams took pictures of each discrete step in the home plant machining processes to be transferred abroad—including machine layout (tools and fixtures), individual set ups, tool positioning, transfer procedures, and work organization. The pictures were then annotated with instructions for set up procedures, machining speeds, tact times and expected output for each stage in production and assembly flow. These “cookbooks” were then sent to the company’s Chinese operations, along with the blue print designs for the machines, to guide the construction of Chinese manufacturing operations all woodworking machine models.

The cookbook functioned as a set of very specific guidelines, but local players were empowered to use discretion while implementing them. The implementation process allowed for any number of local design and procedural modifications in manufacture: the reduction or enhancement of product functionality, the excision or addition of steps in the production process and substitution of materials were all fair game as the local players sought to adapt the home firm’s designs to the Chinese regulations, consumer interests and competitive cost conditions. But local modifications

had to be justified to the exporting multi-functional teams and managers that originated the cookbook. Acceptable changes were noted, new pictures taken, and a local cookbook was constructed. If the changes implemented locally improved the way machines were produced, then the local innovation was embraced by German teams and the new procedures photographed and integrated into the home cookbook.

Because the cookbook is a detailed deconstruction of a machine into literally hundreds of discreet manufacturing operations, it was possible for home country players to adopt small alterations for their own use at home, even as the overall character of the specific machinery model diverged from the one that the company was manufacturing back in Germany. In this way, the formal process of systematic stakeholder monitoring of the cookbook created a recursive multi-directional process of organizational learning that combined disciplined local innovation and product adaptation with openness to global design and manufacturing process innovation.

Crucially, these formal trans-locational learning practices are also deployed, in modified form, to govern relations between customers and suppliers. Instead of a formal cookbook of pictures and instructions for how to implement and adapt proprietary machinery and operations, MNC customers provide Chinese suppliers with clear targets for cost, quality and delivery time for a part or component that the customer and supplier design together. Both parties observe the progress of the supplier relative to the target, and, in cases where targets are missed, both immediately seek to identify the reason and work toward a resolution. When successful, such formal collectively self-analyzing relations produce learning and continuous upgrading, for both the customer and the

supplier, not only across Chinese supply chains, but across entire global production networks.⁴⁰

We observed such relations in a variety of the firms. Take the relations between a German Gear Unit MNC and its Chinese supplier of aluminum housings. In this case, the Chinese supplier did both casting and machining for the German firm (the latter in part on machinery that had been transferred from the German company's home plant in Germany). In both cases, the customer specified broad production quality and cost targets. Formal audits and regular joint procedure review with the customer took place: Engineers from the German company's Chinese plant in Suzhou regularly visited the Chinese supplier as did skilled workers from the Gear producer's German plants. The aim was to help their Chinese counterparts set up the new machinery and understand how to solve problems generated in aluminum housing machining.

These interactions yielded a number of jointly agreed upon deviations from original customer designs and practices, in particular regarding materials used in molds, casting techniques (more skilled laborer input, less automation) and even in the maintenance procedures of the German company's former machinery. In order to optimize the changes, the Chinese supplier upgraded its own manufacturing engineering and design capabilities (an expense which it was encouraged to incur, not only from its German customer, but also from the regional Chinese government which gave tax breaks to firms increasing design capacity). The resulting supplier improvements helped the German company maintain its quality and cost targets, while simultaneously stimulating ideas to adapt the overall Gear Unit designs to facilitate entry into a new user market-- Chinese Omnibus manufacturers. Perhaps most significantly, the company took

machining process modification ideas introduced in China and used them to experiment with the set up of similar processes in its Russian and Indian subsidiaries. This successful mutual learning, moreover, created the possibility for additional more challenging design-intensive collaborations between the German MNC and the Chinese supplier in the next contract round.

There are obvious benefits to Chinese manufacturing suppliers (and, in reverse, to Chinese OEMs working with foreign MNC component suppliers or capital good producers) of this sort of mutual learning activity. It allows Chinese producers to break through the self-limiting structures of the older unidirectional export processing community of practice. The benefits to foreign MNCs, however, may appear to be more ambiguous. On the one hand, the new relations produce mutual learning, and consequently, foreign MNCs gain the ability to improve not only local Chinese operations, but also similar operations in other locations as well. On the other hand, if their Chinese collaborators are becoming such successful and sophisticated learners that they provoke MNC learning processes as well, isn't there a danger that the Chinese will abandon the collaboration with the foreigner and manufacture the product on their own? That is, aren't MNC's worried about losing intellectual property, and hence market presence to their increasingly sophisticated Chinese collaborators?

Our interviews uniformly revealed that foreign manufacturing MNCs in China engage in these recursive collaboration, learning and upgrading relations despite the fact that intellectual property could not be guaranteed in the relationship, especially not in any long term sense. Moreover, foreign managers in automobiles and complex machinery sectors broadly acknowledged that their indigenous Chinese employees (managers and

skilled workers) were gaining knowledge of proprietary products, technologies and procedures , and some were taking what they were learning and deploying that knowledge for their own ends.

The same was true of suppliers. Successful collaborators were looking to establish ties with other potential customers that explicitly leveraged what they learned in their relationship with the MNC. In most interviews, foreign managers viewed these dynamics as inevitable and, after a certain point, non-preventable. All players acknowledge, moreover, that this is true despite what most observe to be continuous improvement in the capacity of Chinese authorities to protect property rights.

Why do foreign MNCs nonetheless proceed with these types of mutual learning relations? They do this because the emerging Chinese competitive and strategic conditions are becoming similar to those in the MNC home regions. Competitive pressure for continuous innovation, cost reduction and change drive most relations in the global market place. Regardless of the property right quality, in relatively mature, integrated product architecture based complex manufacturing sectors, there are few guarantees that a given product or technology will maintain an advantageous position in any market for very long. Rather than orient their systems around protecting technology and product designs, then, firms continuously improve and transform designs to match changing customers needs and identify new customers. Global MNC production arrangements and relations with suppliers are in this sense strategic formally governed systems focused not on making specific products but on constructing collaborative continuous learning processes that drive competence expansion, innovation and self-transformation.

The Japanese and German CNC controller manufacturers noted above are exemplary of the larger trend. Their long-term market strategy is not to produce simple but sophisticated technologies (such as CNC units), but to be recognized by consumers as reliable and quality manufacturers in their industry (e.g., computer automation equipment). Such firms believe that if they can create dynamic learning relationships in China, they will be able to leverage the global technological know-how that they have in automation equipment, gear units or woodworking technologies to make those relations continuously and reliably competitive in the dynamic and expanding Chinese market. The idea is to establish dynamic learning capabilities in China that can, in turn, participate in emergent global learning and innovation operations. This strategy promises more return in the long term than one that seeks to protect market share on any particular product model or generation in a specific national market.⁴¹

Conclusion:

This paper describes contemporary Chinese manufacturing upgrading as a multi-directional, interactive, recursive and learning driven process. Far from a technological *cul de sac*, the experience of export processing and participation in transnational supply chains in a broad array of cases helped Chinese producers learn international best practices in manufacturing. This manufacturing upgrading process created increasingly sophisticated demand for manufactured products within China itself, and this new demand gave rise to new forms of competitive and cooperative market dynamics among both indigenous Chinese and foreign MNCs seeking to service that (impressively large) new kind of demand.

We argue that this new market situation has been associated with a shift to a new, more dynamic multi-directional and recursive form of mutual learning among Chinese producers and foreign MNCs. Chinese producers, engineers and skilled workers—suppliers, customers and local personnel in upgrading MNC Chinese locations—are helping foreign MNCs understand how to adapt their products to the specificities of the Chinese market. Foreign MNCs are radically altering their commitments to the Chinese market by developing more capacious engineering, design and organizational capabilities and practices in their subsidiary operations. Key mechanisms for this transformation are the recursive, team based, mutual learning processes that are generated by the formal procedures in CPSs. Such systems create global learning spirals by imposing systematic interaction between local discretion and global standards. Though highly competitive (and hence, like any market process, capable of producing losers), our story suggests that the larger dynamic of interaction between Chinese players and MNCs has many surprisingly mutually beneficial dimensions.

We can't help pointing out that our story is, at least from one point of view, highly ironic. Initially, the worry with developed country engagement with China was that off-shoring and outsourcing relations would involve the loss of competence to China and/or a shift of home country competence away from manufacturing.⁴² Our research shows, however, that these worries are misplaced (or perhaps overtaken by events) in the automobile and complex machinery sectors. Current Chinese engagements systematically recompose global MNC internal flows and Chinese offshore experiences through recursive mutual learning. As a result, China operations supply MNC home country product development and production processes with useful benefits. The benefits are

likely to be all the greater, moreover, as the gap between Chinese and developed country market sophistication narrows—in part, as a result of the mutual learning processes that this paper outlines.⁴³

In many ways, our ability to point to the ironies in the above paragraph shows the affinity between our pragmatist analysis and the anti-structuralist commitments that animate this volume. The skeptics and worriers we criticize here reason from the undeniable structural observation that asymmetries exist in China's relations with developed country players. Yet while they believe structural asymmetries in resources, competence and endowments constrain and enable individual strategies, we highlight the mutual dependencies and shared understandings linking asymmetrically aligned players in the flow of social process.⁴⁴ The players we describe do not occupy positions in a structure from which they strategize under constraints. Rather our actors are meaningfully inter-related in ongoing processes of negotiation and adjustment regarding the design of products, the scope of markets, the extent of capabilities, the range of training needs—and much more. Social actors mutually recompose their relations as they are disrupted by problems that cannot be resolved through habitual interaction modes or by unilateral action. This process recasts how players understand the context in which they act, their roles within it and their possibilities for future action. Far from being determined by a structure of rules and endowments acting behind their backs, this process of social deliberation recasts the rules and structure.

Hierarchy and asymmetric access to resources exist in our analysis, and are even re-produced, through the on-going interaction. But learning and upgrading recomposes the self-understanding and sense of possibility for the interacting parties. As they learn

and become more capable of increasingly challenging design and engineering tasks, Chinese producers seek to insert themselves in global supply chains and in their own domestic markets in new ways. In response, MNCs change the way they conceive of their Chinese counterparts. They become both potential new partners as well as unexpected competitors on the domestic Chinese market. Once settled in one-way apprenticeship relations, ongoing interaction along these lines transformed the meaningful character of MNC/Chinese relations and created the conditions for recursive learning dynamics. In this way, relations are redefined despite the continued existence of endowment asymmetries. The key thing to see is that the meaningful dimensions of the asymmetries and the range of action possibilities are recast. Upgrading in China among indigenous producers and MNC manufacturing FDI is driven by reflective and creative processes of social action.

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² Edward Steinfeld, *Playing our Game* (New York: Oxford University Press, 2010); Francoise Lemoine, “FDI and the opening up of China's economy,” Centre d’Études Prospectives et d’Informations Internationales, Paris, France, 2000.

³ Loren Brandt and Eric Thun, “The Fight for the Middle,” *World Development* (2010), 1-20; Peter Marsh, “China's New Formula,” *Financial Times*, May 29, 2008, 1-4; Mehdi Shafaeddin and Juan Pizarro, “The evolution of value added in assembly operations,” *Journal of Chinese Economic and Business Studies* 8(4) (2000): 373–397; Lemoine, “FDI.”

⁴ Brandt and Thun, “Fight for the Middle.” Peter Marsh of the *Financial Times* has been chronicling these dynamics for some time; see Peter Marsh, “Bosch plans big drive into China,” *Financial Times*, December 23 2004, 1; Peter Marsh. “Focus on deals high up value chain,” *Financial Times*, April 25 2011, 1-2; Marsh, “China’s new formula;” Peter Marsh, “Companies move to computerise plants in China,” *Financial Times*, June 1 2005 21:56, 1; Peter Marsh, “Emerging economies flex manufacturing muscle,” *Financial Times*, March 14, 2011, 1-4.

⁵ See Sebastian Heilmann and Elizabeth Perry, eds., *Mao’s Invisible Hand*. (Cambridge, MA: Harvard University Press, 2011).

⁶ Steinfeld, *Playing our Game*; Richard Lester and Timothy J. Sturgeon, “China, America, and the global competition for industry,” MIT, Industrial Performance Center Working Paper (2003), K.M. Nam, “Learning through the international joint venture,” *Industrial and Corporate Change* (2011), 1–53; Daniel Breznitz and Michael Murphree, *Run of the Red Queen: Government, Innovation, Globalization, and Economic Growth in China*, (New Haven: Yale, 2011). Our claim must not be taken for more than it is. We do not mean that differences in technological sophistication and organizational practice no longer exist between China and its developing country competitors. That gap is narrowing rapidly, but still exists. We argue that the differences in sophistication constitutes a challenge for both Chinese and MNC competitors. As a result, the entire terrain upon which the Chinese and MNC strategizing is taking place is rapidly shifting upwards in value in a way that increasingly narrows the gap.

⁷ These recursive effects on home country operations will be developed in our report to the Hans Boeckler Stiftung: *Globale Komponentenproduktion – Herausforderungen für*

deutsche Standorte in globalen Produktions-und Innovationsstrukturen der Zulieferindustrie (2012).

⁸ Charles Sabel, “Real time revolution in routines,” in Charles Heckscher and Paul S. Adler, eds., *The Corporation as a Collaborative Community* (New York: Oxford University Press, 2005); Steven J Spear, *Chasing the Rabbit* (New York: McGraw Hill, 2009).

⁹ For the sociologically oriented literature, see Gerald A. McDermott and Rafael A Corredoira, “Network composition, collaborative ties, and upgrading in emerging-market firms,” *Journal of International Business Studies* 41(2) (2010), 308–329; G. Blalock and P.J. Gertler, “Foreign direct investment and externalities,” in T. H. Moran, E. M. Graham & M. Blomstrom, eds., *Does foreign direct investment promote development?* (Washington, DC: Institute for International Economics, 2005), 73–106; N. Lin, “Building a network theory of social capital,” in N. Lin, K. Cook & R. S. Burt, eds., *Social capital* (New York: Aldine de Gruyter, 2001), 3–30. For the practice oriented literature, see J.S. Brown and P. Duguid, “Organizational learning and communities-of-practice,” *Organization Science* (1991), 40–57. F. Blackler and S. McDonald, “Power, mastery and organizational learning.” *Journal of Management Studies* 37(6) (2000), 833–852; Etienne Wenger, *Communities of Practice. Learning, Meaning, and Identity* (Cambridge University Press, 1998); Jean Lave and Etienne Wenger, *Situated Learning* (New York: Cambridge University Press, 1991).

¹⁰ Brown and Duguid, “Organizational Learning.”

¹¹ Bente Elkjaer, “Organizational learning with a pragmatic slant,” *International Journal of Lifelong Education* 22(5) (2003): 481–494; B. Elkjaer, “Organizational Learning: The

‘Third Way’,” *Management Learning* 35(4) (2004), 419–434; B. Simpson, “Pragmatism, Mead and the Practice Turn,” *Organization Studies* 30(12) (2010): 1329–1347.

¹² Sabel, “Real Time Revolution.” See also AnnaLee Saxenian and Charles F. Sabel, “Roepke Lecture in Economic Geography, Venture Capital in the ‘Periphery’: The New Argonauts, Global Search, and Local Institution Building,” *Economic Geography* 84(4) (2007), 379–394.

¹³ John Dewey, *Human Nature and Conduct*, in *The Middle Works, 1899-1924*, Vol. 14 (Carbondale: Southern Illinois University Press, 1922); George Herbert Mead, *Mind, Self and Society from the Standpoint of a Social Behaviorist* (Chicago: University of Chicago Press, 1934); Hans Joas, *The Creativity of Action*, (Chicago: University of Chicago Press, 1995); Gary Herrigel, *Manufacturing Possibilities: Creative action and industrial recomposition in the US, Germany and Japan* (Oxford University Press, 2010).

¹⁴ Sabel, “Real Time Revolution.”

¹⁵ Sabel, “Real Time Revolution,” 121.

¹⁶ We show elsewhere that upgrading has been occurring over the last two decades in China. Gary Herrigel, Volker Wittke and Ulrich Voskamp, “The Process of Chinese Manufacturing Upgrading: Transitioning from *unilateral* to *recursive mutual learning* relations” *Global Strategy Journal*, forthcoming 2012.

¹⁷ See Moran, Graham and Blomstrom, eds., *Does foreign direct investment promote development?*

¹⁸ Timothy, J Sturgeon, “Modular production networks: a new American model of industrial organization,” *Industrial and Corporate Change* (2002); Boy Lüthje, et al, *Contract Manufacturing. Transnationale Produktion und Industriearbeit in der IT-*

Branche (Campus, 2002); G. J. Gereffi, J. Humphrey, and T. Sturgeon, “The governance of global value chains,” *Review of International Political Economy* 12(1) (2005): 78–104; Breznitz and Murphree, *Run of the Red Queen*.

¹⁹ Gulati, Nohriah and Zaheer, “Strategic Networks;” McEvily and Marcus, “Embedded Ties;” Uzzi & Lancaster, “Relational Embeddedness;” Blalock and Gertler, “Foreign Direct Investment;” Lin et al, *Social Capital*. See McDermott and Corredoira, “Network Composition,” for an overview.

²⁰ See Brown and Duguid, “Organizational Learning;” Blackler and McDonald, “Power, Mastery and Organizational Learning.”

²¹ Herrigel, Wittke, and Voskamp, “The Process of Chinese Manufacturing Upgrading.”

²² Cressida Lui, *Collaboration on Thin Ground: Contract Production Arrangements Between Taiwanese Firms and Their American MNC Customers in the Personal Computer Industry*, PhD dissertation, Department of Sociology, University of Wisconsin, in process; Breznitz and Murphree, *Run of the Red Queen*.

²³ See Jeffrey H. Dyer and Wujin Chu. “The determinants of trust in supplier–automaker relationships in the US, Japan, and Korea.” *Journal of International Business Studies* 42(1) (2011), 10–27; Ivarrson and Alvstam, “Upgrading in Global Supply Chains;” Brown and Duguid, “Organizational Learning.”

²⁴ Herrigel, Wittke, and Voskamp, “The Process of Chinese Manufacturing Upgrading.”

²⁵ See Elkjaer, “Organizational Learning with a Pragmatic Slant;” Elkjaer & Simpson, “Toward a Pragmatic Theory;” Simpson, “Pragmatism, Mead and the Practice Turn;” Sabel, “Real Time Revolution.”

²⁶ Christopher Ansell, *Pragmatist Democracy. Evolutionary Learning as Public Philosophy* (Oxford University Press, 2010).

²⁷ In addition to Sabel, “Real time Revolution;” see Charles Sabel, “Learning by Monitoring” in Neil J. Smelser and Richard Swedberg, eds., *The Handbook of Economic Sociology* (Princeton University Press, 1994), 137-165.

²⁸ Elkjaer, “Organizational Learning with a Pragmatic Slant,” Simpson, “Pragmatism, Mead and the Practice Turn.” See also George Romme, “Making Organizational Learning Work: Consent and Double Linking between Circles” in *European Management Journal*, 14, No 1 (1996), 69-75; G. Romme, “Organizational Learning, Circularity and Double Linking,” *Management Learning* 28. No 2 (1997), 149-160.

²⁹ Dewey, *Human Nature and Conduct*; Mead, *Mind, Self and Society*; and Joas, *The Creativity of Action*.

³⁰ Sabel, “Learning by Monitoring;” Sabel, “Real Time Revolution.”

³¹ L. Xi, L. Lei, and W. Guisheng. “Evolution of the Chinese Automobile Industry from a Sectoral System of Innovation Perspective,” *Industry & Innovation* 16(4) (2009), 463–478; Zejian Li, “The Role of International Technology Transfer in the Chinese Automotive Industry,” *MMRC DISCUSSION PAPER SERIES No. 269* (2009), 1–23; Ivarsson and Alvstam, “Upgrading in Global Value Chains;” Breznitz and Murphree, *Run of the Red Queen*.

³² Marsh, “China’s New Formula.”

³³ W.W. Chu, “How the Chinese government promoted a global automobile industry,” *Industrial and Corporate Change* 20(5) (2011), 1235–1276; Eric Thun, *Changing Lanes in China*, (Cambridge: Cambridge University Press, 2006); Li, “The Role of International

Technology;” Herrigel, Wittke, and Voskamp, “The Process of Chinese Manufacturing Upgrading.”

³⁴ We also saw localization upgrading in visits to auto suppliers, woodworking machinery, and drive train and braking systems producers in the Shanghai and Tianjin regions.

³⁵ See Sabel, “Real Time Revolution;” Spear, *Chasing the Rabbit*; and Takahiro Fujimoto, *The Evolution of a Manufacturing System at Toyota* (Oxford University Press, 1999).

³⁶ See Johann Soder, “Ziel: Prozessberater-Pool in allen Feldern aufbauen. Produktion Interview mit Johann Soder, SEW-Eurodrive,” *Produktion*, Nr 7 (February 16, 2006).

³⁷ Sabel, “Real Time Revolution.”

³⁸ Romme, “Making Organizational Learning Work,” ; and Romme, “Organizational Learning, Circularity and Double Linking,” for an interesting theoretical rendering of this dynamic.

³⁹ Charles Sabel and Jonathan Zeitlin, “Experimentalist Governance,” in David Levi-Faur, ed., *The Oxford Handbook of Governance* (New York: Oxford University Press, forthcoming 2012). This understanding of recursivity comes from mathematics and computer science.

⁴⁰ Ivarsson and Alvstam, “Upgrading in global value-chains;” Lui, “Collaboration on Thin Ground.”

⁴¹ This orientation may be specific to the sectors we studied and be less characteristic of industries, like the electronics, where first mover monopolies account for an enormous share of value.

⁴² Kate Bronfenbrenner and Stephanie Luce, “The Changing Nature of Corporate Global Restructuring: The Impact of Production Shifts on Jobs in the US, China, and Around the Globe,” Submitted to the US-China Economic and Security Review Commission, October 14, 2004.

⁴³ See Herrigel, Wittke, and Voskamp, “The Process of Chinese Manufacturing Upgrading.”

⁴⁴ On the non-determining character of asymmetric power relations within multinationals and supply chains, see C. Bouquet and J Birkinshaw. “Managing Power in the Multinational Corporation: How Low-Power Actors Gain Influence.” *Journal of Management* 34(3) (2008), 477–508; Stewart Clegg, David Courpasson, and Nelson Phillips, *Power and Organizations* (Thousand Oaks, CA: Sage Publications Limited, 2006).