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CHAPTER 2

Between the Global and the Local

THE SPATIAL LIMITS TO PRODUCTIVE CAPITAL

Meric S. Gertler

INTRODUCTION

It has been taken as an article of faith for some time that we live in a global economy. Frequent pronouncements by academics, journalists, and policy analysts alike continue to assert publicly the "fact" of globalization with numbing frequency. Bound up in such pronouncements are the ideas that globalization both is a reality and, as a process, constitutes an inevitable and inexorable development. Accepting this "global vision," governments throughout the industrialized (and industrializing) world have taken steps to get their respective houses "in order" by bringing their economic and social policies "in line" with those of the world's dominant economic forces. In the face of threats, implicit or explicit, from the owners of potentially mobile capital that they will redeploy their investments elsewhere, nation-states and subnational governments have increasingly been induced to ensure that their corporate tax rates are not too high, their social programs too rich, their economic policies too restrictive, or their environmental legislation too punitive.

At the center of this increasingly pervasive line of argumentation is the presumption that capital is indeed highly mobile, although the validity of such claims is rarely investigated. They are most often inspired by observations emanating from the world of global finance, and extrapolated, without a second thought, to cover *all* forms of capital. While it is beyond the scope of this chapter to examine critically the recent discourse on global finance, it is worth noting briefly two important points here. First, the appropriateness of transposing a financial metaphor to the analysis of other forms of capital should, upon a few moments' reflection, strike one as a problematic venture. Second,

when one scrutinizes this conception by examining more carefully the empirical realities of contemporary financial markets, one finds that even many of these "received truths" are not fully borne out (see Clark & O'Connor, Chapter 4, this volume; Gertler, in press-a; Helleiner, 1996; and Leyshon & Thrift, 1992; for further discussion of this theme).

My intent in this chapter is to subject to critical scrutiny the prevailing wisdom within economic geography (and the other social sciences) concerning globalization and the mobility of capital, by focusing on the case of "fixed" capital in the form of advanced industrial machinery. In the subsequent sections of this chapter, I briefly review the commonly held views on the subject of globalization and capital mobility. This is followed by an examination of the recent literature on the production and adoption of advanced manufacturing technologies which, among other things, raises serious doubts about the basic premises underlying the globalization thesis. In a subsequent section, I summarize the key findings of my own empirical research, conducted since 1991, on the development, production, and use of advanced manufacturing technologies. This research, based on case studies of Canadian firms, as well as German firms active in Canada, the United States, and elsewhere, indicates that there are indeed significant and enduring obstacles to the free and unproblematic flow of industrial capital between countries, despite the many advances in telecommunications and transportation technologies in the second half of the 20th century. The chapter concludes by considering the implications of this work for our theoretical and empirical understanding of globalization and contemporary capitalist dynamics, as well as for current policy debates. In doing so, I also consider some critical implications for those who subscribe to the common alternative to the globalization thesis—namely, the localization thesis.

FIVE TOUCHSTONES OF GLOBALIZATION

Since the efflorescence of international political economy and radical economic geography beginning in the 1970s (Bluestone & Harrison, 1982; Massey, 1978; Fröbel, Heinrichs, & Kreye, 1980; Massey & Meegan, 1982), the narrative on globalization has typically been based on five closely interrelated assertions. Most basic to this thesis is the argument that capital has become significantly more mobile than in previous times. The motivation for this mobility is as old as capitalism itself—namely, the search for expanded profits, achieved through either the pursuit of higher rates of return on investment available elsewhere, or the spatial expansion of markets (Harvey, 1982). This has produced a greatly expanded spatial range for financial and fixed capital, both within and between individual countries.

Second, innovations in the organizational form of the capitalist firm

have facilitated this process of interregionalization and internationalization (Chandler, 1962; Dicken, 1992a; Storper & Walker, 1989). The multiregional firm arose with the innovation of the M-form (multidivisional) organization, whose multilocational structure was based either on a functional specialization (producing a spatial division of labor) or the creation of geographically organized divisions for the pursuit of spatially distinct markets. This same organizational form came to be replicated at an international scale, producing an international division of labor.

Third, this geographical expansion of capital has been enabled and facilitated by the development of space-transcending technologies of transportation and communication. These have served not only to extend the spatial reach of capital, but also to speed up the rate of circulation. Hence, the process of realization of surplus value, achieved through the transformation of capital from its financial (circulating) to its fixed (constant) form and back again, has been dramatically speeded up, particularly in the last quarter of the 20th century (Harvey, 1989). This has produced, according to Harvey, a process of time–space compression or, to put it another way, the annihilation of space through time.

Fourth, the expanding internationalization of production systems, in which multi- and transnational corporations have constructed elaborate divisions of labor, has a paradoxical character to it. On the one hand, this internationalization has been driven by the prior existence of geographical differentiation (Walker, 1978), as capital seeks to exploit local differences in the supply and price of inputs, the quality of the production environment, markets, historically grounded social relations, and politics. On the other hand, the very process of internationalization itself acts as a leveling or homogenizing force. This spatial homogenization is achieved in a number of ways. However, most relevant to the discussion in this chapter is the interregional and international transfer of production technologies. The principal vector in this diffusion process is the multilocational firm, which is seen as bringing its production methods (both "hard" technologies and "soft" forms of work organization) to new locations through the establishment of branch plants. This process ultimately serves to erode the distinctive character of regions and nation-states.

Fifth, and contributing to this process of erosion, is the contention that, with their heightened powers of mobility and expanded spatial reach, global corporations are able to undermine the regulatory purchase of individual regions and nation-states. As noted in the introduction to this chapter, a process of locational blackmail (or "whipsaw" effect) pits one government against another, as nation-states prostrate themselves before these powerful private actors for the sake of attracting much-coveted employment and investment. The result is what has been referred to in common parlance as "the race to the bottom," as nation-states liberalize economic policies and scale back their so-

cial welfare effort. Furthermore, the multinational basis of these firms' organization allows them to shelter profits from taxation and continue to pursue socially or environmentally regressive practices in more permissive jurisdictions. Hence, so the argument goes, the nation-state has become "hollowed out" and obsolete as a regulatory force (Jessop, 1993). Taking its place are, alternatively, either supranational institutions such as the European Union, the North American Free Trade Agreement (NAFTA) and the General Agreement on Tariffs and Trade (GATT) or subnational states (Cooke, 1993; Ohmae, 1993).

Having now reviewed the fundamentals of the globalization thesis, I wish to argue that it contains at least two key flaws. First, its characterization of the ease with which production technologies diffuse from one location (or country) to another is simplistic in the extreme. Second, the assertion that the nation-state is no longer functional as a regulatory influence in the economy is, at best, premature and, at worst, ill founded. In the remainder of this chapter, I aim to demonstrate that fixed capital (particularly the more advanced forms of industrial machinery and production systems) is, in fact, much more strongly rooted in place, and considerably less "portable" than has been implied in the literature on globalization. However, in making this case, I rely less on arguments of spatial fixity in the weak sense (that is, stemming from the simple physical immutability and immobility of fixed capital; see Richardson, 1973), and more on the nature of the social context surrounding the development, production, and use of such technologies. Furthermore, in arguing the case that machinery production and use are firmly rooted in place, I do not wish to privilege strictly *local* institutions, culture, and regulatory forces to the exclusion of other scales of influence. Hence, I will also argue that, while such local and regional forces do indeed have a role to play, they assert their influence within an institutional and regulatory space that is still defined and circumscribed largely by the nation-state.

In the following section, I review the recent literature on the production and use of advanced manufacturing technologies, laying the theoretical foundations for the arguments just advanced. In the section following this, I provide some empirical substantiation of these claims, by reviewing the findings of my own recent study of the problems and difficulties arising in the long-distance transfer of advanced process technologies.

MACHINE PRODUCTION AND USE: THE SPATIAL CONSTRUCTION OF CAPITAL

The relationship between machine users and producers has been the subject of theoretical and empirical work, first by economic historians (Rosenberg, 1976, 1982a, 1982b), and more recently by students of industrial organization and technological change (Lundvall, 1985, 1988; Porter, 1990). This literature

has suggested that "closeness" between the users and producers of advanced machinery is important for a variety of reasons, laid out briefly as follows.[1]

The argument begins with the general insight that capital goods differ in important ways from the other kinds of inputs purchased by manufacturers. Their function, when combined with labor, is of obvious central importance to the success of a manufacturer's operations. Furthermore, they tend to be long-lived (by definition), and hence the firm will have to rely on such assets for a long period of time. Add to this the consideration that frequently—particularly when the firm is purchasing recently developed, leading-edge technology—a large degree of uncertainty surrounds the future use qualities of these capital goods. Because of these properties, the wise firm will prefer not to purchase advanced capital goods through a simple, discrete, "off-the-shelf" market transaction, but will be more inclined toward engaging in a transaction in which there is extensive interaction and communication with the producer of the machinery—what Lundvall (1988) refers to as an *organized market* transaction.

This mode of purchase is said to offer a number of benefits to prospective machinery users and producers alike, so that complex production equipment is not only more likely to be *adopted* successfully when there is close and frequent interaction between producer and user, but is also likely to be *produced* more successfully as well. This interactive mode of technology acquisition allows users to gather as much information as possible about the properties of the machinery under consideration, and to gauge the reliability and trustworthiness of the producer. Furthermore, it may allow the user to make its technological needs more readily and clearly known to the producer, creating the conditions under which the effective customization of the product to the user's particular application is more likely. To allow customization to occur, however, users must reveal to an outside firm certain proprietary details concerning their products or production processes, and they may be unwilling to do so unless they have been able to build up a sufficient level of trust with machine producers, resulting from a process of close interaction over an extended period of time.

At the same time, this kind of interaction is also important and beneficial for machinery producers. Research on capital goods innovation has demonstrated that prospective users—particularly demanding and technologically sophisticated customers—represent a vital source of creative stimulus for producers, who are more likely to develop important innovations when compelled to meet their customers' needs (Lotz, 1990; Teubal, Yinnon, & Zuscovitch, 1991; von Hippel, 1988). These innovations not only help producers themselves compete more successfully, but also bring obvious benefits to the users who are fortunate enough to enjoy a close relationship with producers, characterized by this process of mutual learning.

Other benefits for users may arise in later stages of the machinery acqui-

sition process. The interactive perspective sees the acquisition process as one of considerable duration, consisting of three distinct stages. Beyond the benefits arising in the preinstallation phase of design and production just described, the second phase (installation and start-up) is likely to proceed more smoothly when producer and user enjoy a close relationship, since (1) the producer will more likely be on hand to assist in the installation and break-in of the new machine or system, providing useful on-site training and assistance, and (2) the start-up process is likely to be easier (i.e., requiring less adjustment and adaptive behavior by the user) when the machine or system has been properly tailored to meet the user's precise specifications. Similarly, the third phase—of "normal" operation of the new machinery postinstallation—will also be more successful (i.e., with fewer breakdowns and coming closer to meeting users' expectations concerning productivity, quality, and functional capabilities) if a close relationship with the producer facilitates the adjustments and debugging that are bound to be necessary as the experience of regular, full-time operation brings to light inevitable operational problems.

Clearly, these kinds of benefits, and the closeness between users and producers that is said to facilitate the technology acquisition process, are most likely to be important when the technology involved is expensive, complex, and rapidly developing. Presumably, when the process technology in question is less expensive, or represents more mature or familiar technology, an interactive mode of acquisition will be less important. For cheaper, well-established, or "tried-and-true" technologies, an off-the-shelf mode of purchase should suffice.

A number of significant implications flow directly from this approach. First, these arguments suggest that a large measure of the success enjoyed by manufacturers in the celebrated industrial districts of Europe and Asia may be attributed to the close and constructive relationship they are able to maintain with nearby producers of innovative machinery. Second, viewed from this perspective, it should come as no surprise that machinery producers in these same regions have become highly successful competitors in international markets in recent years. Third, and perhaps most significantly for the present analysis, this literature implies (although it does not make this point explicitly; see Gertler, 1993) that many of the problems arising when manufacturers in the mature industrial regions of the United States, the United Kingdom, or Canada attempt to implement new, technologically advanced process technologies stem from the fact that the most important sources of innovation and production of these technologies are themselves now a considerable distance from would-be users in these countries—notably in countries like Japan, Germany, and Italy.[2] As a result, users in North America might be expected to have growing difficulties in developing and maintaining a "close" relationship with advanced machine producers. Forced instead to acquire complex technologies using a mode of acquisition more akin to an off-the-shelf transaction, such users are much more likely to encounter the kinds of problems documented by previous case studies.[3]

Despite the compelling nature of these arguments, certain countervailing forces might conceivably intervene to reduce or qualify the attenuating influence of simple physical distance between user and producer. Three, in particular, might be considered. First, it is possible that, despite a preference for direct, face-to-face interaction, users and producers might be able to communicate quite adequately for many purposes by using modern and increasingly effective telecommunications media (especially the fax machine and telephone). For those functions that cannot be provided over the wire, rapid air transportation of technical personnel (or key parts) might serve as a reasonable compromise when users are far away from their advanced machinery producers. In addition, it should be recognized that many European and Asian producers contract with distributors, sales representatives, and maintenance firms in North America to perform on-site service functions on their behalf. Such intermediaries might be able to compensate for the long distances intervening between North American users and overseas producers.

Second, as noted in the previous section, large, multilocational (including multinational) firms have often been portrayed as highly effective, distance-transcending agents of (intrafirm) technology transfer.[4] According to this view, production regions that might be viewed as peripheral (with respect to the location of leading machinery producers) may nevertheless be characterized by the presence of advanced machinery that is being used effectively by the local branch plant operations of such large, multisite firms. The close organizational ties between such branch plants and their foreign head offices (or sister plants elsewhere) may allow the branch operations to benefit from the considerable expertise and experience that exist within the larger firm. If the parent firm has developed its own advanced process technologies, at its head office or other production or research sites, these are likely to be transferred quite effectively to branch plant users at distant sites. According to this argument, then, what matters more than simple physical distance is what one might call *organizational distance*.[5]

Third, one might consider another interpretation of the difficulties encountered by the users of advanced machinery in "peripheral" locations, one that has more to do with differences in cultures, institutions, and the legacy of past industrial practices than with the problems caused by the intervening distance between users and producers. For example, at the most basic level, Lundvall (1988) argues the importance of a common culture and language shared by users and producers, to facilitate the transmission of highly encoded information concerning users' needs and the capabilities and proper operation of complex and rapidly changing process technologies (see also Storper, 1992). Others point to differences in training cultures and attitudes toward technology as the crucial issues (Gordon, 1989; Stowsky, 1987), implicating

the distinct set of practices and attitudes peculiar to Anglo-American firms as the true source of technology implementation problems.

According to this latter view, the typical American, British, or Canadian firm regards technology as something *embodied* entirely within the physical properties and design of machinery and production systems themselves. This stands in sharp contrast to the approach more typical of European and Japanese manufacturers, who not only appreciate the necessity of social interaction for effective machine production and use, but also regard the technological capabilities of a production process as being produced through the interaction between machines and skilled workers who have built up a wealth of knowledge and problem-solving abilities through many years of training and learning by doing.

The consequence of this difference is that Anglo-American users of advanced machinery, who espouse what Block (1990, p. 152) refers to in the macroeconomic context as an "intravenous" model of capital investment, typically expect to be able to extract the full capabilities of such technologies merely by installing them correctly and "flipping the switch."[6] In contrast to their European and Asian counterparts, and in response to the national institutions shaping relations in their labor market, they tend systematically to undervalue the importance of training and to maintain shorter term relations with their workers (instead making extensive use of external labor markets). A further consequence is that an advanced machine designed and built, for example, in Germany will be considerably more difficult to implement successfully in a North American user plant than in a German user plant because the "culture" of industrial practices peculiar to Germany (high skill levels of factory workers, stability of the employment relation, cooperative decision making on the shopfloor, strong emphasis on training) has been incorporated into the design of the German-made machine. According to this view, then, physical distance is really just a proxy for *cultural distance*, where "culture" refers to a set of dominant workplace practices shaped in large part by legislative definitions of employment relations and the nature of the (public and private) industrial training system. Furthermore, as we shall outline in a later section of this chapter, this approach would seem to ascribe continuing importance to nation-states and the economic and social institutions created by them (see Gertler, 1992).[7]

THE PRODUCTION AND CONSUMPTION OF ADVANCED MACHINERY

Over the past several years, I have been pursuing a research project whose findings challenge the blithe notions associated with the globalization thesis about the easy transferability of process technologies and work practices from

one country to another. My analysis also highlights the continuing influence of national-level regulation on intrafirm changes and interfirm relations (see Gertler, 1993, 1995a, 1995b, 1996, in press-b). This study began by focusing on a simple question: why have manufacturing firms in Ontario (as well as in other mature industrial regions such as the U.S. Midwest and the British Midlands) apparently had such a dismal experience when they have tried to implement various forms of advanced manufacturing technologies (AMTs)? The technologies in question include the range of different types of computerized, programmable automation for fabrication, testing, and handling. They also include various information technologies to link up different functions within single plants and between buyers and suppliers. Hence, the object of study here has been the very technologies said to be at the heart of the transition to the "new" competition, the "new social economy," or post-Fordist flexible specialization.

As noted earlier, the leading world sites for the development and production of these technologies are to be found in Germany, Japan, Italy, and other European and Asian countries. According to the globalization thesis, the process of international diffusion of such technologies from these sites should be straightforward and unproblematic, enabled as it is by the use of telecommunications technologies, and propelled by the spread of multinational enterprise throughout the adopting regions and nations. However, the experiences documented amongst technology users in four Ontario industries indicate strongly that this has not been the case.[8] In total, over 400 technology implementation experiences were documented through the use of a postal survey. Follow-up interviews were conducted with 30 user firms in the original sample, which was constructed to include user firms of all sizes, and both Canadian and foreign-owned plants (see Gertler, 1995a, for details on sampling). In subsequent phases of the study, some 15 interviews were conducted with machinery producers in one of the major supplier countries (Germany). In addition, a further 22 interviews were conducted with Canadian-based producers as well as sales representatives or distributors for foreign-manufactured advanced machinery and systems.

A brief overview of my findings will bear out the argument I have just made. First, distance from the producer of AMTs does seem to matter to AMT users (Gertler, 1995a): a healthy majority indicated that it was important and preferable to have their major advanced machinery producers located at least within the same country (the same region—within 75 kilometers—was even better), and over three-quarters reported a strong preference that their machinery producers be located in Canada or the United States. Second, going beyond mere preferences, the evidence suggested that Ontario users were significantly more likely to experience difficulty in operating their advanced production systems or machines when the sources of such technologies were farther away—particularly in Europe or Asia. Third, domestically

owned user plants, especially small or medium-sized and independently owned operations, appeared to be most profoundly affected by such intervening distances. This resulted in part from their relative inability to marshall in-house resources (such as skilled technical personnel) to help them overcome the negative consequences of spatial separation from suppliers.

For larger user plants, and those belonging to multilocational (including multinational) organizations, the effects of relative isolation from advanced machinery producers, while less extreme *were, nevertheless, still quite significant.* This was so despite the fact that larger plants were more likely to receive more attentive and higher quality service from distant machinery producers than were smaller users (because the former made larger purchases at any one time, were more likely to make further purchases in the future, and were regarded by the producers as prestigious or "showcase" customers). Larger users were also better able to afford the cost of achieving more extensive face-to-face interaction with their (frequently distant) machinery producers *before installation*—that is, during the design and development phase. Smaller user firms often found this practice to be prohibitively expensive and tried to make do with less effective, non-face-to-face forms of contact. Larger users were also better able to pay for *postinstallation* service visits directly from the machinery producer (both planned and unplanned) once the warranty period had passed. Furthermore, they were considerably more likely to receive personal site visits from producers (from *any* location) during both the installation and operation phases of technology acquisition. It is also true that user plants belonging to multilocational organizations were considerably more likely to enjoy some of the benefits of a "close" relationship with a distant producer of their advanced machinery, either because another branch of the same firm had forged a close, collaborative link with the producer, or because another branch of the same firm actually produced the equipment in question. However, despite all these advantages, these larger plants still experienced significant problems in implementation.

The reasons why physical distance between users and producers seemed to matter, as far as the users were concerned, ranged from simple, straightforward issues to much more fundamental problems. In the former category were such considerations as time-zone differences and the difficulties associated with moving personnel, machinery, and parts across international borders. Physical separation also usually meant some degree of cultural difference between user and producer, beginning with attributes such as language. However, even when both user and producer shared the same language, it was apparent that the inherent difficulty of communicating complex technical information and concepts without direct, face-to-face interaction remained a source of continuing problems in the technology implementation process, despite the extensive use of telephone, fax, and modem.

Users frequently attributed more fundamental implementation problems to "cultural" differences between them and their foreign machinery suppliers, but it became clear upon further investigation that these problems should ultimately be understood in a different way. While it is indeed tempting to conclude from these findings that *local* culture, institutions, and processes of regulation might exert the most important determining force in the relationship between AMT users and producers, there is good reason to be as skeptical of such claims as one should be of the globalization thesis. A further discussion of my findings bears out this argument.

Users of advanced technologies produced in northern European countries frequently complained of the "rigidity" or "inflexibility" of their machinery suppliers, who seemed (to users) to be unwilling to take their specific technical requirements seriously. When operational difficulties arose (as they frequently did, even for large, sophisticated users) these foreign producers were seen as being quick to blame the "inferior" technical skills of user-plant managers and shopfloor workers, since European users of similar technologies had, according to the producers, experienced few difficulties. Underlying what was recognized as a "cultural" trait was really a set of differences in approaches to technology, training practices, and degrees of empowerment of shopfloor employees in the workplace. These differences were themselves reproduced and reinforced by divergences in the regulatory frameworks that structured the social and economic context within which machinery production and use each take place.

Hence, to take one common example, the set of industrial norms and practices prevalent in Germany stood in stark contrast to those prevailing in most North American workplaces. In particular, North American industrial workers were generally less extensively educated, received less training on the job, had less say in decisions affecting both the day-to-day plant operations and longer term, more strategic decisions of the firm (including technology adoption decisions), and experienced less employment stability and more interfirm mobility than did their German counterparts. Hence, when these same North American workers were asked to implement a new process technology developed for application in a very different setting (involving highly educated, intensively trained, and relatively empowered workers, enjoying long, stable associations with the same employer), problems of implementation were bound to arise (for further elaboration, see Gertler, 1995b). In this sense, then, the physical distance separating the northern European producer from the North American user is also a proxy for distance in terms of the *labor market norms and workplace practices that vary across nation-states and, to some extent, subnational regulatory jurisdictions.*

This situation turns out to be a problem not just for the users in Ontario, but for at least some of the producers abroad as well (Gertler, 1996). A subse-

quent phase of the study involving interviews with German producers of AMTs supplying customers in the Ontario sample of users revealed that, at least initially, these German engineering firms were just as oblivious to the existence and source of this problem as were their customers. In particular, they failed to appreciate the extent to which the nationally shaped workplace regulations, norms, and practices prevailing in the plants of their German users (and indeed their own plants) had come to be reflected in the very design and operation of their advanced machinery and machine tools.

When their initial forays into the North American market led them to realize that U.S. and Canadian workers and workplaces were "different" from their own, the German machinery producers were still likely to see the sources of such differences as a matter of "culture" or "mentality." While it is possible that such differences did arise originally from cultural traits, it is clear that such differences are enshrined and reproduced by the national regulatory frameworks prevailing in each country. Confirmation of this argument is found in the fact that the machinery-producing firms selected as cases for the study were located in several different regions of Germany, including Baden–Württemberg, North Rhine–Westphalia, Hesse, and Lower Saxony, with similar difficulties in user–producer relations and implementation experiences arising with firms in each of these regions. Furthermore, interviews with the producers revealed that, while they frequently sold their machinery to customers in many different regions of Germany, the kinds of implementation difficulties that did arise within their domestic users' plants (generally minor in comparison to what was found in Ontario) had little to do with "cultural" differences, and more to do with the logistical difficulties arising when frequent site visits are not quite as easy to sustain.

These findings are strongly consistent with recent scholarship on the continuing significance of national regulatory features in shaping the trajectory of contemporary change in the workplace.[9] Lane (1987, 1988, 1989, 1991), a sociologist, has assembled an impressive body of empirical research on the role played by national institutional characteristics in producing distinctive workplace outcomes in manufacturing and financial service enterprises. Drawing on evidence from detailed firm-level studies in Germany, Britain, and France during the 1980s, she has produced important insights into the particular aspects of industrial organization and national regulation that facilitate or frustrate the implementation of new manufacturing practices, such as policies to promote enhanced labor flexibility. In British plants, these efforts were impeded by the general nature of the prevailing employment relation, characterized by high turnover rates in the labor force, rigid job demarcations, poor communication and little trust between workers and managers, and very little devolution of power to shopfloor workers. The impact of these traits was exacerbated by British management's almost universal focus on cost control as its principal objective (in contrast to German management's primary interest

in competing on the basis of quality). The most obvious result of such differences (themselves largely produced—and reproduced—by national systems of labor market and industrial relations regulation) was a consistent tendency by British manufacturers to pursue *numerical* forms of labor flexibility, while German firms were far more effective in capitalizing on the benefits of *functional* flexibility in their workforce.

More recently, Christopherson (1993) has shown how the US macroregulatory framework differs significantly from that of Germany's (or Japan's), and argues that this holds significant consequences for the form of "post-Fordist" production systems now emerging in each of these countries. In particular, she notes how the national regulation of capital markets, industrial relations, and labor markets creates a set of incentives for American firms to privilege short-term considerations over long-term ones and to create instability in employment relations characterized by high rates of employee turnover, leading to serious disincentives for employers to invest in employee training. Furthermore, in a system with highly decentralized wage determination and reliance on external labor markets, firms compete directly (and ultimately, unproductively) with one another over wage rates and skilled labor. Despite some notable differences, the Canadian and British systems of macroregulation in capital markets, labor markets, and labor relations systems are (due to their common heritage) considerably closer to the American situation than to that of Germany or Japan.

Returning again to the study of advanced machinery implementation in Ontario, it was also apparent that the conditions Ontario AMT users face are not very conducive to the formation of collaborative relations with manufacturers of advanced equipment for the purpose of jointly designing customized, advanced process technologies, suggesting that these users are being deprived of the full range of benefits arising from such intensive, cooperative interaction. In particular, two findings stand out (Gertler, in press-b). First, it seems to be very difficult to establish and maintain such a close, collaborative relationship with technology producers that are long distances away. For all the reasons stated earlier, overseas relationships of this sort have proven to be especially difficult to strike up and keep going, and they are less likely to lead to beneficial outcomes for either party. Second, within the Ontario user plants, and in great contrast to the "who is 'us'?" arguments of Reich (1991) or Ohmae's (1993) "borderless world," *foreign-owned firms are far more likely to establish collaborative relations with AMT producers in their home country*, and far less likely to seek out local suppliers for the same technology, even when such local sources exist and can be shown to be internationally competitive. Similarly, Canadian-owned firms are far more likely to engage in collaborative relations with, and to source their customized equipment from, local AMT producers. In short, *the nationality of ownership still matters*!

CONCLUSIONS: THE SPATIAL LIMITS TO PRODUCTIVE CAPITAL

Three principal conclusions flow from the research described in this chapter. First, this work suggests that there are real and continuing limits to the effectiveness with which capital, in the form of leading-edge machinery and production systems, can move over long distances. Despite advances in the technologies of transportation and communication, long intervening distances between machinery producers and users do apparently make it considerably more difficult for these two parties to achieve and sustain the kind of close relationship necessary to support the effective deployment of such production technologies. Indeed, one might argue that the increasingly complicated nature of computer-controlled production technologies offsets many of the space-transcending benefits of innovations in communication and transportation systems.

Second, notwithstanding the implementation problems arising solely from the logistical difficulties of sustaining a user–producer relationship over long distances when the product being "used" is highly complex in nature, the truly fundamental difficulties arising in this relationship flow less from logistical limitations or physical realities and more from the fact that *technology is socially constructed.* The chief failures in technology implementation stem from the fact that users are trying to utilize these advanced machines and systems without due regard for the social relations surrounding their use. Because the social relations in the typical Ontario (or American, or British) workplace are so different from those prevailing in machinery production sites such as Baden–Württemberg (or North Rhine–Westphalia), the failure by users to acknowledge these differences in social context means that they have ignored many considerations crucial to the successful implementation of newly acquired machinery and equipment. In this sense, the continuing geographical specificity of these social relations imposes significant limits on the "portability" of advanced production technologies from one location to another.

Third, while logistical difficulties are indeed likely to increase with the simple physical distance between user and producer, divergences in social relations are more likely to arise when producer and user are in different nation-states. Furthermore, these divergences (and the resulting implementation problems) are likely to be especially pronounced when the two nation-states have developed along distinct historical paths. Because Canada's predominantly Anglo-American systems of industrial finance, labor market institutions, and labor relations (with their emphasis on decentralized individualism and short-term time horizons) are *so* different from the German system (corporatist, consensus-based, with long time horizons and stable employment relations), major problems are bound to arise when users in Ontario (or, for that matter, British Columbia) implement German-built machinery. By the same token, one should expect far fewer (and less fundamental) problems when the two nation-states involved share a common (in this case, Anglo-American) heritage and regulatory system, despite long intervening distances.[10]

At least for the economic relations studied in this chapter, the principal scale of regulation remains the nation-state, as it is at this level that the major institutions shaping workplace practices (including technology use) persist. While I do not wish to deny the importance of subnational institutions and "culture" in shaping the social character of production systems, it seems that the continuing role of nation-state institutions has been very much underplayed within the recent literature on innovation networks, industrial districts, flexible specialization, and related issues. On the other hand, the relatively recent literature on national systems of innovation (Nelson, 1993) makes the case that the policies of national governments have been (and continue to be) critical in shaping the possibilities for generating new products, processes, and modes of workplace organization, while precluding others.

It seems clear from this discussion that one of the pressing concerns for economic geography, as well as for the related disciplines of political science, economic sociology, and industrial economics, will be to sort out more systematically the relationship between different spatial scales of regulation—in particular, the relative importance of subnational, nation-state, and international institutional forces in regulating economic processes. What is also clear is that explanations based on only a single scale of analysis (whether it be local, national, or global) will likely prove inadequate. There is thus much work still to be done.

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NOTES

1. The discussion here draws particularly from Lundvall's (1985, 1988) work, since he provides the most systematic treatment of these issues. For a more thorough review of this work, see Gertler (1993). Throughout the balance of this chapter, the term "user" refers to a firm that has acquired and implemented some form of advanced manufacturing technology in its production process. The term "producer" denotes the manufacturer of advanced equipment, machinery, or integrated systems.

2. While the United States has been an important source of advanced manufacturing machinery since the middle of the 19th century, the industry there entered a period of long-term decline starting in the postwar period of the 20th century (Graham, 1993). By 1987, the U.S. industry produced roughly one-third of all machinery shipped by OECD producers, while Japan, Germany, and Italy constituted over one-half between them. In terms of OECD machinery exports, the U.S. industry's share declined steadily through most of the 1970s and 1980s, so that by 1987 it was responsible for less than 15% of total exports by OECD countries. Meanwhile, Germany's share held fairly steady at around 23–25%, and Japan's share rose consistently from under 5% (in 1975) to about 12% (Science Council of Canada, 1992).

3. For an early recognition of the off-the-shelf manner in which most independent Canadian firms are forced to acquire their production technology, as well as some of the inadequacies of this mode of technology acquisition, see Britton and Gilmour (1978, Chap. 6).

4. See the excellent review of this literature provided in Dicken (1992, Chap. 12).

5. Lundvall (1988) offers similar speculations about the possible importance of spatial–organizational structure, but provides no concrete evidence to support or refute his observations.

6. Block (1990) resorts to such terminology to reflect the idea that, in the prevailing Anglo-American approach, the primary determinant of changes in industrial output is simply the *volume* of capital and the flow of investment. Such a view ignores the crucial impact of the *social relations* within which production itself occurs. Block's objective is thus to show how such relations exert considerable influence over the volume and quality of output, productivity, and success with utilizing advanced workplace technologies.

7. Storper (1992) provides a useful discussion of the importance of shared culture within territorial production complexes characterized by what he calls product-based technological learning. He also discusses the concept of user–producer interaction in more general terms, noting its relevance not only to users and producers of capital goods, but also to users and producers of components, materials, information, and final products. However, Storper's conception of "culture" depends far less on state regulatory frameworks than does the approach espoused here, emphasizing instead the traditions, norms, and practices developing from close interaction between spatially clustered economic agents over an extended period of time. For a critical assessment of the treatment of culture in the "new industrial geography," see Gertler (1995b).

8. The sectors are transportation equipment (automotive/aerospace), electrical and electronic products, fabricated metal products, and plastic and rubber products.

9. The classic sources are Maurice, Sellier, and Silvestre (1986); Sorge and Warner (1986); and Streeck (1991). For a recent critical review and synthesis of this literature, see Smith and Meiksins (1995).

10. This observation goes some way toward explaining Canadian manufacturers' traditional and long-standing reliance on, first, British and, then, American production technologies (Innis, 1933). It also suggests that the decline of the U.K. and U.S. machinery industries was as much a problem for the Canadian economy as it was for those two countries.

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