Globalization of Firms and the Competitiveness of Nations

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Holger Crafoord 1908-1982

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The Permeability of Borders and the Speed of Learning among Countries

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This paper offers a speculative discussion on a disarmingly simple question: are the borders of a country less permeable than the borders of the firm? More concretely, how quickly does the technology and capabilities of a firm diffuse within its country as compared to across countries? It is this question that lies at the heart of the important debate on the competitiveness of nations and the international competitiveness of firms.

Of course, the simplicity of the question is misleading. The answer or, more honestly, answers cut across not only many areas of controversy, but across the social sciences. But the kernel of the problem boils down to two critical elements. How does a set of technologies and organizational practices become established within a country, and what kinds of knowledge or technologies are the most easily learned and transferred?

These themes are common in the literature on the evolution of technologies and industries, though the organizational underpinnings have been largely neglected. I propose in the following that countries differ in their underlying "organizing principles" of work and that these principles develop within the confines of a trajectory, much like Nelson and Winter (1982) describe for the development of technologies. These principles cut across industries, thus creating a dense network of firms. These firms, though differing in their products and markets, share common heuristics for organizing their economic activities.

It is because of these commonalities among diverse firms within a country that an analysis of international competition cannot be restricted to single industries. The country of origin influences a firm's capabilities, regardless of its industry membership. It is not imprecise language, consequently, to speak of the competitive advantages of Japan instead of Japanese firms.

Moreover, it is the contention of this paper that the central issue in understanding long-term patterns in country (or firm) competition is not technology *per se* but rather how organizations organize their economic activities. The traditional emphasis has been upon product innovations, and the R&D inputs required to produce such innovations. Rather, in our view, the central issue is the methods, or organizing principles, by which R&D, or any economic activity, is directed. Competition among firms, as well as among countries (to the extent that location matters), is driven by variations in organizational capabilities.

The speed by which new technologies and organizing principles leak across borders is, in part, dependent upon the extent to which the world economy is integrated. Whether the externalities from a single firm's learning spread more rapidly within the inter-industry network of a country before it spills over into foreign countries is as much an empirical question as a theoretical one. It is not, however, only a question of the interrelatedness of national economies as measured in economic transactions, but also the facility by which knowledge and technologies flow among countries.

It is the analysis of the characteristics of country capabilities and the diffusion of these capabilities that is developed below. The first few sections set up the argument that countries are characterized by different technological and organizational trajectories that tend to be stable over long periods of time. The first section turns to the important literature on technological capability and broadens this perspective to include the organizing principles that prevail in a country. The subsequent two sections applies recent work on path development to explain the inertia of switching between technological and organizational trajectories. An extension to the work on real options illustrates some of the potential applications and modelling characteristics. The fourth section argues that the convergence to best practice is slow due to the characteristics of technology and organizing principles. In the subsequent section, the greater difficulty to learn across borders is analyzed in terms of four factors: opportunity to learn, arena of competition, identifiability (i.e. signal-to-noise ratio), and feasibility. The final section addresses the issue of differences in learning capabilities across countries and over time.

I Technological Capability and Organizing Principles

The importance of technology to the international competitiveness of industrial countries has been confirmed in numerous theoretical and empirical studies on the relationship of R&D to a country's industry variation in exports and foreign direct investment. In a recent review of empirical work on trade patterns, Deardorff (1984) concludes that the most robust finding in economic work on the determinants of trading patterns has been the positive relationship of workers skills and technological capabilities to exports. The relationship between R&D expenditures and foreign direct investment has also been the most consistent finding in empirical studies.

The explanations developed in the 1960s to explain this relationship stressed the effects of both supply and demand conditions on technological capability. In his product life cycle theory of trade and investment, Vernon (1967) proposed that there exist certain innovating countries which push out the technology frontier through new product and process developments. Some of these innovations are in made in response to the relative deprivation of factors of production; scarcity, or relative costliness, leads to innovative efforts to substitute.[1] Products derived from these innovations serve, first, the domestic environment and, then, are exported. Product and process know-how eventually diffuses overseas, leading to a reversal in trade flows of these products. There is no particular reason why a single country should lead in the technology of all goods. Rather, as Burenstam Linder (1961) argues, countries tend to specialize in the production and export of goods which reflect their comparative advantage in particular innovations.[2] To him, foreign trade is but the extension of the home market network across borders. Comparative advantage is a component of the technological gap models, not in the sense of static endowments of certain factors, but of dynamic accumulation of specific technological skills developed in response to conditions of local demand.

[1] There is a rich debate on the creation of innovations in response to deprivation, whether due to war-time shortage or to relative factor costs. See David (1975) for a discussion.

[2] See also Davidson (1976) on the relationship of European conditions to the factor bias in innovations.

It is ironical that despite the enduring relationship between technological expenditures and trade and investment composition, the theories of Burenstam Linder and Vernon have not stimulated substantial subsequent research. In part, this neglect reflects the effects of interest in competing theories that have redirected efforts, first, to incorporate the theories of the firm and of direct foreign investment and, later, to extend industrial economics to

laws, but also, on the other hand, to be successively applied to new problems in related markets and industries.

It is this inter-industry diffusion which leads to what Dahmén (1950), in his classic analysis of the growth of the Swedish economy, called "industry blocks," that is, the spilling over of technologies into related industries. In his study on R&D interdependences in the American economy, Scherer found that certain industries not only play a more important role as

parisons are largely lacking — with some exceptions, such as Cole's (1985) analysis of quality circles, a growing body of empirical evidence points to substantial differences in the organization of firms across countries.[5]

A less substantiated claim is that organizational innovations also exhibit a developmental trajectory. There is, however, a considerable number of historical accounts that document the slow diffusion of organizational practices within a country. The gradual development of the American System of Manufacturing, as brilliantly analyzed by Hounshell (1984) in his study of the historical origins of mass production, took more than a 100 years to evolve the concept of standardization. Interestingly, the system evolved from the application of standard gauges in weapons armories used in craft shops, to the application of standardization in the very production process itself, as best exemplified in Ford's assembly line. Of great importance, the pattern of diffusion shows the important role played by a few key industries in diffusing these techniques within the national industrial and service network.

In summary, the claim that I put forth is more radical than the stability of a country advantage in a technology. I conjecture that countries differ in their organizational, as well as technological, capabilities and that these differences have fundamental economic consequences. The process by which a firm organizes its activities, or what we label as its "organizing principles," is also characterized by a trajectory. These principles may consist of how to organize a large organization into multiple divisions, to operate accounting systems, or to manage under high environmental uncertainty of foreign markets. As a set of heuristics, they serve to indicate permissible modes by which economic activity can be restructured. In this sense, they widen, as well as restrict, the development path of a country.

If, however, organizing principles are important, why then are trade and foreign investment patterns so strongly related to R&D? R&D is, of course, not the only major correlate. Marketing and advertising expenditures, in addition to other factors such as scale economies, have also been shown to be a fairly robust correlate. The multiplicity of correlates arises, clearly, out of the imprecision of such terms as R&D and marketing expenditures.

[5] See, for example, Lincoln, Hanada, and MacBride (1986), Maurice and Silvestre (1984) and Kern and Schumann (1984).

From our view, both expenditures represent the investment in the knowledge of the firm, and firms — and this point cannot be stressed sufficiently — invest in those competences in which they are strong. High R&D investments reflect simply the availability to retain earnings in order to invest in the areas reflecting the organizing competence of the firm.[6] Profitability permits the investment in sustaining current, or building new, competences. The characteristics of modern markets are such that these investments are likely to be in the development of technologies.

II. Inertia and Path Dependence

The implications of the above reasoning can be analyzed further by considering the following introspective experiment. An individual is told to choose a ball from an urn. The urn consists of a 1000 balls, each which has the name of a firm from somewhere in the world written on it. Moreover, the sample of firms are stratified to represent in a statistically accurate way the industrial composition of the world. Before looking at the ball, the individual is told to predict what would be the predominant strategy of this firm and to assign a probability that this prediction is actually correct. The individual is then told to draw again, but this time before predicting the characteristic of the firm and assigning a probability, the individual is told the firm's country of origin. I hazard the wager that most informed individuals would assign a higher probability to their prediction in the second trial. It is this difference between the unconditional probability and the probability conditional on the country of origin that represents a subjective measure of the degree to which country factors influence the strategy and capabilities of firms.

This casual experiment is the intuition behind several recent models that have been suggested to explain path dependence revealed in many areas of economic behavior.[7] By path dependence, it is meant that expected future behavior, though never certain, is conditional in a non-trivial way on history. In this view, if investments in unrelated or new industries, by

[6] It should be noted, in this regard, that profitability is as likely to determine R&D expenditures, as the reverse. See Griliches (1986) for a discussion.

[7] I referred to a similar idea as "intertemporal dependence" in an earlier article which laid out some these implications (Kogut, 1986).

from the one inducing exit. The source of this hysteresis band is not only that it is costly in the current period to enter or exit, but that there is fundamental uncertainty over future exchange rates. It is wise to take a small loss today in case the exchange rate should be more favorable in future periods. Thus, only large movements in exchange rates will induce exit and entry.

The effects of hysteresis are increased when the possibility of learning by doing is also considered. Our model did not consider the possibility that operations in the local country leads to better ways to lower unit costs or to adapt products to the national market. When learning effects are considered, the inertial effects are magnified. As long as exit costs are greater than the costs of increasing an investment presence (net of any learning benefits), the firms commitment to a foreign market is likely to follow a ratchet-like sequence. The process of the internationalization of the firm, which has been so carefully documented for U.S. and Scandinavian multinational corporations, is an outcome of these inertial forces.[9]

It is the uncertainty surrounding the costs of switching out a current operating mode, plus the learning benefits of persisting in the current activities, that generate such powerful inertial forces. In the Lippman and Rumelt model, this hysteresis is generated by the uncertainty of imitating the leaders and improved prospects, once being successful, of staying with the successful technology. In Stiglitz's model, inertia is generated again by the benefits of learning and the uncertainty of switching development paths.

IV. Social Context of Learning

It would be misleading, however, to suggest that the potential to learn and imitate are eliminated by inertial forces. To the contrary, the evidence points to a surprisingly rapid imitation of product and process technologies. Mansfield, Romeo, and Schwartz (1979) found that 60% of innovations were imitated within 4 years. In a different study, Mansfield, Schwartz, and Wagner (1981) calculated that, on average, imitation took 70% of the time and cost 65% as much as that for the innovator. In a more recent study, Mansfield (1985) estimated that within 18 months of first deciding to innovate, 50% of the firms reported that their

[9] See the review by Luostarinen and Welch (1989).

technology leaked to rivals. Levin *et al.* (1984) discovered from questionnaire data that over 50% of surveyed lines of businesses believed that innovations, whether major or incremental, could be duplicated within 3 years.

While these studies concerned product and process technologies, these lags are found to be even longer for organizational innovations, as indicated by several empirical studies. Daft (1978) analyzed a number of technical and administrative innovations in public schools. He concluded:

> the administrative component is relatively more important. A substantial portion of technical innovations originate within the administrative core. The technical core appears to be subordinate and tightly coupled to an active and influential administrative core (Daft, 1978:207).

Similar results were reported by Evan and Damanpour (1984) who found that technical innovations tended to be more rapidly diffused within the firm than administrative innovations.

In an international context, Jeremy (1981) concluded that the U.S. firms of the early 1800s were largely capable of imitating British advancements in the textile industry within a few years of introduction. Yet, as the earlier citation to Hounshell's study noted, techniques of standardization spread painfully slowly even within the American colonies. Smith's (1977) study of interchangeability of parts in the U.S. armouries showed a 30 year lag before the techniques were transferred successfully among only two armouries.

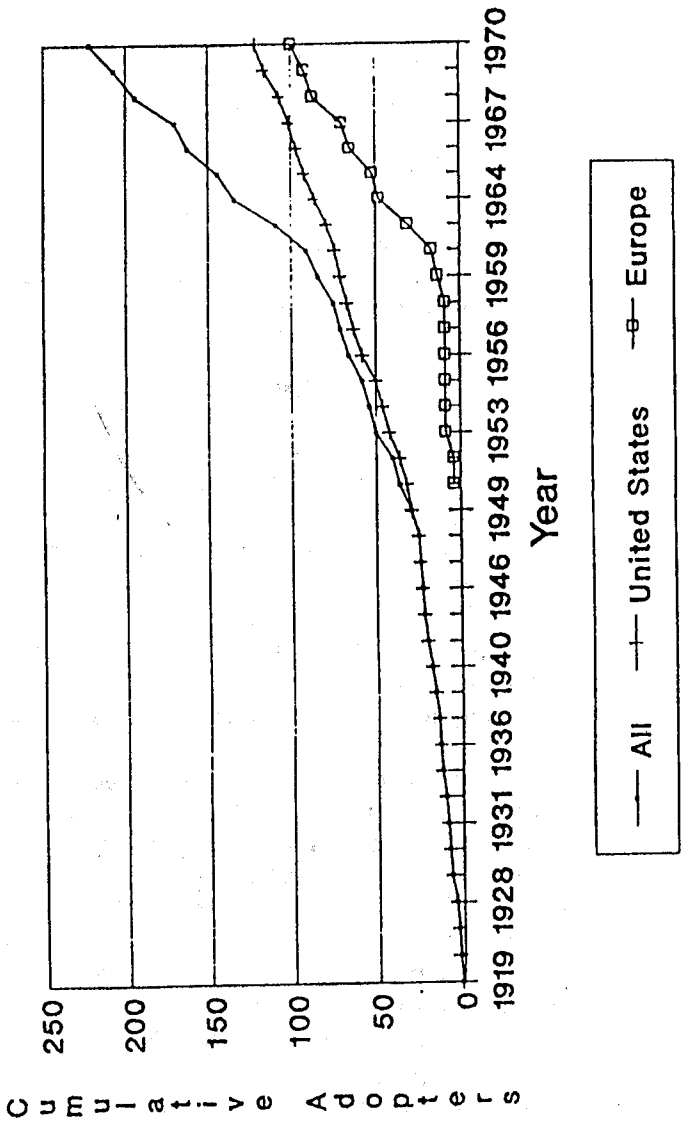
To give some idea of the slowness of the diffusion of organizational innovations, Figure 1 graphs the spread of the multidivisional structure among large U.S. and European corporations.[10] In both regions, the diffusion was far from immediate. This slowness is all the more impressive in light of Armour and Teece's (1978) estimation that the adoption of the multidivisional structure raised rates of return by 2% among American petroleum companies.

Whereas there is ample empirical evidence that imitation times and costs vary by technology, industry, and even country, there is no consensus on the explanation. Certainly, the number of competitors and their resources are a portion of the explanation, but this industry feature then begs the question why the number of imitators varies across industries. In part, the answer is to be

[10] Sources of the data are found in Kogut and Parkinson, 1990.

FIGURE 1

Diffusion of Multidivisional Structure in US and Europe



found in what can be called the "conditions of appropriability," that is, the legal and institutional factors which determine the profitability to the innovation which can be recovered by the innovator. As these conditions vary by country (e.g. patent policy or industry structure), the potential for appropriability also varies across nations.[11]

A more interesting explanation is given by the models on path dependence developed above. By the logic of these models, learning and imitation takes place when the new technologies are related to current knowledge. The more radical the technology or different the trajectory, the more difficult it is to imitate and learn. It is this difficulty which generates the lock-in to inferior practices and prevents convergence to best practice.

Though appealing, this formulation in turn begs the question of what determines the distance between technologies? One factor is the nature of the technology, that is, the degree to which it is tacit, codifiable, or part of a system. For example, in his classic study of the diffusion of technologies, Rogers (1971) suggested four factors (i.e. communicability, divisibility, observability, and complexity) that determine the capability of a technology to be adopted. A similar typology has recently been proposed by Winter (1987), though the theoretic motivation is very different.

In recent work, Udo Zander of the Stockholm School of Economics and I have examined several dimensions of technology and examined through case studies and larger samples how these factors influenced the imitability and transferability of new innovations. If the characteristics of the technology should matter, then technologies which are difficult to transfer within the firm should be difficult to imitate among firms. It is also important to report that we ran into a very obvious, but nevertheless overlooked bottleneck in our scaling. On examination, these dimensions are not intrinsic properties of the technology, but of the social knowledge of the firm. Codifiability is relevant only to the extent that the parties know the codes and can communicate. Technology transfer, even within the same corporation, often incurs the cost of translating the knowledge for the user (Leonard Barton, 1988).

These issues return attention to what "localized" technology means, as used by Atkinson and Stiglitz (1969). In the context of their concerns, localized refers to the externalities by other technologies currently used by a firm or country. We are suggesting a related but distinct issue. The ability to adopt unrelated technol-

[11] This point is discussed at length in Kogut, 1986.

ogies depends not only on the technical similarity to current practice, but also the familiarity of the codification to codes known by the user. Technologies are not inherently obscure. It is how these technologies are expressed, i.e. codified, which poses the difficulty to users unfamiliar with the code.

The slower diffusion rates of organizational innovations can partly be explained by the inaccessibility of the codification of organizational knowledge. Organizational innovations, such as a new computer system, may be fairly transparent in terms of the technical information, but their implementation involves complex interdependence with the existing organizational structure and operation. It is harder to transfer, or imitate knowledge, when the causal properties of the technology are poorly understood and articulated.

V. Intra-Country versus Inter-Country Diffusion

The above discussion of the localness of knowledge and the difficulty of codifying organizational principles provides the basis for why country borders are less permeable than firm borders.[12] The fundamental argument is that it is the similarity in structures among firms within a country which reduces the costs of identifying and adopting a new technology or technique. This argument holds best for new methods of organization and least well for basic research. The explanation can be analyzed in terms of four factors: 1) opportunity, 2) arena of competition, 3) identifiability, and 4) feasibility. The first three factors are related to the Cyert and March (1963) description of problem recognition and the search for a solution; the last is related to their emphasis on political coalitions, for it raises the issue of the desirability of learning.

1) *Opportunity:* One of the most important results arising from the extensive work done on networks in Sweden has been the long-term stability of relationships between buyers and suppliers.[13] The studies by von Hippel (1988) have shown that innovations are often responses to requests by suppliers and that users frequently make important contributions to the development of the technology. Similarly, one of the most ardent advocates of the importance of capital goods in economic development is Nathan Rosenberg (1969), who has described the important diffusion of technologies in capital goods throughout the American economy.

It is, in fact, the importance of the ties within an industrial network which forms the basis of Albert Hirschman's (1958) influential statement on the role of forward and backward linkages in economic development. Nor is the pull of these linkages isolated to developing economies. The expanding of work on the concept of the "filiere" in France is directed at distinguishing simple input-output relationships from those entailing significant spill-over effects (Jacquemin and Rainelli, 1984).

The study of interdependences between industries quickly leads to an observation of the interdependences among countries. Leaving aside the very significant influence of multinational corporations, national boundaries of networks have been eroded by the density of cooperative agreements among firms of different nationalities. Some indication of this erosion is given in Figures 2 and 3, where the number of relationships among US, Japanese, and European firms in the auto and semiconductor industries are graphed. The figures show clearly that there exists considerable interdependence, as measured by the number of relationships, among these three regions. It is likely, therefore, that the distinction of national industrial networks is a less important factor in impeding the international diffusion of technologies today than it has been historically.

2) *Arena of Competition:* An observation often overlooked in the studies on networks is the importance of competition, for competitive pressures push firms into tapping into new technologies. When it spills over borders, competition is, of course, a driver of learning in foreign markets as well. The diffusion of Taylorism and Fordism into France could first be observed in auto industries, partly as a response to the competition from Ford's plants located in the United Kingdom (Moutet, 1975). It was only, however, the competition in the extreme guise of

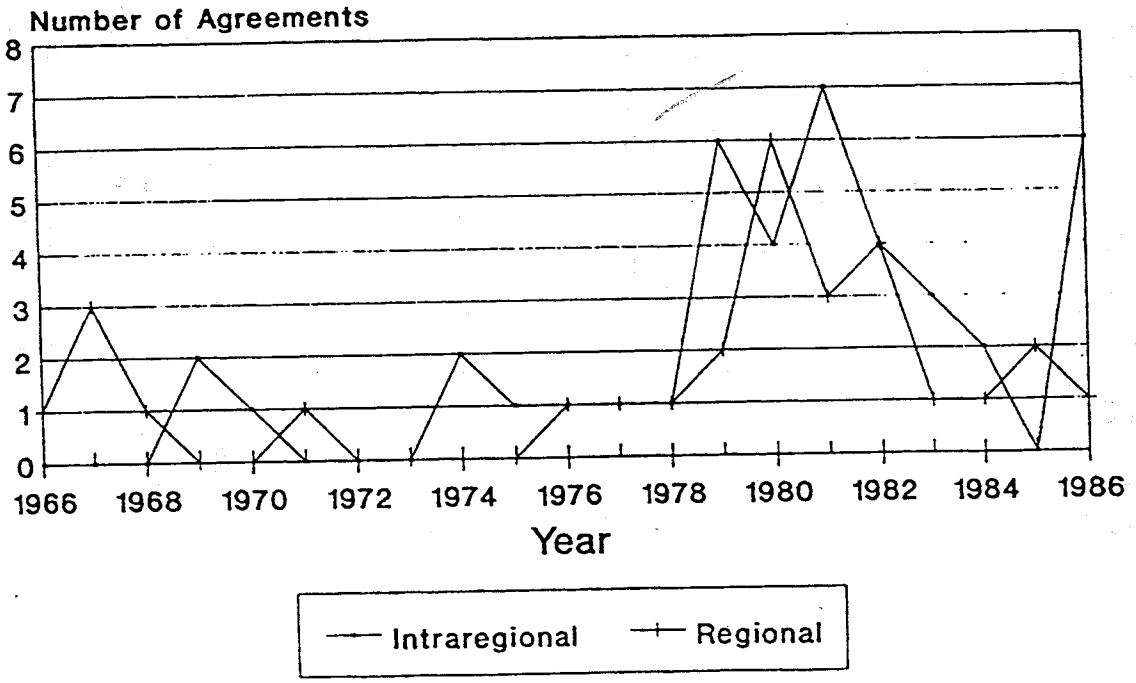
12 Though the importance of regional diffusion has been long noted — as in Marshall (1920: 284-286) —, there is little empirical work showing more rapid diffusion within a country as across countries, with the exception of Benvignati (1982) on textile capital goods and Kogut and Parkinson (1990) on the M-form division. I would like to thank John Dunning for the reference to Marshall.

13 See, for example, Johanson and Mattsson (1986).

FIGURE 2

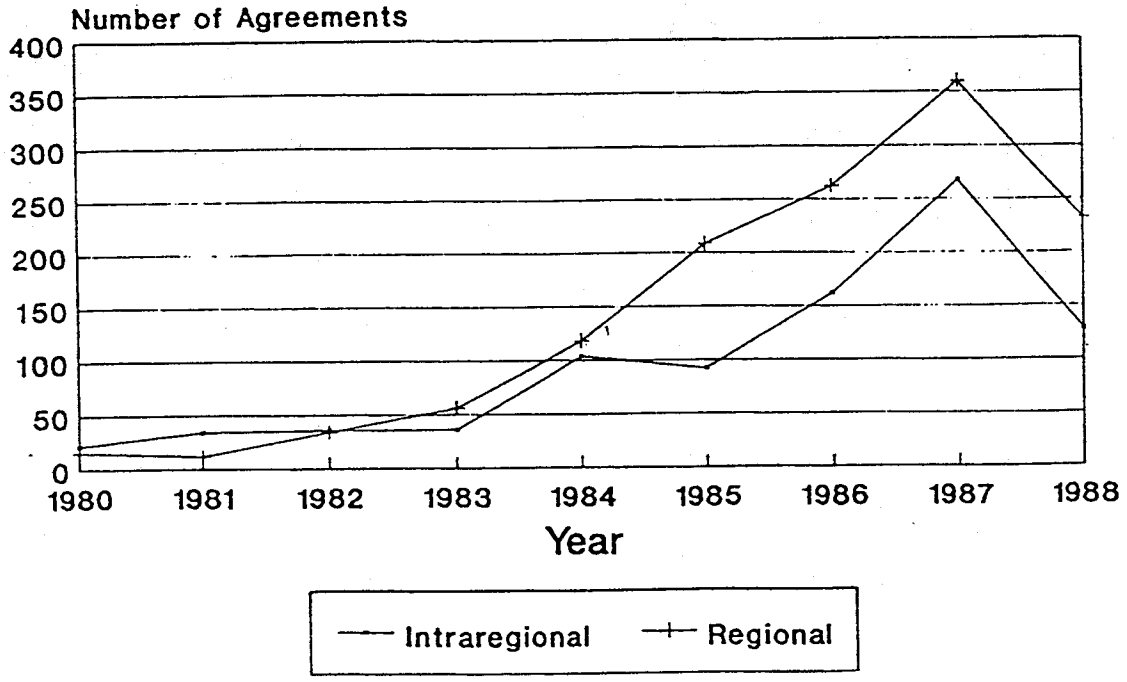
Automobiles

Agreements Within and Across Regions



Semiconductors

Agreements Within and Across Regions



World War I which forced France, Germany, and U.K. to adopt Taylorist principles.[14]

It is easy to overestimate the importance of network interdependences in relation to the force of competition. In this regard, John Dunning's (1986) research on the effects of Japanese investment in the U.K. is especially interesting, for he found that competition was a more important driver of the adoption of Japanese technologies in the U.K. than supplier relationships. This effect may possibly reflect the hesitation or inability of Japanese firms to share technology with local suppliers, but it also points to an important role in stimulating new learning, much as Leibenstein's emphasis on X-efficiency would predict.

3) *Identifiability:* In most models of learning, it is assumed that the individual or organization seeks to adapt its behavior along a gradient in order to approximate some goal. But frequently, the task to be learned is poorly understood and identified. Again, it is easy to see why this problem of identification is greater for learning organizational innovations as opposed to a product. The functionality of the product is usually clear, though figuring out the causal relationships may involve a high level of complexity. March and Olsen (1975) have especially drawn attention to what they call "superstitious" learning, whereby an organization accredits a success, or any outcome, to the wrong cause. In light of the past fifteen years of publication on understanding the Japanese management style, their point has a certain degree of poignancy. But if we turn our attention away from the wonder of the sham and ask why has there been tolerance for endless prescriptions of the Japanese way to success, the answer lies in the great difficulty of identifying the causal factors.

Nor has the problem only run in one direction. In a celebrated study on the transfer of aircraft know-how to Japan, Hall and Johnson (1970) describe in detail the elements transferred, as well as their costs. They note that not only was the exact plant layout transferred, but that a large number of American engineers worked at the plant for a long duration. Blueprints and capital goods were far from sufficient.

The problem of identification is more troubling across borders than within a country for two reasons. The first is best expressed

[14] For France, see Moutet (1975) and Boyer (1984); for U.K., Lewchuk (1986) and Littler (1984); and for Germany, Homburg (1984). An overall view of the diffusion in Europe is described in Devinat (1927).

by the concept of signal to noise. Because of their similarity in organizing principles, a population of American firms are more sensitive to incremental differences among their national competitors. Since there are fewer differences, it is easier to identify the factors responsible for differential performance.

Competition among firms from different nations raises a surfeit of differences that may account for better performance. Over time, learning of tendencies in national organizing principles are acquired, but this process, as in the diffusion of American management practices to Europe, is slow and arduous. A rough indication of this point is given by comparing the diffusion of the multidivisional structure in the Unites States to Europe in Figure 1. Quite clearly, the adoption of the new structure was much slower in Europe, prompting the speculation that the increased American competition in the 1960s forced the adoption of the new organizational form.

A second reason for the difficulty of identifying the causal linkages responsible for success is the complexity of systemic dependences. Transferring a just-in-time inventory system requires more than a change in factory procedure, it also involves a high degree of coordination with suppliers. Understanding the elements which need to be changed in tandem is a complex challenge. Because the system (e.g. supplier relationships, institutional connections, labor relations, etc.) which embeds these elements is likely to be more different between countries than between firms within the same country, the costs and uncertainty of adopting new technologies, especially of an organizational character, work to impede cross-border flows.

4) *Feasibility*: The issue of systemic dependence raises the question of the social feasibility of change. Part of the difficulty is that even when the necessary changes are identified, they are not economically or politically feasible to enforce. This perspective was advanced strongly by Veblen (1915) in his analysis of the benefits of the late modernizer, but it has been further developed by Ames and Rosenberg (1963), Kindleberger (1969), and Salter (1966). In this view, there is a cost to be a early starter because technologies change over time, but property rights are slow to adjust. The classic example is given by Salter and amplified by Kindleberger that new efficiencies in the transportation of coal were neglected in the U.K. due to the problem of deciding

whether the mine owners or the railroads should bear the incremental costs.

A more bold view of the importance of political factors has focused on the conflict among interest groups. Mancur Olson (1982) has been most forceful in advocating this argument, but it is also reflected in Crozier's (1964) analysis of the French bureaucracy, Thurow's (1982) description of the zero-sum society, and Ouchi's (1984) espousal of a corporatist model to resolve the American deadlock between labor and business. The fundamental thrust of this argument is that the incidence of the distribution of benefits rarely coincides with the incidence of costs, thus stimulating the objections of interest group to social and political change.

There is a third explanation for the infeasibility of change that has a certain commonsensical appeal, for it claims that people regret changing their current consumption baskets, inclusive of their social relationships. Leibenstein (1978) seems to have meant something like this when he posited that there is an zone of inertia around the immediate consumption point on an individual's indifference curve. The important work of Tversky and Kahneman (1989) on regret documents persuasively that people seem to enjoy stubbornly persisting in their current choices, even if prior to making them, they evidenced a different set of preferences.

There is a message in this reasoning which appeals to people of a sentimental nature. There is value in quaintness. To operate factories or offices at high levels of productivity may take levels of commitment and performance that are not acceptable in all cultures and countries. To adjust new economic disturbances may also require unacceptable levels of labor mobility, both geographical and occupationally. As long as people pursue objectives not perfectly captured by economic aggregates, deviations from the optimum and persistence in economically antiquated patterns of behavior may be a country's lot. There may be a strict economic loss in the indulgence of sentimental pursuits, but then, not all values are strictly economic.

VI. Learning Capabilities

Of course, the speed by which technology leaks across borders is also influenced by the orientation towards learning and the capabilities to learn of individual countries. The conclusions reached in the recent exchange between Baumol (1986) and de Long (1988) indicate that convergence in wealth among countries occurs through enjoying the spill-over in technology and income across borders, but that some countries, despite their promising positions a 100 years ago, failed to absorb these externalities. Nations do not individually need to be innovative, but their advancement depends upon their ability to enjoy the spill-overs from the technological and economic advancement of other countries.

There has been considerable research on the characteristics of adopters and the diffusion of new products and technologies. There is substantially less known about the characteristics of firms that pursue not only imitative strategies, but are rapid learners of new process and organizational innovations. There is equally little known about variations in learning capabilities among countries.

What is known is largely in reference to the Japanese. In an important study, Clark, Chew, and Fujimoto (1986) analyzed development times in the world auto industry and found rapidly faster introduction of new models in Japanese corporations but without a substantial increase in costs. The study by Mansfield (1988) indicates substantially lower cost-time tradeoffs in new product development. It appears that an important aspect, then, of inter-country differences is the speed by which new technologies are absorbed and brought to the market. From case work and some larger sample research, a key factor seems to be the allocation of engineers to development and implementation (Mansfield, 1988; Westney and Sakikabara, 1985). An implication appears to be, though it is empirically unverified, that there are substantial differences in organizing principles depending on the emphasis upon innovation and imitation.

Of course, the imitative capabilities of Japan may lie at a more profound level. The study by Eleanor Westney (1987) on the adoption of modern institutions by Japan points to a stunning willingness to imitate after the Meiji Revolution. Apparently, the diffusion of American techniques of mass production were so

much in evidence that the Antonio Gramsci, the former leader of the Communist Party in Italy, could observe from his prison in the 1930s:

> In reality American high-wage industry is still exploiting a monopoly granted to it by the fact that it has the initiative with the new methods. Monopoly wages correspond to monopoly profits. But the monopoly will necessarily be first limited and then destroyed by the further diffusion of the new methods both within the United States and abroad (compare the Japanese phenomenon of low-priced goods), and high wages will disappear along with enormous profits (Gramsci, 1973: 310-11).

Again, though, a historical perspective is particularly worthwhile, for the role of imitator and innovator has been radically interchanged in history. It was the imitation of technology by the U.S. and France which was the concern of British manufacturers in the earlier part of the 1800s. In the debates on the imposition of restrictions on the export of capital equipment and on the emigration of workers, Andrew Ure (1835) presented the argument that diffusion was of no significance as the Birmingham manufacturers remained on the frontier of technology. In fact, as the recent study of Jeremy (1983) on the transatlantic diffusion of British technology in the 19th century shows, backward engineering, patent infringements, and employment of former workers were all practices in which American firms excelled.

There is unlikely to be any simple explanation for this historical pattern, but it is certainly of interest to note the recent rise in Japanese research and development expenditures. It might well be that success forces a firm and country to carry the burden of new technological innovations and shift resources from learning to the creation of new knowledge. This transformation, one suspects, is difficult, not only because it requires an alteration in the allocation of resources to innovation, but also, because it requires changes in a relatively inert set of organizing principles.

It may be equally difficult to make the transition from emphasizing product innovation to competing on an imitative strategy. There is no reason to expect an asymmetry in the difficulty of switching between innovation and imitation. The two strategies appear to be characterized by very different organizational structures, though considerable work is required before any definitive statement can be made.

But there is an asymmetry in another important respect, that is, an innovative strategy bears a far greater risk, as the new technology may be imitated and the innovator may have no other advantage outside of an innovative capability. In this case, the innovator is essentially providing a gift to its competitors. Unless these competitors have an uncanny foresight and ability to agree not to kill the golden goose, the survival of a firm bearing the costs of innovation but not recouping its investments is obviously in doubt.

Such a dynamic appears to have characterized the United Kingdom and is currently ailing the United States. Lewis (1957) observed that the United Kingdom would fare better if it would imitate industrial practices in the U.S. and Germany. Peck (1968) found U.K. research and development efforts to be extraordinarily high and argued for a greater recognition of an international division of labor in the allocation of research. These recommendations are prominent in the current debate on the loss of American competitiveness vis-a-vis several countries, but especially Japan.[15]

If this characterization is correct, as I feel it largely is, this disequilibrium is not sustainable. Much like the results for firms within an industry when product innovation does not pay (Nelson and Winter, 1982: 126), innovating firms in the U.S. may decide that the returns to innovative activities are too low and withdraw from the market. Such a trend, as is already evident in dynamic RAM chips, places Japanese firms in an interesting dilemma, for their success poses the possibility of bankrupting the product innovation efforts of competitors, upon which they are often dependent. Without product innovation being licensed or diffused from overseas, Japanese firms would be increasingly squeezed by the imitative efforts of NIC manufacturers. It is not surprising, therefore, that not only have the R&D efforts of Japanese firms increased, but Japanese foreign direct investment in the NICs have increased, as well as the increased establishment of R&D facilities and manufacturing plants in the U.S. and Europe.

This process aids the diffusion of Japanese organizing principles, as already seen in the U.K. (Dunning, 1986), while placing a larger burden of innovation upon Japan. The outward flows of Japanese investments should be seen as the extension of organ-

[15] See, for example, Rosenberger and Steinmueller's (1987) call for the U.S. to shift to greater imitation.

izing principles of work to foreign markets. Similarly, the balancing of the U.S. foreign direct investment stock is a reflection of the wide diffusion of American practices. There should be no reason to suspect, therefore, that the Japanese penetration into foreign markets will slow significantly with a further appreciation of the yen. Rather, the slowing of the Japanese investment position overseas will arise out of the diffusion of its organizing principles, as well as the saturation of those markets served by products best manufactured by these principles.

This diffusion can occur through two very different, though not necessarily exclusive, mechanisms of imitation and selection. By selection, foreign firms that do not adopt more efficient practices are eliminated. After while, the surviving population is characterized by a higher preponderance of Japanese firms. By a mechanism of imitation, foreign firms can adopt the new practices. In time, the population of surviving firms is also characterized by a higher preponderance of Japanese-like practices. Thus, the outcome is the same, except that in the latter case, many of the surviving firms will be non-Japanese in ownership.

It is this fork between learning and selection that confronted firms competing against American competitors in the early and mid decades of the 1900s, and it is this challenge posed most frequently by Japanese companies in the latter decades of this century. Despite considerable scholarship and the growth of large consultancies, neither the contents, nor the feasibility of this new learning have yet to be persuasively defined. One suspects that there is considerable room for further doses of superstitious learning before the characteristics of the organizing principles responsible for the success across a wide variety of Japanese firms are understood. I will refrain from adding to the clutter, with the exception of noting that there is no indication that these principles are fully developed, nor their trajectory completed.

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