Innovation, Networks, and Vertical Integration

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ABSTRACT

A central debate in industrial policy today is that between proponents of large vertically integrated firms on the one hand and those of networks of small specialized producers on the other. This paper argues that neither institutional structure is the panacea its supporters claim. The menu of institutional alternatives is in fact quite large, and both firms and networks — of which there are several kinds — can be successful, growth-promoting adaptations to the competitive environment. Industrial structures vary in their ability to coordinate information flows necessary for innovation and to overcome power relationships adverse to innovation. The relative desirability of the various structures, then, depends on the nature and scope of technological change in the industry and on the effects of various product life-cycle patterns. The principal policy conclusion of this analysis is that the government's role ought to be facilitating rather than narrow and prescriptive, allowing scope for firms to develop organizational forms that are best adapted to their particular environments.

Introduction.

The debate over the institutional forms most conducive to economic growth has intensified in recent years. In the mid-1980s, Michael Piore, Charles Sabel, and Jonathan Zeitlin challenged the notion that the growth of large businesses in twentieth-century Britain and the United States had been either necessary or desirable. On the basis of developments in Continental Europe, they have contended that communities of skilled craftsmen are as capable of generating high standards of living as are giant, vertically integrated firms (Piore and Sabel 1984; Sabel and Zeitlin 1985; Sabel *et al.* 1987; Sabel 1989). Moreover, they claim, small firms are more flexible and thus better adapted to engendering and adopting innovations. To take advantage of these capabilities, they recommend reorienting the American economy towards small, craft-based firms that operate in a cooperative environment. Michael Best (1990) has reinforced this call, questioning the efficiency of both vertically integrated Western firms and Japanese networks and arguing instead for the growth of geographical concentrations of small firms organized cooperatively along the lines of the "Third Italy."[1]

Other writers believe that large vertically integrated firms are in the best position to develop and exploit innovations. In contrast to Piore and Sabel and Best, William Lazonick contends that economies of scale will remain overwhelmingly important and that small firms will not be able to compete effectively in many areas. As a result, Lazonick believes, growth must be based on giant organizations that are able to combine strategic flexibility with access to economies of scale. But to survive, such organizations must have "privileged access to

[1] The "Third Italy" is the area of northeast Italy centering on the regions of Emilia-Romagna and Tuscany. Although a number of substantial cities — such as Bologna, Modena, Florence, and Reggio-Emilia — are in the area, much of the industry is located in smaller towns that specialize in the production of various items including ceramic tiles, textiles, and machine tools. These local industries are frequently organized in government-sponsored cooperatives that provide access to cheap capital and to services in marketing, accounting, etc. Initiative in design and other fields, however, is retained by the member firms, that are commonly family-owned and have twenty or fewer employees. See also, Lazerson (1988), Brusco (1982), and Hatch (1987).

resources," including control of marketing and the supply of inputs, in order to provide the security to justify investments in large production facilities (Lazonick 1990 and 1991a).

Richard Florida and Martin Kenney also believe that a high degree of vertical integration is desirable, but stress the need to coordinate basic research and development activities with product development and manufacturing in order to gain maximum benefits from scientific and engineering breakthroughs (Florida and Kenney 1990a). Florida and Kenney and Lazonick are critical of Piore and Sabel and of current American developments in Silicon Valley and along Route 128 in Massachusetts because, they claim, small firms cannot fully realize the potential that seminal discoveries offer. As a result, well-articulated Japanese and Korean industrial conglomerates are appropriating the bulk of the benefits of American discoveries and, increasingly, are themselves making the important breakthroughs on which future growth will be based (Florida 1990a, ch. 6).[2]

An intermediate position has been staked out by Michael E. Porter. Porter believes that, in order to be successful in international markets, firms must first develop the knack of competing domestically. To achieve this, he advocates a high degree of rivalry among firms in their home markets. He also cites the importance of networks of suppliers to provide inexpensive and flexible access to inputs (Porter 1990). And, like Piore and Sabel, Porter believes that geographic concentrations of producers can increase productivity by enhancing access to knowledge and other factors of production. Although Lazonick (1991b) has criticized Porter's support for a high degree of domestic competition and networks of support firms, it is clear that, in contrast to Piore and Sabel, Porter is not advocating the establishment of ateliers when economies of scale are present.

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[2] This chapter is reproduced in Florida and Kenney (1990b). See also, Lazonick, (1991b).

There appear to be two basic differences between Porter and Lazonick. First, Porter believes that the American economy is large enough in most industries to justify competition among several large firms, while Lazonick supports monopolies or very tight oligopolies in the domestic economy. To Lazonick, the most important rivalry is on the international stage and industries on the national level should conserve their strength for competition with firms from other countries. Second, Porter believes that an extensive web of outside suppliers and regional agglomerations of producers provide flexibility to cushion downturns and give broad access to technical improvements, whereas Lazonick emphasizes the security that arises from maintaining resources under centralized control.

Prescriptions for government industrial policy also vary among analysts. Lazonick (1990, 1991a, 1991b), for example, contends that governments should promote centralization and concentration to permit firms to meet competitive challenges from large foreign firms. Piore and Sabel (1984) and Best (1990), on the other hand, recommend that governments actively support the growth of small firms and industrial districts by generating policies that simultaneously promote competition and cooperation. Finally, Porter (1990) believes that governments should emphasize the creation of environments that encourage domestic and international competition by promoting technological change, but that governments are in general ill-equipped to provide detailed economic direction.

All of these authors are grappling with the same problem of locating the patterns of industrial and firm organization that are most efficient in permitting a nation to innovate and gain or maintain productive superiority.[3] They have nevertheless reached a variety of

[3] Lazonick, Piore and Sabel, Best, and Florida and Kenney are also explicitly interested in finding ways of providing more interesting work, greater job stability, and better wages for the industrial labor force than currently prevails in the United States. In general, they recommend that this can be accomplished by increasing the intellectual content of factory employment and the scope for decision-making available to individual workers. Florida and Kenney, for example, "see the Japanese model as a successor to fordism that uses new organizational forms to harness the intellectual as well as the physical capabilities of workers." (1991, p. 383.) Here, however, we concentrate on the authors' proposals concerning firm and industrial organization.

contradictory prescriptions. The fundamental reasons for this confusion are twofold: the authors define firms and networks in fuzzy and inconsistent ways; and they provide sweepingly general recommendations to cover a variety of cases that are in many ways dissimilar.

In this paper, we examine the relationship between innovation and industry and firm structure to determine whether flexibility and the scope for change vary across environments. We conclude that the ability of various types of organizational structures to support innovation successfully depends crucially on the scope of the innovation and the relative maturity of the industries involved. As a result of the wide range of variations present in advanced industrial economies, any generalized government policy towards innovation is likely to be unsuitable for the needs of many sectors.

The Lessons of History?

Lazonick and Piore, Sabel, and Zeitlin have all used historical evidence to support their policy recommendations. Lazonick draws heavily on the work of Alfred D. Chandler, Jr. to demonstrate that the growth of manufacturing since the late nineteenth century has been closely correlated to the degree of horizontal and vertical integration in "cutting-edge" industries. In *The Visible Hand* (1977), Chandler showed that the rapid growth of firms in a number of American industries between 1870 and 1940 was based on significant and continuing increases in economies of scale. In order to take advantage of these scale economies, small firms that had been restricted to local markets merged to serve regional or even national markets. Horizontal integration in itself was rarely if ever enough to guarantee viability, however, because such collections of small enterprises could not gain the benefit of scale economies unless they were rationalized into larger units under central control. Thus the "visible hand" of management was needed to initiate and direct the new giant firms.

Moreover, because of the larger investments in fixed capital which were required, enormous size entailed greater risk. As a result, managers attempted to shield giant firms from market uncertainties by integrating forwards and backwards in the hope of ensuring supplies of inputs and, in particular, increasing the demand for finished products to keep pace with growing productive capabilities.

More recently, Chandler has extended his analysis to British and German history. He states, for example, that Britain's relative decline as a manufacturing power after 1870 occurred because "British entrepreneurs failed to make the essential three-pronged investment in manufacturing, marketing, and management in a number of the capital-intensive industries of the Second Industrial Revolution."[4] In other words, the British erred in not building large facilities or, when they did, in continuing to rely on market mechanisms and not providing adequate internal marketing and management skills to coordinate and protect their investments.

This, essentially, is the model that Lazonick projects into the future. He believes that to prosper nations must take advantage of substantial economies of scale in major industries, and that this requires centralized management and a high degree of vertical integration to overcome market deficiencies. To the extent that American firms are inhibited — either through government policy, market fragmentation, or managerial ineptitude — from matching the control that foreign competitors hold over resources, they will, he feels, lose out in a world of increasing returns.

[4] Chandler (1990), p. 236. Chandler explains the three prongs in more detail on p. 8.

Piore, Sabel, and Zeitlin provide a very different view of recent developments.[5] To them, the adoption of the paradigm of mass production represents the triumph of an idea rather than an economic necessity. Because of the highly publicized triumphs of producers such as Henry Ford, large firms came to be regarded as the norm. Nevertheless, craft production retained advantages in flexibility and variety that were overlooked as Britain and the United States moved towards gargantuan factories in the twentieth century. As counter-examples, Sabel and Zeitlin cite certain industries in France and Italy that maintained their craft traditions and prospered as a result. Piore, Sabel, and Zeitlin maintain that large firms often fail to cope successfully with the accelerating rate of innovation that they perceive, or to take advantage of the flexibility permitted by new production technologies. They recommend instead that the American economy be reoriented towards smaller firms, clustered in industrial districts, similar to those in the Third Italy, where they can develop symbiotically.

It is clear that Lazonick and Piore, Sabel, and Zeitlin are all correct in the sense that both large and small firms have thrived historically and continue to exist. But neither set of examples precludes the other because different industries are involved. In certain industries, such as iron and steel, automobile manufacturing and some branches of chemicals, economies of scale proved so strong that small firms were virtually wiped out in the first half of the twentieth century.[6] Chandler, however, probably overestimates the importance of these industries (Supple 1991; Landes 1991). In many other cases, economies of scale were limited, although increases in productivity may nevertheless have been great. In these latter industries, which include some branches of machinery manufacture, clothing, and retailing,

[5] The historical material in Ch. 2 of Piore and Sabel (1984) is a reworking of an article by Sabel and Zeitlin (1985). See also Sabel (1989) and Sabel *et al.* (1987). The latter article contrasts the recent decline of large textile machinery firms based in Massachusetts and the prosperity of similar but much smaller firms in Baden-Wurttemberg.

[6] Except, of course, for a few specialist firms such as Rolls Royce that could produce in small volumes because customers were willing to pay premium prices for high quality or distinctive features.

small, highly competitive firms have been able to retain strong positions. Thus, if history is a guide to the future, then either the Lazonick or the Piore and Sabel scenario is feasible.

But it is a fundamentally ahistorical procedure to project future developments on the basis of supposed past, or even current, trends. Each experience occurs within its own context. The patterns outlined by Lazonick and Sabel and Zeitlin are essentially compressions of the experiences of many institutions (firms or industries) within their own environments. Not only is there reason to believe that the context of future developments will be different from that of the past, but there will be a variety of different contexts within which future firms and industries will be developing simultaneously.[7]

What is needed, therefore, is a way of predicting how these institutions will behave within their particular environments rather than an overarching model that may be inadequate to deal with the needs of any particular institution. It is to this that we now turn.

Networks and Networks.

Vertically integrated firms and loose webs of small producers are only two of types of networks operating in modern economies.[8] One way of classifying networks is according to their degree of formal articulation. When examined in this way, they range along a spectrum from market-based systems, with each transaction between components being conducted separately, to unified concerns that, as far as possible, internalize their activities through common ownership and control of the functions of supply, research, operations, and

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[7] Lazonick (1991a, pp. 271-3) contends that an historical approach to development is preferable to the pared-down methodology of conventional economists, who have sacrificed much of the explanatory complexity of reality to produce "an economic theory that is not bound by time and place." Even if one accepts Lazonick's critique of "conventional" economics, however, the fact remains that immersion in historical complexity will not, in itself, lead to good predictions if the conditions pertaining in the past were significantly different from those of the future.

[8] For a summary of the literature surrounding networks, see Bureau of Industry Economics (1991).

marketing. This way of casting the spectrum from "market" to "firm" goes back at least to Coase (1937) and is implicit (and sometimes explicit) in most of the modern transaction-cost literature.[9] Although useful for many purposes, however, this unidimensional characterization lacks much of the subtlety needed to think carefully about networks. There are in fact many dimensions along which various forms of industrial organization differ from one another. For the moment, we suggest that expansion from one dimension to two will yield a high marginal increase in explanatory power.[10]

There is something of a debate in the present-day economics of organization between the nexus-of-contracts view of the firm (Cheung 1983) and the property-rights view (Hart 1989). The former holds that organization within a firm is no less a contractual matter than organization through markets, and a "firm" is nothing more than a particularly dense intersection of contracts. What differs between market and firm is the nature of the contracts involved, with contracts within the firm having an ongoing and more open-ended character (Ben-Porath 1980). Such contracts require various degrees of conscious, ongoing administrative coordination among the parties. We might say, then, that the essence of the firm in this view is the nature of the coordination involved. In the property rights view, by contrast, ownership is the issue. The boundaries of the firm, rather fuzzy under the "nexus" view, are here brightly illuminated by the title to ownable assets, and two stages of production are held to be vertically integrated when the assets involved are under common ownership.

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[9] For example, Williamson, 1985.

[10] Powell (1990, pp. 296-300) suggests that the notion that there is a "continuum" of organizational forms ranging from markets through networks to vertically integrated firms is both inaccurate and analytically unhelpful. We feel that there are systematic relationships between organizational forms and various exogenous and endogenous conditions which can usefully be represented as spectra. We do concede, however, that as in figure 2 below, the order in which the organizational forms appear along a given spectrum may vary depending on which other factors are under consideration.

Rather than debating which view best captures the essence of the notion of vertical integration, we can recognize that each captures an aspect of what integration means. Moreover, these two aspects are potentially separable. A major automobile firm can be integrated into the production of a particular part in the sense that it owns a company producing such parts, even if the parent deals with the subsidiary largely through the market on a more-or-less equal footing with other suppliers. At the same time, two distinct legal entities may be engaged in an ongoing development project that involves exclusive dealing, significant exchange of information, and administrative coordination.

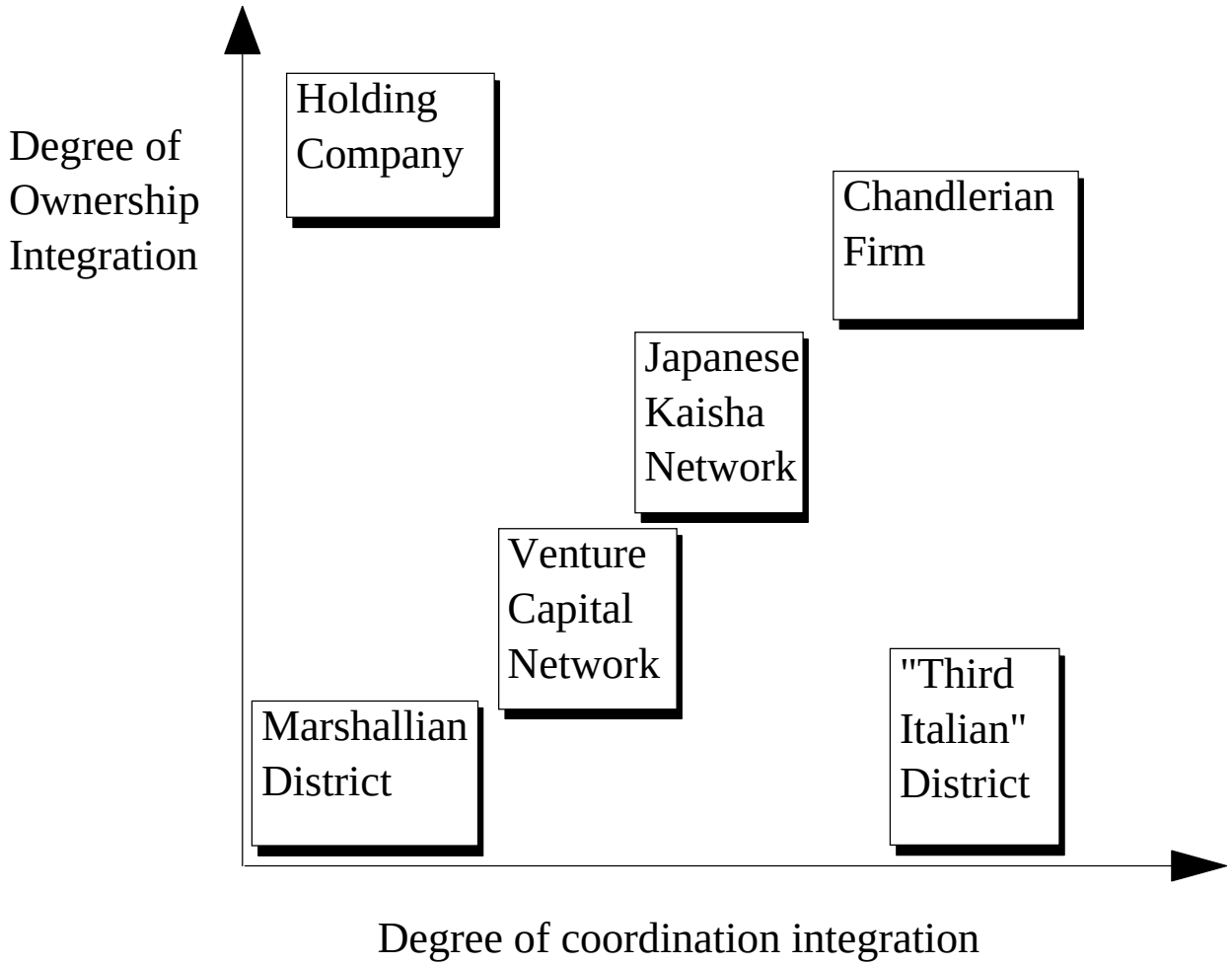

Figure 1: two dimensions of integration.

We thus have two dimensions along which to analyze organizational forms. One dimension is the degree of ownership integration; the other is the degree of coordination integration. (See figure 1.) We can use this construct to revisit various kinds of actually existing networks.

The loosest type of network is the Marshallian industrial district. Alfred Marshall (1961) based this concept on a pattern of organization that was common in late nineteenth century Britain in which firms concentrating on the manufacture of certain products were geographically clustered. In some cases, these clusters were highly specialized. While Lancashire as a whole was the center of cotton textile production, for example, individual towns within the county concentrated on spinning or weaving and on specific counts of yarn or styles of fabric. Similarly, different shipbuilding districts specialized in particular classes of vessels, and various Midlands cities such as Birmingham and Coventry became centers of different branches of the engineering industry. The characteristics of Marshallian industrial districts are similar to the "social structures of innovation" listed by Florida and Kenney: "integrative systems comprised of ... technology-oriented enterprise, highly skilled labor, considerable ... private R & D expenditures, extensive networks of suppliers, manufacturers and vendors, support firms such as law firms and consultants ..., strong entrepreneurial networks, and informal mechanisms for information exchange and technology transfer." (1988 p. 130.)

The two dominant characteristics of a Marshallian industry district are high degrees of vertical and horizontal specialization and a very heavy reliance on market mechanisms for exchange. Firms tend to be small and to focus on a single function in the production chain. Suppliers of intermediate goods commonly sell their stocks locally, within the district, although the final products may be marketed internationally. Firms located in industrial

districts are also highly competitive in the neoclassical sense, and in many cases there is little product differentiation. The major advantages of Marshallian industrial districts therefore arise from simple propinquity of firms, which allows easier recruitment of skilled labor and rapid exchanges of commercial and technical information through informal channels. As Marshall described them, industrial districts illustrate competitive capitalism at its most efficient, with transaction costs reduced to a practical minimum; but they are feasible only when economies of scale are limited.

Recent commentators have revived the term "industrial district" to describe somewhat different types of organizational arrangements. As applied to the Third Italy, the term indicates a higher degree of cooperative coordination than would be present in a Marshallian industrial district. In this part of Italy, vertical and horizontal specialization are again high and firms are generally small. Competition is high and barriers to entry and exit are low. Competition is limited to certain spheres of activity, however, in which firms might be expected to develop distinctive competences (Lazerson 1988).[11] In general, this means design, especially in industries such as ceramics and textiles. For those activities in which economies of scale extend beyond the range of individual small firms and the degree of standardization is high, firms in industrial districts in Italy tend to favor cooperative arrangements, which are normally government sanctioned. Cooperation is common in such activities as business services, including bookkeeping; sponsorship of trade fairs and other domestic and, in particular, international marketing ventures; and the provision of utilities and other infrastructure.[12] Cooperation also extends to the provision of capital, which the

[11] This is consistent with the analysis that Bettis, Bradley, and Hamel (1992, pp. 18-20) present of outsourcing by Western firms, in which they indicate that firms should protect their core competences by producing them internally and that they should restrict outsourcing to peripheral activities. *Sabel et al.* (1987) describe similar conditions in Baden-Wurttemberg. Sabel (1989, p. 53) also discusses the role of distinctive competences in networking situations.

[12] Good descriptions of the operation of Italian industrial districts is given in Best (1990) and Lazerson (1988). Similar arrangements prevail in certain American agricultural cooperatives such Land-o-Lakes or Ocean Spray that provide infrastructure and processing and marketing facilities for members.

banks lend directly to official cooperatives, who guarantee the loans and determine the distribution of funds among member firms (Brusco and Righi, 1987). As a result, small firms are able to sell their output in world markets and to gain some of the benefits of scale economies while continuing to compete strongly with each other.

Because of the legal advantages that pertain to small firms, many producers in the Third Italy are reluctant to employ directly more than fifteen or so workers. To avoid expanding too far, however, firms do take ownership positions in "satellite firms" that maintain legal independence. Interestingly, the satellite firms are not generally used to expand output and increase market control, but to protect the core competences of the original enterprise by providing intermediate goods at lower cost or with greater security. The acquisition of satellites is also used to gain control over complementary design capabilities. The networks of satellites therefore represent small islands of ownership and control integration within the larger horizontally integrated networks of the cooperatives (Lazerson, 1988).

A second recent variation on the industrial district is the Innovative Network, as represented by Silicon Valley and Route 128. As in Marshallian industrial districts, coordination integration is low in these districts,[13] but some coordination is supplied by the venture capitalists who put up the initial seed money. The venture capitalists are specialist investors who have close connections throughout the districts and are also able to provide new firms with entrepreneurial and managerial guidance and connections with potential suppliers and customers (Florida and Kenney 1988).[14] Under this arrangement, there are two

[13] According to Saxenian (1991), however, in Silicon Valley there is now considerable cooperation among vertically specialized firms in the computer systems industry.

[14] Although Florida and Kenney are moderately well disposed towards venture capitalists in their article, they are far more negative in Ch. 4 of their 1990 book on *The Breakthrough Illusion*.

networks, one of producers that approximates the market orientation of the Marshallian industrial district, and a second network of venture capitalists that is superimposed on the network of producers. In addition, the degree of local focus is frequently reduced to the extent that the venture capitalists come from other regions.

Although there is stronger orientation towards cooperation in the Third Italy than in Marshallian industrial districts, both models are based on organic growth. Even the government sponsorship of collective action in Italy is a reinforcement of a socialist ethos that has been the dominant attitude among small producers in Emilia-Romagna for nearly a century. Thus the emphasis in both models is on competition within an appropriate institutional context. In such Innovative Networks as Silicon Valley and along Route 128, there has been a similar organic growth: The development of nuclei of isolated firms into large clusters required more than two decades (Dorfman 1983; Miller and Cote 1985). The imposition of a network of venture capitalists, however, marks a significant step in the direction of centralization and outside control. As a consequence, the organic nature of competition in the local industries is reduced and industrial districts dominated by venture capitalism represent a movement along the dimensions of both coordination integration and ownership consolidation, even if such arrangements fall far short of vertical integration in the Chandlerian vein.

Modularity is a form of organization that is related conceptually to industrial districts. When there are few economies of scale in assembly and consumers prefer the ability to choose components rather than pre-packaged sets, vertical specialization will occur, with firms concentrating on individual modules. But while firms retain significant independence in design, manufacturing, and marketing, they cannot be totally oblivious to the practices of either their competitors or of manufactures of other modules because assembly requires a high degree of standardization to permit compatibility. When there is modularity, therefore,

both vertical and horizontal networks may arise, perhaps with government enforcement as in the case of radio frequencies (Langlois and Robertson 1992).

Writers like Piore and Sabel extol industrial districts for their "flexible specialization," which allows swift adaptation to market changes and permits the realization of a wide range of separate visions as manufacturers concentrate on product niches (Piore and Sabel, 1984; Saxenian, 1990). Industrial districts are less appropriate, however, when there are potentially large economies of scale or high transaction costs. Under these conditions, different types of organization are needed.

One possibility is the establishment of core networks. As the name implies, these are organized around a single firm, which is usually a large assembler. The satellite firms supply intermediate inputs to the core, which effectively coordinates the network as a whole. The relationships between U.S. and Japanese automobile manufacturers and their assemblers illustrate two types of core networks. U.S. auto firms have traditionally dealt with suppliers at "arm's length," using short-term contracts and exacting discipline by switching to other sources if they are dissatisfied with price, quality, or regularity of delivery. Suppliers fill orders as detailed by the core purchasers and are seldom given any discretion over design (Helper 1991).

American core networks often approximate monopsonistic market relationships. Although, in theory, suppliers may serve a variety of firms, in practice this may be precluded by asset specificity, as dies and other capital equipment cannot be readily transferred to other uses. As a result, large U.S. firms are able to use their bargaining power to exact low prices when dealing with small suppliers operating in competitive markets. The transaction costs of maintaining impersonal market relationships may be great, however, as the willingness of U.S. core firms to switch suppliers engenders little loyalty from the latter, who therefore tend

to stick to the letter of contracts and are reluctant to offer help when they are able. In any case, given the centralized nature of decision-making, there is only a slim chance that suggestions emanating from suppliers — including internal captive suppliers — would attract any attention at the core.

By contrast, the networks of Japanese automobile firms arguably serve to reduce transaction costs by establishing what Florida and Kenney (1991, p. 395) have termed "tightly networked production complexes." One aspect of this networking lies along the coordination dimension. As Smitka (1991) and others have argued, the longer-term "relational" contracts among Japanese assemblers and suppliers, supported by rational, economically motivated structures of trust, reduce the transaction costs of bilateral monopoly. Moreover, such contracts, by encouraging the sharing of information, spur supplier-generated innovation in a way foreclosed to the American firms. Another, less-noticed, aspect of Japanese automotive networks is that they represent a more effective decentralization scheme. Rather than hoarding most technical and design knowledge inhouse, Japanese lead auto firms parcel out discrete modules to suppliers. "Typically," as Helper and Levine (1992, p. 563) write, "a Japanese automaker will not undertake the design of a part that it requires for a new model. Instead it will specify exterior dimensions and performance characteristics, and allow a specialist supplier to design the part to best match its process." For example, an American firm typically assembles a car seat from parts supplied by some 25 different subcontractors. By contrast, a Japanese firm will subcontract the entire seat to a "first-tier" subcontractor, who will then assume primary responsibility for design, quality, and compatibility (Womack, Jones, and Roos, 1990). This efficient modularization also serves to reduce transaction costs, allowing the network of outside suppliers to achieve a higher level of productive capabilities than in the American system. The suppliers respond in

Japan by increasing product specialization to a high degree (Odaka, Ono, and Adachi 1988), giving the system some of the character of a Marshallian network.[15]

Another aspect of the Japanese supplier network in automobiles lies along the ownership dimension. Although Japanese core firms directly produce a smaller proportion of their components than do their American competitors and have a far smaller number of workers per unit produced, they often own a substantial stake in their suppliers, who are therefore not truly independent. Japanese suppliers are also provided with help in finding land close to the core factory to facilitate just-in-time deliveries. In part, the virtues of this ownership quasi-integration derive from the coordination integration it facilitates. Because of their close financial connections, Japanese core firms have an interest in the prosperity of their suppliers and an incentive to engage in reciprocal cooperation that is not present in America. But a dynamic perspective casts the ownership aspects of the network in a somewhat different light. Such ownership ties are part of efforts by the lead firms to create and cultivate the network of suppliers rather than efforts to manage the network once created. The strategy of creating an external network rather than producing inhouse has long been a conscious strategy in the Japanese auto industry, albeit one forced on the industry in part in response to labor unrest in the early 1950s (Smitka 1991).

Formal vertical integration is at the far end of our spectrum. Here, stages of production are under common ownership, and administrative coordination prevails over arm's-length coordination. Again, ownership integration does not by itself lead to centralized control, as firms may choose to have divisions deal with each other on an arm's-length basis to simulate market transactions. Alternatively, central management may through oversight or weakness lose control over internal divisions, which are then able to act independently.

[15] On networks in Japan from a native's perspective, see Imai and Itami (1984) and Imai (1988).

Indeed, it is important to remember that the innovation of the multi-divisional (M-form) structure was in one sense an innovation in decentralization. What made the large vertically integrated firms possible was an efficient parceling out of knowledge and control to modular subunits, with the core retaining only higher-level strategic functions.[16] This system is thus rather closer to the Japanese core network than one might think, except that strategic control is arguably greater in the M-form firm and, as Williamson argues in theory and students of industry have confirmed in practice,[17] internal supply divisions lack the "high-powered incentives" of a financially independent (or at least quasi-independent) relationship.

Thus, in practice, the degrees of vertical integration available to producers are finely graded and may be chosen according to needs. There is no single degree of integration, or form of firm or industry organization, that suits all purposes. In some cases, firms may even mix forms as in the case of taper integration, in which firms produce a proportion of their needs for a given input internally and purchase the remainder from outside suppliers (Harrigan, 1983).

The degree of horizontal integration is also important in determining how effectively an innovation is adopted. The ability to generate research funds, for example, and the variety of options that might be tried in an uncertain research environment may be affected by the size of firms and their ability to cooperate. Small firms are often lauded for their responsiveness to the need for change. Moreover, many independent research efforts may generate more ideas than a few larger teams (Nelson and Winter 1977). When research is expensive, however, small firms may be unable to pay the price of admission while large firms and consortia can tap greater pools of resources.

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[16] Williamson (1985) discusses this decentralization in cybernetic terms: that it permits a separation of control over disturbances in degree (day-to-day management) from control of disturbances in kind (strategic management).

[17] For example, Womack, Jones, and Roos (1990), p. 143.

Forms of horizontal integration also vary. In a Marshallian industrial district, firms are independent for most purposes.[18] Formal horizontal combinations characterize the industrial districts of the Third Italy, however, and *ad hoc* horizontal combinations promoted by venture capitalists operate in American industrial districts that feature Innovative Networks. In general, large U.S. firms are discouraged by antitrust laws and other regulations from horizontal cooperation, but this is less true in Japan and Europe. As in the case of vertical integration, the most efficient form of horizontal integration for promoting innovation depends on the circumstances of the particular case.

Specialization and Appropriability

Specialization and the appropriability of benefits also exert conflicting influences on the choice of organizational form in an innovative environment. The advantages that flow from specialization and the division of labor should lead to a low degree of vertical and horizontal integration. The ability of an originator to appropriate the benefits arising from an innovation may be constrained, however, if the adoption and use of the innovation depend significantly on the activities of other firms, either at the same or different stages in the production process. When there are important appropriability problems (when the benefits flowing from an innovation are likely to elude the originator and fall into the pockets of others), increases in horizontal and vertical integration may therefore enhance the probability of both origination and adoption.

The advantages of specialization for promoting innovation are well-known. Adam Smith believed that workers would become more alert to improvements as they concentrated on performing fewer activities. By analogy, vertically specialized firms would also be

[18] Although even in nineteenth-century Britain certain kinds of collective action were common, especially employers' associations to combat unions.

expected to be more adept than integrated firms at isolating and solving problems. Horizontal specialization could also foster innovation by increasing the number of competing units searching for solutions to a given problem. Whereas there would be only a few groups of problem solvers in an oligopolistic market and the number of firms in which innovations could be implemented and tested would be limited, competition among a large number of firms could generate significantly more ideas and provide more opportunities for trial and adoption. Furthermore, if firms were clustered and the mobility of personnel high, as in an industrial district, rapid exchanges of information would speed up the sorting process leading to the identification of the best solution.

However, this method of problem solving might be inappropriate for certain types of systemic innovation. When the innovation involves changes that span stages of production or even industries, the same sort of concentration of activity that Smith praises could make it less likely that linkages would be discovered — that information would flow to where it is needed. As a result, specialization could retard recognition that an innovation produced for one purpose could serve other needs. Moreover, innovations adopted at one stage of a production chain could prove to be suboptimal for efficiency at other stages. Thus excessive specialization might hamper both the development and adoption of innovations. Development, for example, would appear less attractive if only a portion of a wide variety of potential uses were envisioned initially; and adoption would be less likely if potential users were unaware of innovations that were developed for other purposes but might be of use to them.

Such factors underlie the appropriability problems discussed by David J. Teece (1986) and Will Mitchell (1989; 1991). There are two essential sets of barriers that could keep the developer of an innovation from gaining a high enough share of the benefits to make development worthwhile. These barriers correspond to our two dimensions of

coordination and ownership. The first, as we have just discussed, is imperfect information flows. When people are unaware either of the existence of suitable solutions for their problems or of problems that can be beneficially treated by particular solutions, then the payoff to, and incentive for, innovative activity will be reduced. The second set of barriers concern power relationships. Discovers of a breakthrough who are not directly involved in the industry to which the innovation is to be applied may have very limited bargaining power because they cannot themselves bring about implementation. In order to gain any benefits, they may therefore be forced to sell or license the innovation at a small fraction of its ultimate value to the user if they are to gain any profits at all. Moreover, if imitation is easy — if patents or trade secrets do not effectively protect the innovator — an innovating firm may be at the mercy or competitor (or even supplier) firms who can enter quickly and take cheap advantage of the capabilities created at high cost by the innovator. To profit well from innovation in such circumstances, the innovator would have to own many of the assets complementary to the innovation.

Both of these kinds of obstacles point towards vertical integration as a means of speeding up the rate of innovation. Information impactedness (to use Williamson's term) can be reduced if the developer of an innovation and the user are in the same organization. Users — marketing or production teams — can make R & D experts (whether within their own organizations or elsewhere in the network) aware of specific commercial needs to which they should devote attention. On the other hand, if researchers in such a network come up with an unanticipated development, they can easily alert others in the extended organization who might be able to use it. In the absence of coordination integration, potential benefits might be lost altogether or ceded to others. It is arguable, for instance, that the relative decline of many mature industries in Western economies in recent decades is in part the result of their stark separation from many industries, particularly in semiconductors, in which relevant innovations have been generated. In the more coordinated *keiretsu* system of Japan,

however, the separation has been muted and manufacturers of mature products have had better access to the information needed for innovation.

Vertical integration can also redress adverse power relationships. Under joint ownership, the owners or their immediate delegees can reorganize capabilities because they have ultimate (though not necessarily day-to-day) control. They can buy and sell and hire and fire. When the same organization is both the developer and the user of an innovation, then, the benefits are internalized and appropriability is no longer a problem. Potential developers would not be deterred by the prospect of surrendering a high proportion of the payoff. Notice, however, that this argument applies to ownership integration, not coordination integration, since in principle the innovator need only take financial positions in the complementary assets — long positions in those likely to appreciate and short positions in those likely to depreciate.[19] How much coordination integration is necessary will depend on the pure information costs of informing and persuading those with *de facto* control over cooperating assets. Ownership integration itself does not guarantee enough coordination to solve the problem of information fragmentation, which could in principle be solved by a closely linked network that was not integrated in ownership.

Morris Silver (1984) has provided a further explanation of the role of vertical integration in promoting innovation. According to Silver, innovating firms sometimes are forced to integrate forwards or backwards because they cannot find specialists who appreciate the full potential of the innovation and are willing to associate themselves with a new product. This may be either because they literally cannot understand what the innovators need or because they do not believe that the innovation is commercially viable. In these cases, in order to implement their ideas, innovators may have to engage in tasks they

[19] On this point, see also Mark Casson (1982), pp. 206-8.

would rather delegate to existing specialists through market mechanisms. For example, when developing the assembly line, the Ford Motor Company was obliged to produce the prototypes for many of its new dedicated machines because it could not convince machine tools firms that it was practicable to build machines of the required specifications (Langlois and Robertson 1989).

One implication of this is that the desirability of vertical integration may depend on the existing array of capabilities already available in the economy. When the existing arrangement of decentralized capabilities is very different from that required by a major systemic innovation, vertical integration — which permits a quicker and cheaper creation of new capabilities — may prove superior (Langlois 1992b). This may indeed help explain the prevalence of large vertically integrated companies in the historical periods that Chandler chronicles. The major rearrangements of capabilities enabled by rapid economic growth and the rapid decline of transportation and communications costs in the nineteenth century were refractory to the existing system of decentralized capabilities. Change came from large integrated firms who could sweep away ill-adapted structures in a wave of "creative destruction." At other times and in other places, however, entrenched vertical integration can prove just as refractory to change (Robertson and Langlois 1992). In the pre-war American automobile industry, for example, the strategic move by General Motors to the annual model change, along with product innovations emanating from smaller, less-integrated auto makers, forced Ford reluctantly into the production of a new model (the Model A), whose development disrupted the firm's entrenched internal sourcing chain and forced considerable vertical disintegration (Abernathy 1978; Langlois and Robertson 1989). One can make the case that the overall American problem in dealing with Japanese and other foreign competition since the 1970s has had much the same character.

Networks and Economic Change

Bound up in the preceding discussion were two distinct characteristics of innovation that affect the appropriateness of organizational forms, namely, the systemic character of the innovation and its radicalness. These two factors often ride together, but in principle they are separable. Following Teece (1986), we can talk about an innovation as systemic if change in one part of the system (one stage of production, for example) necessitates corresponding change in other parts; by contrast, an innovation is autonomous if change in one part can proceed without materially affecting the rest of the system. The conventional view, which we have followed so far, is that decentralized networks of innovation do well under conditions of autonomous innovation but that systemic innovation calls for integration of both ownership and coordination in order to surmount adverse power relationships and avoid information impactedness. Moreover, one would typically think of systemic innovation as more "radical" than autonomous, since changing many parts of a system is clearly a relatively drastic procedure, whereas adjusting only a part seems to be necessarily an incremental business. But there is an often-forgotten sense in which autonomous innovation can be the most radical of all; or rather, in which the most radical of innovations is necessarily autonomous.

Consider an innovation that most would view as radical: the personal computer. This innovation required bringing together information from many diverse areas: semiconductors, programming, electronic assembly, etc. Yet this innovation was not the work of large vertically integrated firms whose capabilities spanned many disciplines. Rather, it was the work of small firms, whose early attempts to get the large organizations to take them seriously were persistently rebuffed. Many large firms failed miserably in the business, and even the success of IBM came as the result of almost completely abandoning its internal capabilities in favor of those of the market (Langlois 1992a).

Marshallian and Italian Districts	Chandlerian Firms	Japanese Networks	Innovative Networks
Parametric	**Strategic**	**Structural**	

Figure 2. **Degree of radicalness of uncertainty**

Although the radicalness to which internal organization is adapted may be greater than that to which certain kinds of market-based networks are adapted, there is in the end a kind of radicalness (or newness or uncertainty) that large organizations do not handle well. For this type of uncertainty, a decentralized network does much better (Langlois and Everett 1992). But such a network may be very different from the kind of decentralized network adapted to slow or incremental change. Consider the following distinctions. (See figure 2.) At one end of a spectrum we might think of parametric change, that is, change of certain known variables within a known framework.[20] For example, it may be highly uncertain which grade of cloth or which style of tile will be demanded this season, but it is well known to all what it means to produce a grade of cloth or a style of tile. For this kind of uncertainty, Marshallian and Third-Italian structures arguably work well. A more radical kind of uncertainty or change we might call strategic. This would typically involve rearranging capabilities in fairly drastic ways, but within known boundaries. Here a vertically integrated firm may have an advantage over a pure market network, for many of the reasons detailed above. Once the dynamic random-access memory chip became a known commodity, for instance, large Japanese (and more recently, Korean) firms were able strategically to redirect capabilities into their mass production more decisively than less-integrated American firms.

[20] The distinction between parametric and structural follows Langlois (1984).

At the most radical extreme, however, is what we may call structural change. The personal computer may be an example. Here the ability of a decentralized Innovative Network to generate a wide diversity of information signals and to move rapidly may be an overwhelming advantage. Of course, as time passes, the same technology will change status, suggesting, as we develop more fully below, that the appropriateness of organizational structures varies over the product life cycle.[21]

Industry Structure and the Scope of Innovation

If, as we have outlined, there is a tradeoff between the diversity of ideas that specialization and fragmentation may encourage, on the one hand, and the ease of implementation and internalization of returns permitted by vertical integration, on the other, then the choice of an appropriate industry structure will vary depending on the market forces operating within and upon the industry. When, for example, appropriability is not a problem, vertical specialization will be favored more strongly than when the originators are unlikely to capture the returns to an innovation themselves. The optimal degree of horizontal integration is also a function of specific influences surrounding an innovation, especially when development costs are beyond the resources of small firms.

Our discussion here concentrates on two factors that we consider to be particularly important. In this section, we investigate the ways in which the range of uses of an innovation — its scope — might influence the pattern of industrial structure that maximizes

[21]Contrary to widespread prediction to the contrary, however, the personal computer industry has not matured in such a way that advantage has fallen to large vertically integrated concerns, Rather, the industry has arguably matured into a high-volume mass-production network akin to nineteenth-century Lancashire in cotton textiles. Large firms continue to be singularly unsuccessful, and those large firm that do play in the market do so by emulating their vertically decentralized competitors. The Japanese and Koreans have made few inroads despite dominance in certain high-tech components like flat-panel displays and CD drives. The most successful firms in the industry are Intel and Microsoft, both of whom essentially limit their integration to some strategic alliances. Overall, unit costs and industrial concentration continue to fall hand in hand. (Langlois 1992a.)

the benefits derived from the innovation. In the next section, we consider the effects of different product life-cycle patterns in the using industries on the adoption of an innovation.

Most innovations have a limited number of uses. This is true of much incremental change and also applies to significant innovations that are confined to one or a few industries. When the scope of an innovation is limited, the need for communication between developers and users is restricted to a narrow and easily-definable group. In these circumstances, information exchange is especially easy when there are existing channels of communication, as in an industrial district in which suppliers and customers deal with each other regularly and have a good idea of their respective needs. Even without geographic clustering, established market mechanisms can work well when the scope of innovation is confined. For example, specialist machine manufacturers who supply a particular industry may have good national or international connections that allow them to provide information on new models to potential customers quickly and cheaply. Another channel for communication would be the trade press, which can pick up news on developments from diverse sources and supply it to other interested firms.

There are, however, limits to the ability of firms to use markets effectively. When there is product differentiation, the producing firms are relatively small, and the population of customers is diverse and geographically dispersed, as in the ceramic tile, clothing, or textile industries, information problems may be overwhelming. Under these circumstances, the costs of spreading and acquiring information about innovations might be beyond the resources of both suppliers and buyers. Institutional arrangements like those in the Third Italy can help to overcome the problem. Very few individual tile manufacturers are capable of advertising their distinctive patterns worldwide, and very few tile distributors abroad have the time or money to visit the manufacturers to inform themselves on available styles. As the prosperity of the industry depends heavily on exports, one of the major functions of the

producer cooperatives is to arrange with small manufacturers to provide centralized exhibits and organize participation in international trade fairs. As a result, quasi-horizontal integration — the producer cooperative — forms the basis of quasi-vertical integration, as the producers are able to add marketing expertise to their distinctive competences in design (Best 1990; Porter 1990).[22]

When an innovation has a wide scope of uses, small firms operating in established channels may be less successful at communicating their discoveries because the problem of gaining credibility expands as the developer needs to attract attention among firms in unfamiliar sectors. Potential users may also experience difficulties in locating innovations from diverse sources if the initial applications are in different industries.

Major economy-wide changes like electrification or the use of semiconductors or railroads are extremely rare, but innovation across several industries occurs frequently. If discoveries are made by specialists, in line with the Smithian model, the developers may have neither knowledge of nor interest in applications in other industries. In other words, the very institutional framework that encourages the innovation in the first place can also retard its spread. Inventors with a wider perspective, however, who set out from the beginning to make discoveries with broad applicability, may not have the contacts with users required to gain adoption in any single industry, let alone in a variety of sectors.

These and similar institutional complications may account for the relatively slow spread of discoveries across industries. It took several decades, for example, for the diffusion of electricity for domestic, industrial, and traction purposes (Hughes 1983), and the spread of applications of electronic components is still gaining pace more than four decades

[22] These arrangements result in important two-way channels of information because they reduce the cost to producers of collecting information on customers' preferences as well as spreading information on the producers' wares.

after the invention of the transistor. The search for suitable institutions is again important because, the longer the time period involved in diffusion, the more difficult it becomes for the initial developers of an innovation to appropriate the gains.[23] If the gains are uncertain, this may mean not only a disincentive to development in the first place, but also a loss to the country of development if the innovation is captured to a degree by foreign producers who recognize uses that were not apparent to potential users in the country of development. When the eventual adoption by foreigners is significantly greater than in the country of origin, even the original core industry may migrate internationally (Robertson and Langlois 1992).

Innovation and the Product Life Cycle

The choice of suitable forms of internal and external organization to promote innovation and capture the resultant gains depends as well on the product life cycles (PLCs) of industries that might adopt or be affected by the innovation. It is well known that uncertainty varies over the stages of the PLC, in general reducing as the product progresses from the introductory stage to maturity. Uncertainty can again increase in mature industries, however, if the impact of an innovation is so high that it greatly affects the nature of the product or the production process. The choice of an appropriate structure will therefore depend on which stages of the PLC the source and user industries are at.

When an innovation is adopted by an industry that is in the introductory and growth phases of the PLC, the degree of uncertainty in both the source and user industries is very high. There are unlikely to be established channels of communication that the firms in the source industry can tap because the nature of the user industry is amorphous, with a high

[23] The need for (vertical) ownership integration may be strengthened by the limited time period allowed to holders of patents. If potential users of an innovation cannot be recruited quickly, the effective life of patents, as measured by the profits to their holders, is shortened significantly.

turnover of firms and lack of knowledge as to the nature of the users' products until a standard variation is finally decided upon by users. In such cases, it is very difficult to economize on information costs for both the user and the source because the necessary information might be coming from many directions at once.

Coordination integration is unsuitable in such an environment because it increases "certainty" within an organization (a firm or closely articulated network) by artificially reducing the number of sources of information that are treated as credible. Innovations from external or non-accredited sources tend to be ignored or downgraded when there is coordination integration. When the flow of innovative ideas is high and the form of the user product in flux, it is crucial to be able to tap as many options as possible.

This implies the use of an Innovative Network, or "network of networks," that allows rapid exchanges in which both the source and user firms draw on the widest range of information available, consistent with a reasonable cost of collection and processing. The performance of such Innovative Networks is enhanced if they can draw on various types of clearing house activities provided by trade associations and similar groups. Government organizations such as MITI in Japan can also perform generalized information services.

When the user industry is mature and the innovation is largely autonomous in that it does not require drastic changes to the product or the production process, then a Marshallian or Third-Italian type of network would be most appropriate. These minor, or parametric, changes do not justify the cost involved in establishing elaborate information networks and coordination integration is also unnecessary because the cost to the would-be users is very low if they are not among the first to learn about a particular innovation.

Change along the product life cycle, however, is not necessarily unidirectional (Moenaer, *et al.*, 1990). The most interesting case in many ways (and one that receives much attention from Lazonick, Florida and Kenney, and Porter) occurs when an innovation has a systemic impact on a mature product that, as a consequence, requires substantial revamping of other aspects of that product or its manufacturing process. When this occurs, the path of the user industry is deflected from the usual "S" curve of the PLC into either Mature Uncertainty or Mature Growth, as in figure 3. In both cases, the mature user is returned to a stage of higher uncertainty similar to that in the growth stage of the PLC.[24]

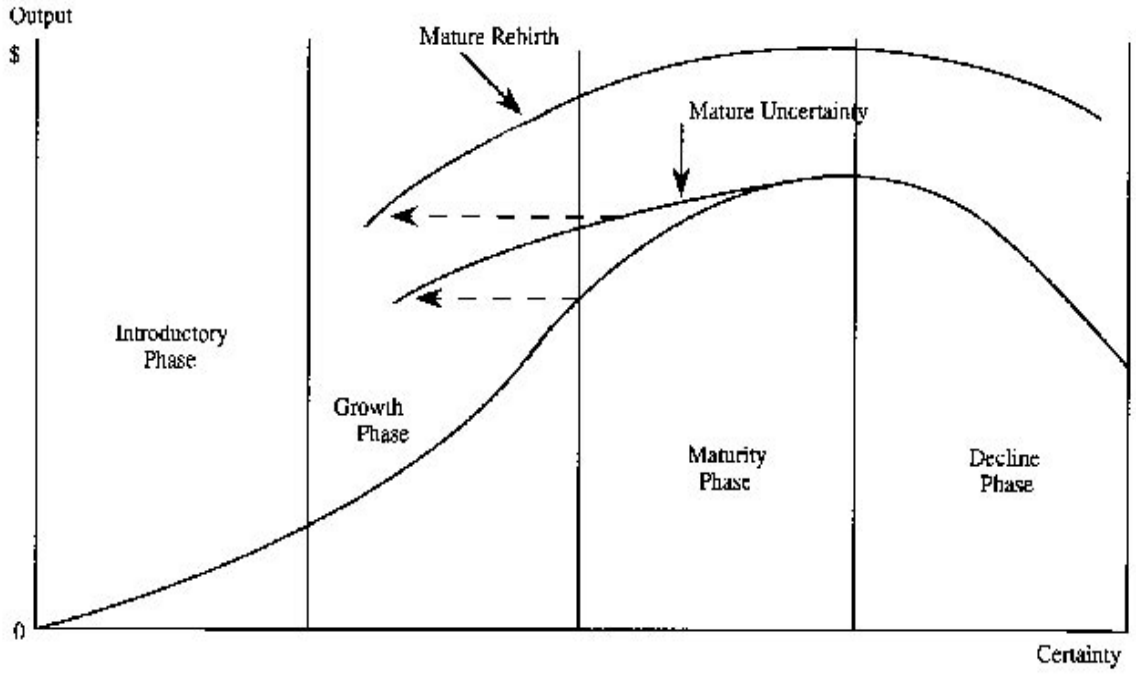

Figure 3.

[24] The major difference between Mature Uncertainty and Mature Rebirth centers on the elasticity of demand for the product. When elasticity is high, a systemic innovation in a mature product may result in a renewed acceleration of growth, or "rebirth," but if demand is inelastic the innovation will result only in greater uncertainty. See Cheah and Robertson (1992).

Examples of these structural or strategic changes range from the incorporation of microcomponents into existing types of machinery to the adoption of just-in-time manufacturing methods. Because such an innovation requires a total rethinking of the nature of the product and/or the manufacturing process, users must have a detailed knowledge of the technology of the innovation and of the varieties available. This can best be achieved through substantial coordination integration as provided by a vertically integrated Chandlerian firm or a Japanese network, because these are the forms of organization that (for a price) give users access to detailed information commensurate with the high importance of their requirements.

The choice between Chandlerian or Japanese network organizations will, in turn, be a function of degree of maturity and hence the extent of uncertainty prevailing in the industry supplying the innovation. If the supplying industry is in the early growth stage of the PLC and uncertainty concerning the nature of the innovation itself is high, the Japanese network solution is probably more appropriate because it permits the user of the innovation to collect information on a broader range of options. But when the innovation is near the end of the growth phase and the number of viable options has been narrowed, the Chandlerian solution is more suitable because the user firm does not need to spread its information net as widely and can therefore put more emphasis on coordination integration to make sure that the innovation is incorporated efficiently into the user product.

In either the Japanese network or Chandlerian case, however, the benefits of the innovation, as employed in that user industry, are likely to be appropriated by the user. This is because the other capabilities associated with the product are going to be held closely by the user firms which are already established. These user capabilities are particularly important in established oligopolies and include patents relevant to other aspects of the

product or process, marketing skills, and the production of complementary products (Mitchell 1989 and 1991).[25]

The distinction between mature and innovative user industries is illustrated by the effects of the adoption of semiconductors on the consumer appliance and computer industries. Recent major changes in refrigerator technology, for example, have significantly increased the reliance of manufacturers on external sources of knowledge. Whereas refrigerator firms previously had internal knowledge of all important aspects of their product, they must now conduct outside searches to obtain information on essential new technologies (Granstrand *et al.*, 1992). Similarly, Florida and Kenney (1990a) cite the decay of the mature consumer electronics industry as a major problem for American semiconductor manufacturers. In Japan, semiconductor researchers can work together with producers of washing machines and other white goods in environments with a high degree of coordination integration to find new uses for chips, as well as ways of introducing improvements into the appliances. In the U. S., however, opportunities are lost for semiconductor applications because developers and users are separated, resulting in lost efficiency to both groups.[26]

By contrast, there have been significant reciprocal advantages for parts of the U. S. semiconductor industry, particularly microprocessors, and producers in such areas as microcomputers, work stations, and other computer-based systems (Langlois *et al.* 1988). In the latter case, both the source and user industries are in the growth phases of their PLCs and face considerable uncertainty. Thus the Innovative Network in Silicon Valley is well-adapted to their needs (Saxenian 1991). Conversely, the more centralized organizational

[25] If the innovation is truly revolutionary, however, existing firms may not possess sufficient capabilities to absorb it. Indeed, other firms, with different capabilities, may be better equipped than established firms to adopt the innovation and thus win a niche in the industry or even come to dominate it. See Robertson and Langlois (1992).

[26] This is, in fact, the anticipated outcome for a mature industry that undergoes vertical disintegration and comes to rely so heavily on outside suppliers that it suffers degradation of its basic competences and can no longer respond adequately to changes in its environment. Bettis, Bradley, and Hamel (1992).

arrangements in Japan have contributed to the relative lack of success by Japanese firms in microprocessors and computers (*The Economist* 1992; Zachary and Yoder 1993).

Conclusion

The primary message that flows from our analysis is that the context of innovation is complex and varied. This may seem a mundane assertion — until one notices that may if not most of the leading theorists and commentators on industrial competitiveness have implied otherwise.

When there is innovation, the most efficient relationship between source and user firms will depend on, *inter alia*, the prior existence of information networks, the scope of the innovation, its impact on various user industries, the presence or absence of economies of scale, and the stages of the product life cycle reached by both the innovating product and any product into which it might be incorporated. It seems, therefore, that no single government policy designed to facilitate change in one or another of these environments will be suitable for all. In fact, the number of permutations and combinations of efficient relationships is so large that it is improbable that any policy, or even group of policies, would be suitable for more than a small fraction of a nation's industries. Attempts to implement broadbrush policies may therefore be destructive because they can upset useful forms of organization in industries that are relatively unaffected by a particular innovation. For example, even if one accepts the contention of Piore and Sabel and Best that small firms operating in networks are more likely than other types of firms to be innovative and conducive to flexible specialization in the future, most modern industrial economies are still highly dependent on industries with significant economies of scale whose existing capabilities, and therefore their ability to serve the public, would be severely damaged if they were to be broken up in a search for faster rates of change.

On the other hand, the wide assortment of useful forms of organization that we have discussed also casts doubt on the wisdom of antitrust laws and other broad policies that prohibit firms from freely entering into relationships that allow them to operate more efficiently and effectively. If coordinated networks like those in the Third Italy or Japan are needed to encourage and diffuse innovation, attempts to ban them can cause significant harm (Bower and Rhenman 1985; *Business Week* 1992).

Overall, then, the most acceptable view of those canvassed here is Porter's. Government policy should be facilitating rather than narrow and prescriptive in that it should offer scope for firms to develop the organizational forms that are best adapted to their particular environments. This requires the provision of infrastructure and whatever regulations are needed to prevent anti-social activities and to channel rent-seeking behavior in productive directions; but it also entails self-discipline on the part of legislators and bureaucrats to resist the temptation to second guess firms and enforce overarching strategies.

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