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ELECTRONIC MARKETS AND ELECTRONIC HIERARCHIES: EFFECTS OF INFORMATION TECHNOLOGY ON MARKET STRUCTURE CORPORATE STRATEGIES

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ABSTRACT

This paper analyzes the fundamental changes in market structures that may result from the increasing use of information technology. First, an analytic framework is presented and its usefulness is demonstrated in explaining several major historical changes in American business structures. Then, the framework is used to help explain how electronic markets and electronic hierarchies will allow closer integration of adjacent steps in the value-added chains of our economy. The most surprising prediction is that information technology will lead to an overall shift toward proportionately more coordination by markets rather than by internal decisions within firms. Finally, several examples of companies where these changes are already occurring are used to illustrate the likely paths by which new market structures will evolve and the ways in which individual companies can take advantage of these changes.

Analytic Framework

Economies have two basic mechanisms for coordinating the flow of materials or services through adjacent steps in the value-added chain: markets and hierarchies. *Markets* coordinate the flow through supply and demand forces and transactions between different individuals and firms. In markets, buyers choose among many potential sellers. *Hierarchies* coordinate the flow through managerial decisions rather than market forces. In these hierarchical relationships (which sometimes include legally separate firms in a sold-supplier relationship) the buyer has only one supplier.

We can analyze the relative advantages of markets and hierarchies in terms of tradeoffs between production costs and coordination costs. In general, since markets allow production resources to be shared among more buyers, they have lower production costs than hierarchies. But markets also require buyers to gather more information about potential suppliers and they are more susceptible to costs that arise from dealing with "opportunistic" trading partners. Therefore, in general, markets have higher coordination

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costs. These coordination costs for markets are greatest when (1) the products being exchanged are individualized for a particular buyer and (2) the products are difficult to describe.

The full paper shows how a slightly expanded version of this simple model can help explain several major historical changes in American business structures during the last century: from small firms coordinated by decentralized markets to large, functionally organized hierarchies and then to large, multi-divisional product hierarchies.

Contemporary Changes in Market Structures

Since coordination involves communicating and processing information, the use of information technology seems likely to decrease the unit costs of coordination. While this reduction benefits both markets and hierarchies, it should favor markets, since it reduces the importance of the dimension on which markets are inferior to hierarchies.

The two specific factors that contribute to coordination costs are also likely to be changed by information technology: (1) the use of flexible manufacturing technology reduces the cost of customizing products for particular buyers; and (2) the use of electronic interconnections reduces the cost of exchanging complex product descriptions.

All these factors favor a shift towards proportionately more use markets. One dramatic example of such a shift has already occurred in the airline industry where the electronic marketplace provided by computerized reservation systems has resulted in a doubling of the proportion of bookings made by travel agents rather than by customers dealing directly with airline sales departments (from 35% to 70%).

Evolution of Electronic Markets

Several participants in transactions may have a motive for establishing electronic interconnections that serve as the basis for electronic markets:

- *Producers and distributors* (such as American Hospital Supply) may be motivated to establish electronic interconnections in order to bias customers toward their products.
- *Buyers* (such as General Motors) may be motivated to establish electronic databases containing information about the products they use in order to improve their selection of suppliers, order processing, and inventory management.
- *Financial service providers* may use their current involvement in transferring funds or extending credit as the basis for providing electronic markets that lead to even more revenues from these activities (e.g., Citicorp's telephone shopping service for its credit card holders).
- *Information technology vendors* who already supply the hardware, software, or networks for an electronic market may increase their revenues further by becoming "market makers" themselves (e.g., telephone companies charging for "electronic yellow pages" services).

From biased to unbiased markets. In the airlines industry, United Airlines introduced the first computerized reservation system. It allowed travel agents to book only United flights. In order to compete with this system, American Airlines established a system that included flights from all airlines, but with American flights listed first. United soon followed suit. Eventually other airlines and the CAB forced both systems to eliminate the biased listing. Now the two systems continue to provide the same reservation service to other airlines for a significant fee.

It seems likely that this pattern will be repeated in many other industries as well. Producers who start out by providing a biased electronic market will eventually be driven by competitive and legal forces to remove, or significantly reduce the bias. For example, American Hospital Supply's electronic connections with its customers have initially increased its market share. However, most of its medical products are not individually adapted to specific customers, and their descriptions are relatively simple and standardized. Therefore, our model leads us to predict that this system (or its competitors) will move toward including products from many different suppliers).

From unbiased to personalized markets. In some markets, the vast range of alternatives that could be provided by an unbiased electronic market might overwhelm buyers with too many alternatives. In these cases, techniques from artificial intelligence may be used to screen advertising messages and product descriptions according to precisely the criteria that are important to a given buyer. Air travellers, for instance, might specify rules with which their own "automated buyers' agents" could compare a wide range of possible flights and select the one that best matches that particular traveller's preferences. The preferences might include decision rules for trading off between factors such as cost, convenient arrival and departure times, window seats vs. aisle seats, minimum number of stops, and so forth. These personalized markets would, in a sense, be "biased" but their bias would be toward the preferences of individual buyers rather than suppliers.

Evolution of Electronic Hierarchies

While we expect an overall shift toward electronic markets, in cases where products are individualized to particular customers and product descriptions are complex, electronic hierarchies will be desirable to improve product development or to improve product distribution. In product development, CAD/CAM, electronic mail, and other information technologies can be used to enhance the hierarchical coordination between design and manufacturing groups. These technologies can increase the number of design alternatives considered, reduce development time and costs, and produce higher quality products. For instance, Xerox's new electronic process for engineering change notices (ECN's) appears to have contributed to reducing administrative costs and increasing the quality and timeliness of product development. In product distribution, just-in-time and other inventory systems benefit both buyers and suppliers.

A plausible trajectory for the development of electronic hierarchies involves a succession of stages, each with increasing costs and benefits of integration:

- *Stand-alone databases* which one or both parties make accessible to the other party (e.g., early versions of American Hospital Supply's order entry system).
- *Linked databases* which have a formal online mechanism for passing information from one to the other (e.g., the current version of AHS's order entry system).

- *Shared databases* which contain information for both parties in the electronic hierarchy (e.g., CAD/CAM systems shared by design and manufacturing groups in different companies).

Implications for Corporate Strategy

1. All market participants should consider whether it would be advantageous for them to provide an electronic market in their marketplace. For some participants, providing such a market may increase the sales of their current products or services. For all participants, it provides a potential source of new revenues from the market-making activity itself.

2. All organizations should consider whether it would be advantageous for them to coordinate some of their own internal operations more closely or to establish tighter connections with their customers or suppliers using electronic hierarchies.

3. Market forces make it very likely that biased electronic sales channels (whether electronic hierarchies or biased electronic markets) for non-specific, easily described products will eventually be replaced by unbiased markets. Therefore, the early developers of biased electronic sales channels for these kinds of products should not expect that the competitive advantages these systems provide will continue indefinitely. They should instead be planning how to manage the transition to unbiased markets in such a way that they can continue to derive revenues from the market-making activity itself.

4. All firms should consider whether more of the activities they currently perform internally could be performed less expensively or more flexibly by outside suppliers whose selection and work could be coordinated by computer based systems.

5. Advanced developers of computer-based market technology should begin thinking about how to develop intelligent aides to help buyers select products from a large number of alternatives. Such intelligent aids may eventually be able to act, in part, as automated agents for the buyers. They may also, in some situations, be able to provide detailed information to suppliers about their customers' preferences.