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Latecomer Strategies: Evidence from the Semiconductor Industry in Japan and Korea

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Abstract

The effects of strategic order of entry on firms' performance have long been an issue in many areas of study. Past research efforts, however, have been concentrated mostly on first mover or early entrant advantages. To contribute to developing a theory of latecomer strategies, the authors investigate how latecomers compete successfully or even leapfrog early movers. They review previous studies on early mover advantages and disadvantages, and group the sources of such advantages or disadvantages into three areas: the firm, its market, and its competitors. The theoretical focus is how a firm converts the opportunities stemming from entry order into performance. The authors seek to confirm and extend relevant theories by examining how late entrants have caught up with incumbent industry leaders in the global semiconductor industry. On the basis of in-depth case analysis of three Japanese and three Korean semiconductor companies, they identify and categorize successful latecomer strategies into two types: strategies for overcoming latecomer disadvantages and strategies for utilizing latecomer advantages. *Focusing, thin margin or loss bearing, and volume building* form the essence of strategies for overcoming disadvantages, whereas *odd timing, time compression, human-embodied technology transfer, benchmarking, technological leapfrogging, and resource leveraging* form the essence of strategies for utilizing advantages. Because many companies in Asia have had to face the reality of being latecomers, the Asian perspectives are particularly useful for studying and explicating latecomer strategies.

(*Latecomer Advantages and Disadvantages*; *Latecomer Strategy*; *Global Semiconductor Industry*)

Introduction

The effects of order of entry on firms' performance have been examined in many areas of study. Whether and when to initiate a move is a strategic decision and should be based on the expected payoff under uncertainty (Wernerfelt and Karnani 1987) or relevant contingencies moderating performance (Kerin et al. 1992). The literature on entry order effects has concentrated on the advantages of early movers. Notions such as switching costs and preemption suggest that early movers are in the best position to determine the competitive "rules of the game."

However, for many firms, when to move may not be a matter of strategic choice. Rather, entering late may be the only realistic option given their competitive dynamics; that is, when a firm intends to enter a market where entrenched incumbents prevail, moving early is precluded at the outset. In an international context, underdeveloped domestic markets, lagging scientific knowledge in local settings, poorly developed or nonexistent related industries, and other environmental elements at the country level often constrain indigenous firms in certain countries from moving first in the world market.

How can a late entrant catch up with early movers and eventually take a leadership position? Theories on leaders and innovation abound, but only scant systematic research has examined how a firm can follow or imitate to win.[1] To investigate that issue, we take an exploratory approach. On the basis of a two-year study of the semiconductor industry in Japan and Korea, we examine how late entrants have surmounted their inherent disadvantages and have sometimes taken a leadership position in limited product areas. Specifically, we conducted in-depth field studies of three Japanese and three Korean semiconductor manufacturers. Case analysis of the Japanese companies provides a complete description of their successful takeover of industry dominance from the United State s. A more compelling case is provided by Korean semiconductor companies, which entered the semiconductor industry virtually from scratch and managed to leapfrog into the top ranks of dynamic random access memory (DRAM) producers. The objective of our article is to contribute to developing a theory of latecomer strategies. Explicitly focusing on the follower's perspectives could generate new concepts and theories that are

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distinct from those accounting for first mover and leader advantages.

We begin with a brief review of current theories on early mover advantages and disadvantages focusing on how late entrants overtake early movers. The benefits and costs of a pioneer strategy versus a follower strategy are highlighted. Next, evidence from case analyses of Japanese and Korean semiconductor manufacturers is described. Factors at both the firm and country levels that explain the strategies of Japan and Korea are analyzed. Then, on the basis of current theories and case analysis, we discuss more detailed contingencies that moderate order of entry effects. We identify and describe two types of latecomer strategies: strategies to overcome early mover advantages (i.e., latecomer disadvantages) and strategies to utilize latecomer advantages. Finally, remaining theoretical and empirical issues and future research directions are suggested.

Early Movers Versus Latecomers

Relevant literature on entry order effects can be found in many areas of study, but the most notable have been industrial economics and marketing (for comprehensive reviews, see Lieberman and Montgomery 1988, Kerin et al. 1992). Since the seminal work of Bain (1956), industrial economics researchers have been interested in how and why entry barriers are built, maintained, and eroded. Their results imply that early entrants are favored by certain barriers that deter latecomers. Consequently, industrial economists have focused primarily on early mover, or leadership advantages. An important stream of research stemming from the industrial economics tradition was initiated by Mansfield (1961), who began investigating the economics of technological changes, particularly in relation to the diffusion of technological innovations. By examining imitation of innovations, Mansfield and his colleagues helped balance the then-tilted perspectives on entry order in the area of industrial economics. Subsequent literature (e.g., Nelson and Winter's (1982) book proposing an evolutionary model) provided a more comprehensive picture of leader-follower dynamics (see also Grabowski and Vernon (1987) for a simulation model of "pioneering" and "imitative" R&D).

Another distinct line of research on entry order effects has been pursued by marketing researchers. Entry order poses a fundamental issue in marketing. Given limited market space, both geographic and perceptual, entry order is theorized to be associated with a significant impact on the relative positioning of players and hence performance. Initial theoretical development relied on industrial organization economics, but subsequent elaborations have been directed at specifying product-market contingencies that moderate the effects of entry order on market performance (Kerin et al. 1992, Robinson 1988, Robinson and Fornell 1985). An interesting behavioral perspective has also been developed to shed light on how early movers preempt consumers, particularly early adopters (Howard 1989), and how consumer preference is formed through learning processes (Carpenter and Nakamoto 1989, 1990). Researchers have used several categories to refer to early movers and latecomers. "First mover" is the most frequently used term (Kerin et al. 1992, Lieberman and Montgomery 1988). However, the definition often is not clear. It is the very first firm or a host of early entrants. (If the latter, how broad should the group be?) One of the limitations of PIMS database is the definition of "first mover" as "one of the pioneers in first developing such products or services" (Kerin et al. 1992, p. 38). Some researchers have used narrower categories, such as pioneers, early followers, and late entrants (Lambkin 1988). We refer to Japanese and Korean companies as latecomers in the semiconductor industry, and to U.S. companies as early movers.

We briefly review the relevant literature to make the following arguments and set our theoretical premises:

1. A firm may have early mover advantages or latecomer disadvantages.
2. Latecomers have room to overcome the early mover advantages or latecomer disadvantages. Furthermore, being late affords certain advantages.
3. Therefore, contextual contingencies can be presented that should enable a latecomer to catch up with or even leapfrog an incumbent leader (e.g., by exploiting sources of competitive advantage and transforming them into realized benefits).

Early Mover Advantages

Sources of early mover advantages can be grouped into three areas: market, competition, and the early-moving firm itself. The *market* (or *consumers*) provides opportunities for firms that come earlier than others. Early movers begin building their images in the market as they launch new products. As time progresses, they gain reputation in the market, which often leads to consumer loyalty (Ries and Trout 1986). When the situation involves uncertainty, the consumer's reaction, on average, is likely to be conservative and result in repeat purchase or use of familiar (i.e., early movers') products (Schmalensee 1982). Carpenter and Nakamoto (1989, 1990) explain that consumers form their preferences through learning processes based on heuristic judgment. Consumers learn through experience how to value the combination of attributes of a product, and the initial samples are often pioneering brands. Hence, a certain prototypical image is built for the new product and, in various ways ranging from word of mouth to intensive advertising, the image is reinforced and shared among consumers. Through that process, a nontrivial *cost of switching* among different brands is created. Switching costs can also result from other, more tangible, sources: initial investment or transaction costs of a buyer to adapt to a particular product and formal contractual switching costs (Lieberman and Montgomery 1988).

Early mover advantages stem also from *competition.* The mechanism for competitive effects in favor of early movers can be encapsulated by the notion of *preemption.* Early movers are in the position to preempt the limited opportunities available in diverse aspects of the market. Input factors such as natural resources, real estate, suppliers, and employees with necessary skills can be preempted by early entrants (Lieberman and Montgomery 1988). Further, early movers can make preemptive or even predatory investments in plant and equipment to deter entry by others (for a formal modeling, see Dixit 1980), and can preempt key dimensions in the geographic and product characteristics space (Lieberman and Montgomery 1988). Preemption may interact with market opportunities, particularly when early movers focus on exploiting the competitive vacuum in the market. However, conceptually we find it useful to distinguish between competition effects, which involve rivalry among firms, and market factors, which reflect the market or consumers *per se.* That is, even without competition, market factors can still be a valuable source of early mover advantages.

Finally, *the early-moving firm* can have a further source of advantage through *learning by doing.* Moving earlier than others implies more time to experience the process of value-adding activities to produce and sell the product. Advantages may arise from each identifiable value-adding activity (e.g., research and development, manufacturing, marketing and sales) and learning rates. Technological leadership reflects the early mover's accumulated experience in research and development and additional related activities. When it is protected by patents, the early mover advantage should be enhanced even further. Learning curve effects have been documented to afford benefits as seen in the cumulative experience in manufacturing (Argote et al. 1990, Kim and Kogut 1996). A steep learning curve enables early movers to gain significant advantages over late entrants (e.g., see Lieberman 1987). In addition, accumulated experience in downstream activities can provide important benefits to early movers. Understanding and properly handling marketing and sales often prove crucial to a firm's performance. When the firm enters foreign markets, the complexities of marketing and sales are even more compelling (Root 1987). By moving earlier, a firm can learn about the market sooner than others and achieve meaningful gains at least for a certain period of time.

Early Mover Disadvantages: Opportunity for Latecomers

By similar logic, sources of early mover disadvantages or latecomer advantages can also be reduced to three areas: market, competition, and the late-moving firm itself. The evolution of the *market* (or *consumers*) opens up opportunities for late entrants. The market is not static; it changes over time and the direction of change is not entirely predictable. Most notably, *changes in consumer tastes* can disrupt the competitive landscape. Early movers that ignore such changes or do not respond to them may be overtaken by new entrants in meeting the changing consumer tastes (Richardson 1996). Timing is crucial, and newcomers often are ready to attack the market while an incumbent is overcoming its own inertia. Also, when facing uncertainty about market changes, the new entrants are often more willing to take risks. To compete against well-established incumbents, new players can succeed by adopting disruptive strategies (D'Aveni 1994).

Related to but not necessarily endogenous in the market are *changes in technologies.* They can offer a valuable window of opportunity for latecomers, particularly when the new technologies make obsolete or destroy incumbents' competencies. Late entrants equipped with new technological competence may be able to set new industry standards and eclipse early movers (Richardson 1996, Tushman and Anderson 1986). Latecomer advantages may also take the form of *free-rider effects* stemming from the evolution of the market and technology. By entering later, a firm may avoid the costs of educating consumers in the product category. Information spillover lends another advantage to latecomers in such form as significantly reduced R&D costs from diffusion of technologies over time, which could be due to the lower cost of imitation (Mansfield et al. 1981) or learning from the mistakes of early movers (skipping trial and error), another kind of free-rider effect.

Industry *competitive dynamics* can be another source of latecomer advantages, largely because of the *incumbent inertia* of early movers. Early entrants pioneer the market and their resources will be developed and arranged to meet the (early) market requirement. Hence, two types of inertial forces can emerge within the firm and its operations. One involves the set of resources committed to specific fixed assets (e.g., manufacturing facilities and distribution channel). Those sunk resources are likely to increase if there are significant economies of scale. They eventually will act as constraints when the firm must change in response to environmental changes (Porter (1980) refers to them as "exit barriers"). The second type of inertial force resides within the people and organizational processes of the firm. As an organization continues to operate, it forms increasingly "hard wired" routines in its processes (Nelson and Winter 1982) which embody values and beliefs of the people in the organization. Embedded organizational routines, values, and beliefs are likely to persist even when changes are needed. Such inertial forces tend to be particularly strong when the early-moving firm has been successful in the market. In all, incumbent inertia affords another window of opportunity for late entrants.

The final source of latecomer advantages is *the late-moving firm* itself. By entering late, a firm can view the market response to initial movements of competitors and make judgments with more concrete information and less uncertainty. That *enhanced level of information* is likely to turn into benefits if the late entrant is qualified with certain characteristics. For example, when the late entrant has indirect experience or "deeper pockets" than its competitors, it may overtake early movers simply through attrition and superior resources (D'Aveni 1994). Numerous giant resource-rich companies have let early movers test the market and then, with positive signals, have dwarfed the earlier entrants by developing incomparable resources. Examples of such companies are found in various industries: Matsushita in consumer electronics, General Foods in food processing, and Evergreen in ocean shipping (see Schnaars (1994) for detailed cases). Potential benefits can be expected in virtually every distinct value-added activity, ranging from R&D to marketing. Also, when the late entrant has previous experience or complementary assets (Teece 1987) related to the new product, it may catch up with early movers by relying on those *shared experiences or assets*, for example, by exploiting economies of scope (Kerin et al. 1992).

Table 1 summarizes the advantages of early movers versus latecomers.

Turning Opportunities into Performance

Lieberman and Montgomery (1988, p. 52), in their review of early mover advantages and disadvantages, conclude that the "endogenous nature" of first mover advantages should be explored: "An important theoretical challenge is to flesh out this dynamic process, and distinguish the impact of firm proficiency and that of luck." They further argue (Lieberman and Montgomery 1990, p. 21) that "the ultimate net impact of pioneering generally depends on the firm's skills and positions, competitors, and changes in the environment." Similarly, Kerin et al. (1992, p. 39) suggest a conceptual framework of first mover advantage, where "product-market contingencies" are specified to capture how opportunities or "positional advantages" are translated into performance (i.e., market share and profitability). Their product-market contingencies include environmental (e.g., demand uncertainty, market type, market evolution, etc.) and firm (e.g., entry scale, scope economies, etc.) variables. Similarly, an understanding of latecomer strategies—*how* a late-entering firm can turn opportunities arising from entry order effects into superior outcomes (what Day and Wensley (1988) called "conversion of positional advantages")—requires an analysis of environment (including competitors) and of firm-specific skills and resources. Specifically, we address two issues:

1. What environmental forces favor latecomer strategies?
2. What skills and resources must the firm have to benefit from latecomer strategies?

By analyzing field research data on the semiconductor industry in Japan and Korea, we empirically describe how entry order effects unfold in the evolution of an industry. Analytical emphasis is on the effects of institutional, cultural, organizational, historical, and environmental factors on latecomer strategies. We thus extend current conceptual notions primarily by elaborating and specifying particular contextual contingencies of entry order effects found in our empirical setting. Once those issues are explored, we outline conditions for latecomer strategies.

Case Analysis: The Semiconductor Industry

Research Methods

The data for case analysis were collected through literature search and field studies of three Japanese and three Korean semiconductor manufacturing companies. The research project was launched in March 1992 and completed in February 1994 (Cho 1995). Initial data collection was done by reviewing published materials on the sample firms and the semiconductor industry. Books, monographs, industry yearbooks, company annual reports, and newspapers were the primary sources for the background research. The second stage of data collection involved site visits and interviews at the sample firms. Two of the authors working as a team visited the three Korean companies and interviewed five key executives in each company. Interviewees were selected on the basis of their involvement with the semiconductor strategy of their company and their employment with the company

Table 1 Early Mover Advantages Versus Latecomer Advantages

Source	Early Mover Advantages (Latecomer Disadvantages)	Latecomer Advantages (Early Mover Disadvantages)
Market/Consumers	Switching costs	Changes in consumer tastes
	Consumer loyalty	
	Uncertainty	Changes in technologies
	Transaction costs	
	Formal contracts	Free-rider effects
		Consumer education
		Information spillover
		Skipping trials and errors
Competition	Preemption	Incumbent inertia
	Input factors	Lock-in of assets/resources
	Production capacity	Organizational inertia
	Market-side opportunities	
The firm	Learning by doing	Enhanced level of information
	Technological leadership	Resourcefulness
	Learning curve effect	Shared experience or assets
	Overcoming market complexities	

throughout the period under study (since the early 1980s). One of the authors interviewed executives of the three Japanese companies, with the aid of a Japanese-speaking researcher. Three to five people in each of the firms were interviewed.

Following Kieser (1994), we adopted an "inductive strategy" of historical analysis. Japan and Korea were both latecomers in semiconductors. However, Korea entered the industry at a later stage and after Japanese companies had established their competitive positions. By juxtaposing the two countries with three cases each, we attempted to draw a general conceptually grounded framework for latecomer strategies. On the basis of the historical case analysis, we identified latecomer strategies that could lead to further theoretical elaboration and empirical investigations.

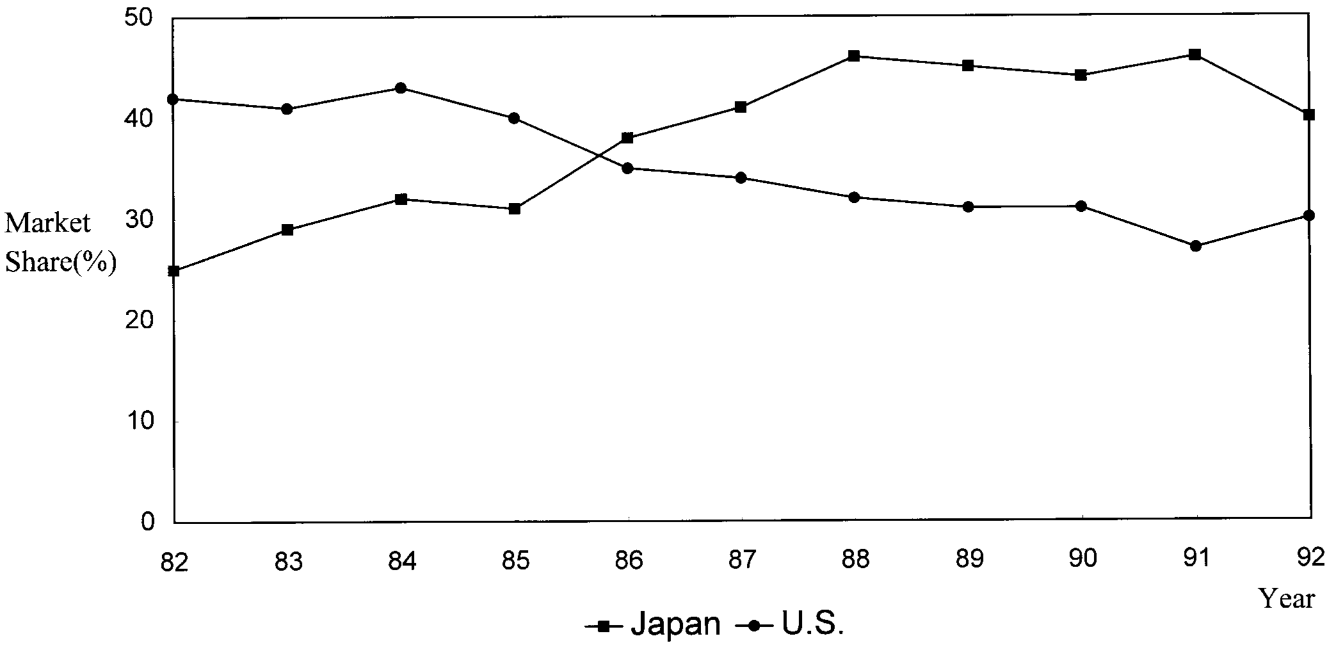
Japanese Takeover: From a Follower to the Leader

In 1986, 32 years after their entry, Japanese companies took over the dominant position in the semiconductor industry from the United States. The growth of Japanese semiconductor production had been phenomenal. Overall production volume had increased between 1971 and 1992 at an annual average rate of more than 18%. Integrated circuits accounted for a major share with 23% annual growth (Semiconductor Yearbook 1985–1993). Japanese manufacturers took industry leadership between 1986 and 1992, controlling 38% to 46% of the world's semiconductor market. Figure 1 shows the changing market share of the United States and Japan in the world's semiconductor shipments. Table 2 lists the top 10 producers in the global semiconductor industry over time.

The Japanese success can be attributed to many related factors. To uncover those success factors, we drew on field studies of three Japanese semiconductor manufacturers: NEC, Toshiba, and Sharp (Cho 1995). Those three companies were chosen for several reasons. Since its inception, the Japanese semiconductor industry has been led by three groups of firms—telecommunications equipment makers (NEC, Fujitsu, and Oki), general electric/electronic companies (Hitachi, Toshiba, and Mitsubishi), and consumer electronics companies (Matsushita, Sanyo, and Sharp). NEC, Toshiba, and Sharp were chosen as representatives of each respective group of firms. NEC and Toshiba were vacuum tube producers when they entered the semiconductor industry in the mid-1950s. Tracking those two companies reveals major steps that leading Japanese semiconductor manufacturers have taken since the very beginning of the industry. Sharp began semiconductor production only in 1970. It illustrates how Japanese companies linked semiconductors to end-products or "system products." Unlike its domestic rivals, Sharp has sought production of diverse semiconductor products with limited volume. Contrasting Sharp, NEC, and Toshiba illuminates several late entry strategies.

Through the case studies, we found several factors that contributed to eventual Japanese dominance of the semiconductor industry. First, large diversified companies took *gradual steps in sequentially building competencies.*

Figure 1 Market Share Changes: United States and Japan



Source: Nikkei Tsushin.

Table 2 Top 10 Producers in the World Semiconductor Industry

	1981	1986	1991	1993
1	TI	NEC	NEC	Intel
2	Motorola	Hitachi	Toshiba	NEC
3	NEC	Toshiba	Intel	Motorola
4	Hitachi	Motorola	Motorola	Toshiba
5	Toshiba	TI	Hitachi	Hitachi
6	National	Philips	TI	TI
7	Intel	Fujitsu	Fujitsu	Samsung
8	Matsushita	Matsushita	Mitsubishi	Fujitsu
9	Philips	Mitsubishi	Matsushita	Mitsubishi
10	Fairchild	Intel	Philips	IBM
	U.S. (5), Japan (4), Europe (1)	*U.S. (3), Japan (6), Europe (1)*	*U.S. (3), Japan (6), Europe (1)*	*U.S. (4), Japan (5), Korea (1)*

Source: Dataquest.

Underlying their gradual approach were *strong leadership and the clear vision of top managers.* Second, the inherent nature of the semiconductor business was such that it created opportunities for followers to *technologically leapfrog* and assume industry leadership over incumbents. Japanese semiconductor manufacturers made technology policies and investment decisions to meet limited windows of opportunity, and successfully advanced to a leading position. Finally, the *development of Japanese semiconductor manufacturing equipment makers, traditional intense domestic rivalry, and the varying roles of the Japanese government* in part explain Japanese success in semiconductors. We discuss each factor in detail.

Sequential Competency-Building and Top Management Leadership. Japanese success in semiconductors is characterized by the companies' gradual approach to building competencies (see also Bartlett and Ghoshal 1989, Hamel and Prahalad 1985, and Itami 1988 for more cases of Japanese firms' gradual approach). Through an incremental and *sequential* approach in building necessary capabilities, Japanese semiconductor companies have achieved solid and lasting competitive status that has survived many major environmental changes. What supported the sequential competency-building process was strong leadership by top managers and their articulated vision. NEC's Kobayashi, for example, developed "C&C" (computers and communications) as NEC's corporate vision and has effectively communicated the vision with the rest of the organization since 1964 (Kobayashi 1985, 1989; NEC 1991).[2]

Foreseeing that the technologies of computers and telecommunications would converge under digitalization, Kobayashi guided NEC's semiconductor business toward meeting C&C criteria. In that context, NEC chose to invest in N-MOS technologies in developing integrated circuits in the mid-1960s (Itami 1988, NEC 1980). N-MOS was an untested and hence risky technology at that time; P-MOS was the industry standard. Despite the risk involved, the technological superiority of N-MOS in terms of integration and calculation speed was conceived as a better fit with the C&C concept. Vision and top managers' leadership were instrumental in NEC's aggressive investment in that C&C served as a "grand concept" guiding the direction of the corporate knowledge base (Nonaka and Takeuchi 1995). By and large, Japanese semiconductor companies took three sequential steps in their competency-building: securing take-off, mastering manufacturing skills, and building technological leadership.

The first step was to develop an internal demand for semiconductors. The strategic objective was to secure a successful *take-off* in the new industry. Some of the companies used their initial semiconductor products in other product lines already in place, such as telecommunications equipment (NEC) and electronic goods (Toshiba). Others, like Sharp, created new products using semiconductors (i.e., transistor-based electronic calculators in 1964[3]). Building the internal or captive demand for inhouse semiconductors in the early stage had significant strategic implications. The captive demand served as a foothold in expanding the semiconductor business. In times of recession, the internal demand proved to be a valuable buffer against shrinking markets. Also, the captive demand provided a test market and learning ground for semiconductors. Close interaction and feedback from internal users led to early detection of technical and quality-related deficiencies. The relationship often turned into a "virtuous circle". The firms' own end products or system products, consumer electronics or telecommunication equipment, were improved because the in-house products were the first to incorporate the latest chips. Also, the firms' internal demand for semiconductors used in their own end products proved to be the most valuable source of market information, and thus led to further improvement in the quality and marketability of their semiconductor products.[4]

As Japanese semiconductor manufacturers gained experience, they took the second step of competency-building. They launched massive investment in process technologies and manufacturing facilities to achieve economies of scale and learning curve effects. The objective of this step was to master *manufacturing skills.* Once initial issues, from production to marketing, were resolved, the Japanese semiconductor makers began targeting aggressively at external demand. At NEC, a total of 48.5 billion yen or 30% of corporate capital investment during 1968 and 1975 was directed at enhancing semiconductor production facilities including factory automation (company reports). The figure rose to 50% of corporate capital investment during 1976 and 1981 (Electronics Yearbook 1980–1982). Oil shocks and worldwide recessions did not stop NEC's massive investment in semiconductor production. NEC's world semiconductor market share increased from 2.2% in 1974 to more than 10% in 1992, and remained on top for seven years from 1985 through 1991 (*Electronics Yearbook* 1992). Toshiba's "Operation W," an immense investment in dynamic random access memory (DRAM) launched in 1982, is another example of building manufacturing competence (Kashiwabara 1990, Nakagawa 1989, Nikkei Sangyo Shimbun 1991.2.5–8). In all, Japanese companies' combined capital investment in semiconductors far exceeded that of the United States during the 1980s. The consistent level of capital investment by Japanese companies was made possible through cross-subsidization within corporate boundaries and low interest rates. Unlike their Japanese counterparts, most U.S. semiconductor manufacturers were fully devoted to semiconductors and had only limited access to external resources. Consequently, U.S. companies could not match the level of Japanese investment in scale production, particularly in DRAM, and many exited the market.

After gaining manufacturing competence, Japanese companies finally sought *technological leadership.* In that final step, Japanese semiconductor manufacturers significantly increased investment in R&D, focusing on upgrading their technological capabilities. NEC's R&D expense had increased by an annual average of 21% during the 1970s and the increase remained at about 19%

during the 1980s (NEC 1971–1990). NEC's efforts to be an innovator and leader in microprocessors, dominated by Intel at the time, resulted in the introduction of its V-series microprocessors in 1984. After leaving its alliance with Intel, NEC aggressively built its own network by second-sourcing the V-series from such competitors as Zilog, Matra-Harris, Sony, and Sharp. NEC intended to set industry standards for microprocessors. Similarly, Toshiba demonstrated its will and capability to become an innovator and leader when it chose C-MOS technologies, instead of the then-dominant N-MOS, in producing 1 mega (M) DRAM in 1985. Toshiba became the leader in 1M DRAM and was second only to NEC in world semiconductor sales in 1986. Sharp exemplifies another Japanese approach to technological leadership. As a latecomer even among the Japanese, Sharp consistently sought niche strategies by focusing on design capabilities. In keeping close connection to system products, Sharp pioneered liquid crystal display (LCD)-related chips. Optoelectronics and application-specific integrated circuits (ASICs) based on strong design capabilities were the essence of Sharp's technological leadership.[5] Figure 2 depicts the sequential approach of Japanese semiconductor manufacturers in building their capabilities.

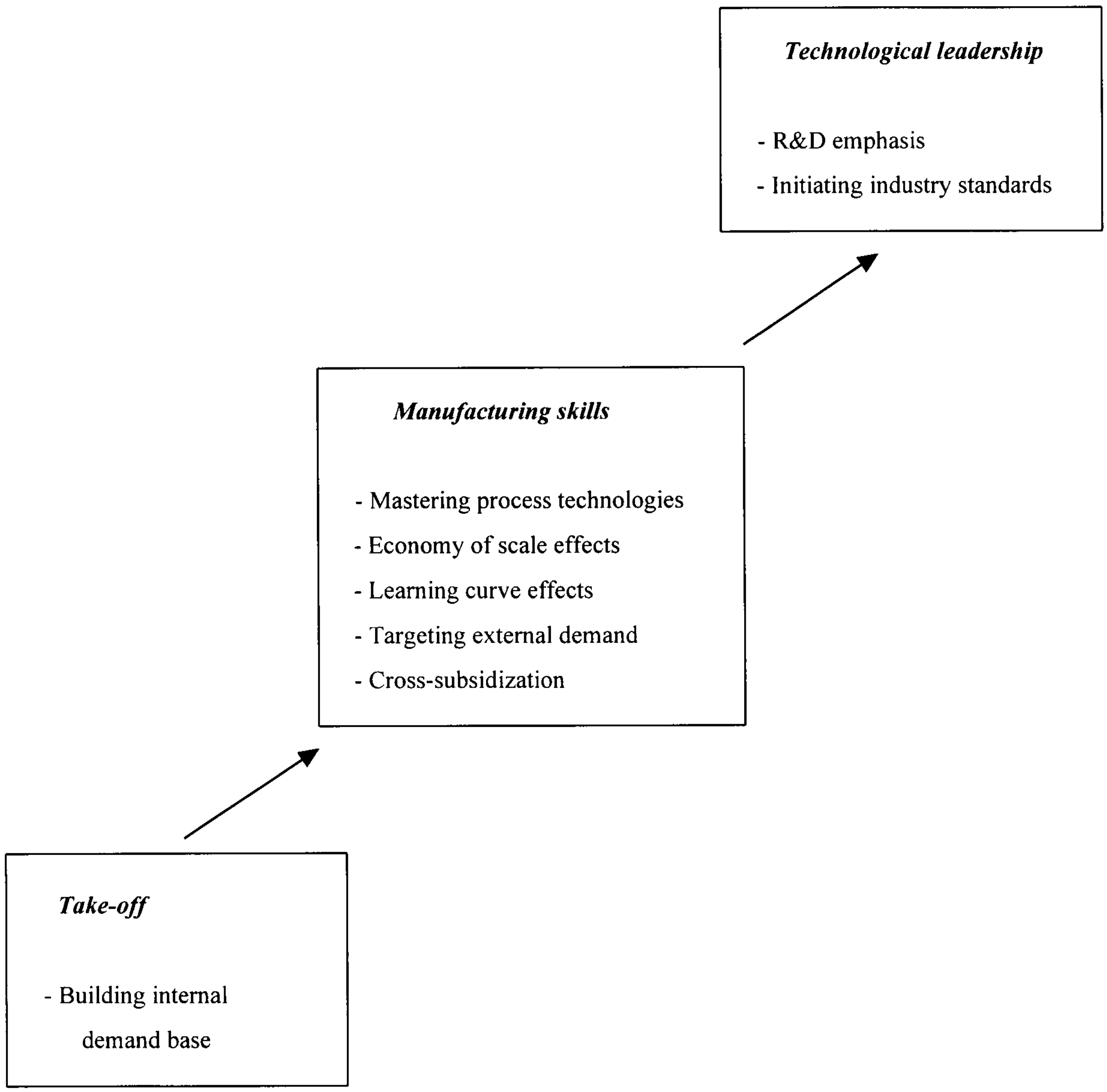
Technological Leapfrogging. Another set of factors for Japanese success in catching up with the United States was in taking advantage of the opportunities provided by the semiconductor industry. The industry had been characterized by rapid technological changes.[6] New technologies often proved to be major improvements over current ones (e.g., miniaturization of memory chips), or sometimes even replaced them (e.g., C-MOS technologies). Such fast-paced technological development can create a potential for catch-up by late entrants. When new technologies make current technologies obsolete, early movers can find themselves in a disadvantageous position. They may be locked into their prior investments or organizational capabilities. Successful players may have difficulty shifting their strategies or technological investment to respond to environmental changes because of either inertial forces of past success or the psychology of escalation of commitment (Staw 1981, Brockner 1992). The history of semiconductors has revealed many such technological discontinuities or "competence-destroying" technological changes (Tushman and Anderson 1986). If latecomers enter the market with investment in new competence-destroying capabilities, they may compete successfully with industry incumbents. Particularly when latecomers have superior resources, their chances for successful leapfrogging are great. We found evidence that Japanese companies took advantage of the characteristics of the semiconductor industry. Particularly, Japanese companies chose to invest in new *process* technologies of manufacturing semiconductors to leapfrog early entrants. With their ability to marshal and commit superior financial resources, Japanese companies pushed the industry into the arena of new technologies that they chose.

In the mid-1960s, NEC began developing N-MOS technology, which remained a promising but commercially risky project. P-MOS technology was the industry standard at that time, and huge development costs kept U.S. companies from pursuing N-MOS. NEC's risk-taking began paying off in the early 1970s. NEC announced successful development of N-MOS 1K in 1972 and N-MOS 4K in 1973 and opened the era of exporting largescale integrated circuits (LSIs) to the United States. That was the first time the Japanese initiated a stream of technological development in the semiconductor industry (Itami 1988).

Toshiba's C-MOS technology involving the production of 1M DRAM is another case in which the Japanese took advantage of technological leapfrogging. Since NEC's success, N-MOS had become the industry standard, being considered the most appropriate technology for mass production because of its simple manufacturing process and low costs. C-MOS technology was more complex and costly but had the advantage of consuming less energy. In 1985, Toshiba announced massive investment in the mass production of C-MOS 1M DRAM, and introduced sample chips within less than a year. The energy-saving feature of Toshiba C-MOS 1M DRAM was well received by consumers and the product was a hit in the world market. Competitors soon decided to adopt C-MOS technology and Toshiba became the industry leader in the DRAM area (Kashiwabara 1990, Nakagawa 1989).

Other Factors. Many other factors contributed to the Japanese success in semiconductors. Domestic rivalry and the Japanese government were particularly important. Along with chip manufacturers, Japanese semiconductor equipment makers evolved into world-class competitors. In 1980, Taketa ranked as the world's tenth largest equipment manufacturer. Since then, Japanese companies have made impressive strides into the world's top 10 list. In 1985, four Japanese semiconductors equipment makers were ranked in the world's top 10, and five Japanese firms made the list in 1990. Tokyo Electron was ranked first in the world, Nikon second, and Advantest, Canon, and Hitachi occupied the fourth to the sixth positions. During the 1980s, Japanese chip producers' dependence on foreign equipment fell from 60% to 30% (interview note). The technological advances of equipment makers alongside chip producers has had obvious benefits for both groups, particularly in the context of international competition. The preference of home-based (country) equipment manufacturers should counteract the potential threat

Figure 2 Sequential Competence-Building Process of Japanese Semiconductor Companies



of foreign makers' discriminatory policies. Further, close collaboration is possible because of national identity, *keiretsu* affiliation, geographic proximity, and common language. The result has been significant product improvements.

Rivalry between domestic companies also has contributed to Japan's success. As in many other Japanese industries, domestic competition has been regarded as more important and threatening to Japanese chip makers than competition overseas. Winning domestic competition has been regarded as a ticket to success in foreign markets and has brought significant emotional confidence along with much symbolic meaning. Abegglen and Stalk (1985) and Porter (1980) pointed out the importance of local competition among Japanese companies in explaining Japanese global competitiveness. Moreover, success in semiconductors generated spillover effects to the companies' other business lines. The fierce competition among domestic companies has led to higher quality, lower costs, and improvement in other areas.

The Japanese government has played varying roles in the development of the semiconductor business (see Cho (1995) for details). In the early stages, the government maintained policies protecting the local semiconductor manufacturers. Diverse measures to protect the nascent industry (e.g., foreign exchange control and regulations on foreign investment and licensing) were employed until 1976. The Japanese government shifted its role from protector to coordinator beginning in 1976 when the VLSI Project was launched.[7] The Ministry of International Trade and Industry (MITI) and Nippon Telegraph & Telephone (NTT) initiated industrywide collaborative efforts to develop very largescale integrated circuits (VLSI). Duplicate investment by individual companies was minimized and concentrated efforts were funneled through the consortium. NTT's role also extended to the purchasing of Japanese-made semiconductors for its own telecommunications equipment.

By playing various roles in a timely manner, the Japanese government has provided crucial support for development of the Japanese semiconductor industry.

Emergence of Korean Companies: Entrepreneurial Leadership

In November 1992, Samsung announced the development of 64M DRAM, the world's first successful commercial production of that level of DRAM miniaturization. In 1993, only a decade after it first focused on DRAM manufacturing, Samsung stood at the top in world DRAM production (and was seventh in total semiconductor production; see Table 2). Concurrently, other Korean semiconductor manufacturers were making their way up. In 1993 Hyundai and Goldstar Electron (renamed LG Electron in 1994; LG hereafter) ranked as the world's ninth and tenth DRAM makers, respectively (Dataquest 1994). Korean companies, following their Japanese predecessors, have collectively proven successful in the semiconductor industry. After the initial investment by Komy of the United States to set up an assembly plant in Korea in 1965, a series of foreign investments through the mid-1970s enabled Fairchild, Signetics, Motorola, and Toshiba to utilize low-cost Korean labor in simple assembly. It was only in the early 1980s that Korean companies began targeting the semiconductor market and finally established their presence on a massive scale.

Through field studies, we found several factors that explain Korean companies' success. Some resemble the Japanese factors, but others seem specific to the Korean experience. Obviously, Korean companies learned from the earlier success of the Japanese companies, but they modified the Japanese strategies or sometimes molded their own. Analysis of the Korean cases revealed several differences from the Japanese. First, at the time of entry, Korean companies were laggards in *all* technological areas related to semiconductors whereas Japanese companies had significant technological capabilities, particularly in consumer electronics. Second, local market conditions in Korea did not support an immediate demand for semiconductors. Korean companies entered semiconductors without a local market for a base but with the strategic intent of capturing a share of the overseas markets. Given those differences, *entrepreneurial moves* played an important role for the Korean firms. Their unique ownership structures—family ownership and control—enabled Korean companies, despite their large size, to enter such entrepreneurial ventures quickly and successfully.

We conducted case analysis of three Korean companies: Samsung, Hyundai, and LG. Their similarities include membership in large family-controlled conglomerates or *chaebols*, employing similar strategic moves in the semiconductor business. Overall, the Korean companies' strategies centered around the entrepreneurial leadership of the founder/owner top manager and focused on relentless investment in a narrowly defined target product (DRAM).

The Korean companies' success factors can be summarized as follows. First, Korean companies share factors that largely *replicate the Japanese model*. Second, Korean manufacturers reveal some elements that are Korea-specific. In entering the new industry, top managers of the Korean companies exercised unique *entrepreneurial leadership*. Odd timing, time compression, and human-embodied technology transfer were essential elements of Korean entrepreneurs' highly spirited catch-up strategies. Those bold moves were made largely because of their inexperience in the semiconductor business. Their lack of experience made them take greater risks to leapfrog industry leaders. Other factors were also important. As in Japan, *domestic rivalry* and the *government* played major roles in the development of the Korean semiconductor industry. Finally, a trade dispute between the United States and Japan over semiconductors proved favorable to Korea. We discuss each factor in detail.

Replicating the Japanese Strategy. In analyzing the Korean cases, we observed many factors paralleling Japan's successful strategies. Korean companies began with a particular product segment, DRAM, and invested mostly in state-of-the-art manufacturing facilities and process technologies to achieve manufacturing excellence. Toshiba's success with DRAM seemed to have inspired Samsung and other Korean makers in determining the initial direction of their semiconductor business. One executive at Samsung said, ". . . late Chairman Lee thought that Toshiba was the model to follow. Toshiba demonstrated how a latecomer can succeed with a clear target product segment and aggressive investment in manufacturing processes."[8] DRAM was the most logical choice for Korean *chaebols* for several reasons. It was the best candidate for mass production. Being a standard product, it required little design capability and the steep learning curve promised significant scale economies.[9] The traditional strength or competence of Korean *chaebols* had been in mass manufacturing of standardized products.[10] In addition, their diverse, often unrelated, businesses allowed cross-subsidization of the massive investment required in DRAM manufacturing.

Korean companies, however, could not fully replicate the Japanese model of sequential competency-building. Unlike the Japanese, Korean semiconductor makers did not develop significant internal demand as a base. From the outset, they jumped into the manufacturing stage and began investing heavily in mastering DRAM manufacturing competence.[11] In addition, Korean companies did not undertake initiatives in new, emerging technologies (such as NEC's initiative in N-MOS and Toshiba's in C-MOS). As a product matures, new technologies with higher production efficiency replace older ones. Possibly, alternative new technologies of DRAM manufacturing had become limited, and hence Koreans had little opportunity to develop initiatives. Finally, Korean makers have not yet reached the stage of shifting investment focus from manufacturing to R&D. Although Samsung and others successfully narrowed the technology gap with advanced countries in the DRAM area by aggressive investment in manufacturing facilities and related process technologies, product design remains dependent on foreign technologies. Time will tell whether Korean companies will gain a competitive edge through R&D.

Entrepreneurial Leadership. With no prior individual and organizational experience related to semiconductors, no significant demand for semiconductors in the domestic market, and a huge initial investment, Korean companies' entry into full-scale semiconductor production can be explained only by their sheer determination to change strategic direction (i.e., make entrepreneurial moves). Because Korean chip makers belong to large diversified conglomerates or *chaebols*, they might be expected to suffer from inertial forces of bigness. At the time Korean companies entered the semiconductor industry and moved aggressively to upscale investments, founders and their families virtually owned and controlled the companies.[12] The founders/owners/CEOs (Samsung's late chairman Lee Byung Chul and now-retired Hyundai chairman Chung Ju Young) were never challenged by the internal organization. Because of their strong status and power, they were able to lead the companies with their own personal vision.

Their lack of experience coupled with the unique ownership structure made it possible for the founder/owners to "bet their companies" on entering the DRAM market. Investments in semiconductors increased at an annual average rate of about 45% from 1984 through 1991 (Chu 1992). Notably, Korean makers continued to invest in manufacturing facilities even in 1985 when the industry underwent a severe worldwide recession. In a sense, their lack of experience often led to *odd timing* in doing business in semiconductors. The odd timing, however, was based on strategic intention to catch up with the leading group. As a result, their selection of timing led Korean manufacturers to go against the competitive stream to their benefit by taking high risks to leapfrog the industry leaders. The series of investments not only expanded production capacity, but also periodically upgraded manufacturing facilities. For example, newer equipment and more advanced process technologies were installed in the new plants or as replacements in the extended parts of the existing plants.

Korean chip makers also revealed a distinct behavioral pattern in managing time. They tended to view the semiconductor business as not very different from other manufacturing businesses. Their earlier experience in quickly building plants and increasing production volume gave Korean companies relevant skills and confidence. For example, Samsung completed construction of its first production line in just sixth months, about half of the industry average construction time. Hyundai's executive said, ". . . one of the key success factors in semiconductor business, especially in DRAM, is to build production line quickly to churn out products faster than competitors . . . and we are very good at this kind of *time compression* based on our experience in construction and shipbuilding" (italics added). Given the short life cycle of standard memory products, Korean manufacturers' ability to shorten the setup time or "to compress the time" for production was an important factor in their success. Time compression is a manifestation of a focused approach driven by entrepreneurial leadership.

Although strategic alliances, mostly licensing, have been an important source of technology transfer (e.g., Samsung-Texas Instruments; Toshiba; Hyundai-Texas Instrument; LG-Hitachi), human-embodied technology transfer is a unique strategy of the Korean semiconductor companies based on Korean culture. Unlike their Japanese counterparts, the most talented students in Korea go to the United States for advanced studies and receive such degrees as a Ph.D. in science or engineering from major universities. Many of them get jobs in American industries, but yearn for opportunities to return to Korea. It was that group of highly educated Koreans with necessary industrial experience in the U.S. semiconductor firms that the Korean semiconductor companies recruited as managers and executives. Samsung's entry into semiconductors was made possible by a team of Korean engineers who had been recruited from a variety of semiconductor firms in the United States (Samsung Electronics 1989). Hyundai and LG soon followed suit. Thus, Korean companies transferred a significant portion of semiconductor technologies, particularly in their early stages, through the direct movement of people. *Human-embodied* technology transfer has been regarded as the most effective and fastest way to transplant and absorb technologies, especially ones that are process-oriented and tacit (Mansfield et al. 1982, Teece 1976). The Korean scientists and engineers brought back from the United States were the main engine in the growth of Korean semiconductor makers.

Other Factors. Domestic rivalry, the government, and a chance event in the industry, also influenced the success of Korea's strategy. Domestic rivalry among *chaebols* was so pervasive and intense that one of the most important concerns in strategic decision making at a typical Korean *chaebol* was the potential impact on its position in relation to other *chaebols* and the opportunity to leapfrog. The many interrelated factors resulting from their fierce competition include tangible economic factors, such as preferential treatment by the government of high-ranking firms, and emotional factors, such as competition driven more by archrivalry than by obvious economic benefits. Semiconductors were seen not only as a promising future business, but also as a means of lending the Korea's leading *chaebols* a high-tech image (interview notes). Partly because of a bandwagon tendency, all *chaebol*-related semiconductor companies chose DRAM as their target product segment. Those isomorphic moves among domestic rivals had important consequences for Korea's overall competitiveness in semiconductors. Investment was narrowly focused in the DRAM area. Competitive expansion and upgrading of DRAM production facilities by the three *chaebols* (Samsung, Hyundai, and LG) quickly led to economies of scale at each individual company. Samsung's success gave conviction to its domestic rivals, who interpreted investing in semiconductors as "feasible" by looking at Samsung's gains. As one executive at LG said ". . . if Samsung did it, we can do it." Because of the virtually complete overlap in semiconductor technologies among companies, a very effective R&D collaboration can be expected once they are organized around specific national or mutual goals such as the VLSI Project (sponsored by the Korean government).

The Korean government has played an important role in the development of semiconductors in Korea. In 1982, the Korean government announced its first program to support the semiconductor industry. That comprehensive program gave overall direction to the industry in Korea. Tariff reduction, preferred interest rates, subsidies for R&D, and other measures were implemented to support semiconductor manufacturers. In addition, detailed numerical targets for export, production, and R&D were suggested by the government. In 1986, exactly a decade after Japan, the Korean government launched the VLSI Project, a collaborative project involving domestic chip makers and government institutions. Since then, the role of the Korean government has been to coordinate related efforts by both public and private sectors. Through those varying roles, as in Japan, government has been a factor in Korea's success in semiconductors (Cho 1995).

Finally, Korean companies were affected favorably by a trade dispute between the United States and Japan. To win market dominance, Japanese semiconductor producers drastically cut the price of 64K DRAM and 256K DRAM in the mid-1980s. Driven by an increasing trade surplus with Japan and fear of Japanese dominance in semiconductors, the U.S. government began trade negotiations with Japan over semiconductors. In 1987 Japan finally entered into an agreement with the United States about export restraints for semiconductor products. The concept of fair market value (FMV) was introduced and prices were stabilized. However aggressive Japanese price cutting and the downturn in demand before 1987 had forced many U.S. DRAM makers to exit the market. Seeking more added value, Japanese semiconductor producers moved to manufacture 1M DRAM chips. Resultant shortages in the DRAM supply afforded a valuable opportunity for Korean companies to emerge as key players in 64K and 256K DRAM. Thus, aggressive investments of Korean companies began paying off partly because of an element of luck (Kim 1995). Tables 3 and 4 summarize our empirical observations mapped onto theoretical notions.

Summary and Conclusion

The case analysis of Japanese and Korean semiconductor manufacturers shows that latecomers *can* compete successfully against industry leaders. Our analytical focus is how individual organizations convert opportunities from the environment, competitors (early movers), and their own skills and resources into tangible outcomes. We present specific firm-level transformation mechanisms and related strategies (*latecomer strategies*) that enable a late entrant to become a successful competitor, or even to leapfrog to an industry leadership position. Our findings extend and deepen those of previous studies, particularly in relation to "contingencies" of entry order effects (Kerin et al. 1992).

On the basis of past and present findings, we argue that

Table 3 The Semiconductor Industry in Japan and Korea: Strategies to Overcome Latecomer Disadvantages

Latecomer Disadvantages (early mover advantages)	Strategies to Overcome Latecomer Disadvantages	Evidence[a]
Market/Consumers		
Switching costs	Focusing	Initial entry targeting at standardized/commodity products (e.g., DRAM) where switching costs are low (J, K)
Consumer loyalty		
Uncertainty		
Transaction costs		
Formal contracts		
Competition		
Preemption	Thin margin or loss bearing	Lowering costs and price to penetrate market (K)
Input factors		
Production capacity		
Market-side opportunities		
The Firm		
Learning by doing	Volume building	Building volume to accelerate learning curve effects (J, K)
Technological leadership		
Learning curve effect		
Overcoming market complexities		

[a]J indicates the evidence is from the Japanese semiconductor industry; K indicates it is from the Korean industry.

Table 4 The Semiconductor Industry in Japan and Korea: Strategies to Utilize Latecomer Advantages

Latecomer advantages (Early mover disadvantages)	Strategies to utilize latecomer advantages	Evidence[a]
Market/Consumers		
Changes in consumer tastes	Odd timing	Making investment decision during market downturn (K)
Changes in technologies	Time compression	Building plants in much less time than is needed by early movers (K)
Free-rider effects	Human-embodied technology transfer	Technology transfer via strategic alliances and hiring experienced people (J, K)
Consumer education		
Information spillover		
Skipping trials and errors		
	Benchmarking	Choosing the best model and imitating (J, K)
Competition		
Incumbent inertia	Aggressive capital investment in new technology and equipment (J, K)	
Lock-in of assets/resources		
Organizational inertia		
Technological leapfrogging		
The Firm		
Enhanced level of information	Resource leveraging	Using internal demand for take-off and continued demand buffer (J)
Resourcefulness		
Shared experience or assets		
		Using available financial resources through cross-subsidization (K)

[a]J indicates the evidence is from the Japanese semiconductor industry; K indicates it is from the Korean industry.

latecomer strategies are feasible, but with some qualifications. Analyzing relevant product-market contingencies (Kerin et al. 1992) and mechanisms of first mover advantages and disadvantages (Lieberman and Montgomery 1988) should help identify proper contexts (e.g., industries or product segments) in which followers can compete successfully against leaders. More importantly, companies should investigate factors within themselves. Given the particular context, one should ask, "Do we (as an organization) have skills and resources necessary to catch up with early movers?" The firm should understand its own past history that has led to accumulation of such skills and resources. The skills and resources should then be related to the competitive context to draw feasible strategies. Because entry order inherently involves the time dimension of competition, further research on latecomer strategies needs to be undertaken in dynamic environments (e.g., D'Aveni 1994).

Our cases demonstrate that there can be multiple success formulas for late entry and that the approaches taken by Japanese and Korean companies differ despite some similarities. Even within countries, variations are evident. However, some commonalities can be drawn from our cases of successful latecomers. In the following discussion, we summarize two types of latecomer strategies: strategies for overcoming latecomer disadvantages and strategies for exploiting latecomer advantages.

Strategies for Overcoming Latecomer Disadvantages

First and foremost, *focusing* is a key strategy for overcoming the latecomer disadvantages. Early movers often preempt the market by creating significant switching costs. Latecomers can address that potential disadvantage by focusing. Specifically, their initial entry into the new industry should be targeted at one or more very specific product segments as penetration points. Initial products could be related either to current organizational competence (e.g., Korean companies' assembly and mass production skills) or to demand-side experiences (e.g., Japanese companies' internal demand). Focused investment in the targeted product segments should lead to incremental building of competence (e.g., Japanese companies' sequential competency-building).

A second strategy for overcoming latecomer disadvantages is *thin margin or loss bearing.* Latecomers should be committed for the long term to the business they enter, and therefore be prepared to withstand hardship or even losses until their operation passes the break-even point. Samsung experienced a prolonged period of losses in the early 1980s until it broke even in 1987. LG went through an even worse experience in terms of profitability until it recouped most of its sunk investment by 1993. In retrospect, the long-term strategy of withstanding an interim period of low margin or losses was necessary for the eventual success of these Korean chip makers but may be limited to the *chaebol* or *keiretsu* form of business system.

Volume building, or reaching scale economy in the shortest time possible, is a third strategy for overcoming latecomer disadvantages. Latecomers typically lag behind early movers in terms of technology or quality levels, which are time-consuming to match. Yet, they can leapfrog early movers in terms of quantity by price reduction coupled with large-scale investment in manufacturing capacity. Because of the learning-curve effects, a latecomer using such a strategy should achieve competitive costs and competitive position in the market. In an expanding market, the strategy should result in high profit margin. In a declining market, it should result in increased share.

Strategies for Exploiting Latecomer Advantages

Through *odd timing,* latecomers can catch up with early movers by breaking current rules. Japanese companies' adoption of new process technologies and Korean companies' aggressive investment during a worldwide recession illustrate this strategy. The Korean cases particularly reveal odd (i.e., seemingly irrational and often unexpected) timing for entry and investment as judged by incumbent players. In part, Korean companies' lack of experience in the semiconductor business led them to make such bold moves. Their inexperience implied low inertia within the organization in building the semiconductor business. Ironically, the Korean companies' cases suggest that lack of in-depth knowledge and experience was an asset rather than a liability, hence the notion of the *power of ignorance.*

In reality, however, odd timing does not stem from, and thus differs from, the power of ignorance, which has a somewhat pejorative nuance. Odd timing is based on top managers' strategic intention and willingness to take risks. The cases of the six firms indicate that each bold investment decision appeared to be oddly timed to other people. Mr. Kobayashi's declaration of C&C in 1977 was not appreciated from outside as it was inside. Late chairman Lee of Samsung faced a similar situation. Yet, the odd timing was a manifestation of the decision makers' shrewdness in projecting the future and aligning the appropriate strategies.

A second strategy is *time compression.* Latecomers have the opportunity to mobilize the direct experiences of the contractors or suppliers who have worked with the early movers. By using those invaluable resources, the latecomers can substantially reduce the time needed for plant construction or securing supplies. In the semiconductor industry, an average cycle of a generation of product is one-and-a-half to two years, necessitating expeditious plant construction and supply of chip-making equipment. Hence, a latecomer's advantage in the form of time compression can be substantial.

A third strategy is related to technology transfer. Technology diffusion or information spillover can be vital in successful followership. Korean chip makers achieved a latecomer advantage through *human-embodied technological transfer,* that is, hiring Korean scientists with the needed education and experience from U.S. firms, thus transferring technologies from industry leaders.

A fourth strategy is *benchmarking,* selectively imitating the best performers and learning from them. The Korean semiconductor industry learned from its Japanese counterpart. Carefully analyzing preceding examples, Samsung set Toshiba as its role model and imitated Toshiba's strategies. Followership also occurred within Korea, as Hyundai and LG soon imitated Samsung.

A fifth strategy involves taking advantage of rapid technological changes. In the semiconductor industry, rapid technological advances create windows of opportunity for latecomers. NEC's choice of silicon and N-MOS technology and Toshiba's bet on C-MOS technology are prime examples. They also illustrate how latecomers can turn incumbent inertia to their advantage through *technological leapfrogging.* Industry leaders (U.S. companies) were committed to current technologies, and they perceived exit barriers to be very significant.

Both Japanese and Korean semiconductor companies successfully leveraged their internal skills and resources. Japanese companies' sequential competency-building process through *resource leveraging* illustrates how late entrants can identify internal strengths from which they can gradually form competitive advantages (see also Mathews and Cho (1996), available upon request). Because the Japanese semiconductor companies are members of business groups or *keiretsu,* one of their sources of knowledge is other member firms. Exchange of knowledge within the *keiretsu* through intense "social interactions" has been critical and indeed a strength of Japanese companies, including semiconductor makers (Nonaka 1994). That feature of the Japanese business system set off the first stage of competence-building: linking semiconductors to internal demand for related products. Internal demand served as both an initial testing ground and a platform for early semiconductor products. Another feature of the *keiretsu* system is cross-subsidization among businesses. Japanese semiconductor companies' massive investment in process technologies to enhance manufacturing efficiency was made possible largely through cross-subsidization. Eventually, Japanese firms shifted their attention to gaining technological leadership.

The Korean cases also reveal an ability to leverage skills and resources. Korean semiconductor companies belong to large family-controlled conglomerates or *chaebols* that are similar to Japanese *keiretsu.* Knowledge sharing within corporate boundaries and cross-subsidization are Korean chip makers' traditional strengths. Because of the infancy of related products of Korean *chaebols,* internal demand for semiconductors did not play an important role in the early stage of the Korean semiconductor industry. Cross-subsidization was perhaps the most crucial factor in the Korean companies' success, along with the entrepreneurial push by chairmen (founders/owners/CEOs). The consistently high level of investment by Korean manufacturers in semiconductor business was made possible largely through cross-subsidization.

Cross-Cultural Observations

As our study involved organizations in different countries, the findings enable us to make some cross-cultural observations. In both Japan and Korea, the government played an important role in developing the local semiconductor business. Government can be viewed as one environmental factor, but to varying degrees (depending on the industry) it can influence competition through direct or indirect means. Our findings show how national governments can become involved when the competition extends into the international arena. Detailed discussion of national government involvement is beyond the scope of our article, but clearly the government in a country of early movers or latecomers may design and implement relevant policies to support local firms effectively in international competition. Firms should explicitly consider the government and other institutional factors as an important contingency moderating entry order effects.

The different paths taken by Japanese and Korean semiconductor makers illustrate that the same rules do not explain the successful strategies of both early followers and later entrants. The 40-year history of Japanese semiconductors gave the Japanese firms the time to develop their technology through a sequential competency-building approach. They were relatively early in following U.S. companies in comparison with Korean firms, and therefore faced a relatively lower level of risk in operation. Korean companies were burdened by their short history and lack of necessary technology. They were laggards in all technological areas related to semiconductors, whereas the Japanese companies had significant technological capabilities. Korean companies' entry was not supported by local or internal demand, so they had to rely on the overseas market from the start. The implication is that later entrants need to adopt a much more risk-taking attitude than early followers.

Our exploratory study was intended to discover some heuristics for latecomer strategies. As researchers anchored in the context of a less developed or *follower* country, we have found it difficult to explain business phenomena systematically by merely relying on current theories largely embedded in the Western, or *leader*, context. Studying organizations in a less developed country requires explicit attention to how to follow and imitate. Often, such organizations are indeed "born as latecomers" because of lagging domestic markets and lack of technological bases. A fundamental question in a less developed country has been: "How can we catch up with the leading countries?" At an organizational level, the question is how to catch up with the world's early-moving or established competitors. Our findings should contribute to the discourse and theory-building related to "catching up" by latecomers. A genuinely unique *Asian perspective* on organizations probably will develop. However, we are certain that unique *contexts* demand more focused attention, which in turn requires rather differentiated directions of research on organizations. Latecomer strategies could be an area that is conducive to development of an Asian perspective.

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Endnotes

[1]Schnaars (1994, p. 1), for example, reports that "a search of *ABI/Inform*—a computerized business database that tracks articles published in more than seven hundred leading business journals—lists a total of 9,006 articles on the subject of innovation but only 145 on imitation."

[2]Kobayashi publicly announced his C&C concept at the International Telecommunications Conference in 1977.

[3]Sony's invention of a radio using transistors in 1957 is another case.

[4]For extensive theoretical argument and empirical evidence about the demand-driven information, see von Hippel (1988).

[5]See Nonaka and Takeuchi (1995, pp. 185–189) for how Sharp took optoelectronics as a "technological field" in building its knowledge base.

[6]For the history of semiconductors, see Braun and MacDonald (1978, 1982).

[7]The year of 1976 marked a significant change in the Japanese government policies; the Japanese government removed regulations on foreign investment.

[8]Toshiba did not keep up with investment in integrated circuits at one key stage, and then had to invest a lot to catch up. Toshiba's successful catch-up driven by massive follow-up investment strongly appealed to late chairman Lee (interview note).

[9]For a discussion on the learning effect in semiconductor manufacturing, see Howell et al. (1988).

[10]Initially, Samsung chose SRAM as the primary target because of the ease of entry, product diversity (within SRAM), and projected growth rates. Soon after, Samsung changed its strategic focus into DRAM, realizing the importance of market size and the potential benefits of mass production.

[11]The result has been a chronic imbalance between demand and supply in the Korean semiconductor industry. In 1991, about 87% of domestic semiconductor demand was imported and more than 85% of production was exported (KSIA 1992).

[12]Ownership has been dispersed to a significant degree since then (company reports).

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