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# STRATEGY AND ENVIRONMENT AS DETERMINANTS OF PERFORMANCE: EVIDENCE FROM THE JAPANESE MACHINE TOOL INDUSTRY

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*This study examines the roles played by the environment and realized strategies on firm-level performance in the Japanese machine tool industry. We examine the effect of environment and strategy on performance using longitudinal data on a sample of 25 Japanese machine tool firms over the period 1979–92. Our results indicate that both firm strategies and the environment play significant roles in influencing profitability and growth. More specifically, whereas both strategy and environmental variables are significantly related to firm profitability, only environmental variables are associated with firm growth. Additionally, in contrast to U.S.-based studies, we find that capital expenditures and technological change are not negatively associated with profitability. Rather technological change has a positive impact on firm growth. We discuss the implications of these results for strategic management and provide suggestions for future research.*

## INTRODUCTION

Several hundred empirical studies in strategic management have examined firm-level strategy–performance relationships (Capon, Farley, and Hoenig, 1990). Many of these studies investigate the strategy–performance relationships by excluding the role played by the environment. Additionally, many of these studies are cross-sectional in nature and provide only static snapshots of strategy–performance relationships (Capon et al., 1990). With a few exceptions, many of these studies focus on firms and industries within the U.S.A. Empirical studies examining the relative impact of strategy and environment on performance in Japanese industries are rare, and longitudinal studies based on Japanese firms are virtually nonexistent (Ito and Pucik, 1993). Hence, the strategic management field can be criticized for two reasons: (1) not

tracking organizations' strategies as they evolve over time (Galbraith and Schendel, 1983; Ginsberg, 1988); and (2) not examining simultaneously the impact of strategy and environment on firm-level performance in non-U.S. contexts.

In this study we address some of these concerns by examining the relative effects of the environment and firm-level *realized* strategies (Mintzberg, 1978) on firm-level performance using longitudinal data collected on the Japanese machine tool industry (JMTI). Machine tools are industrial products that are usually defined as power-driven machines that are used to cut, form or shape metal (Carlsson, 1989). We chose the JMTI for three reasons. First, this industry has been a spectacular success story of Japanese business prowess. Starting from a meager 1 percent share of the world market in 1955, the JMTI rose to dominate the world's machine tool output by 1982. Second, although worldwide sales of machine tools are comparatively small ($30 billion in 1991), machine tools are an integral and indispensable part of every advanced economy. This industry serves important sectors

of the economy such as automobiles, appliances, aircraft and electronics. The productivity of firms and the quality of products that countries produce in these sectors depend squarely upon the quality of machine tools. Third, with the emergence of computer-based controllers, the machine tool industry experienced a major shift in technology, thus providing us with an opportunity to investigate the impact of technological change on firm-level performance. Although it is just one of the environmental factors driving the evolution of an industry, technological change is crucial in understanding how environmental change influences performance.

This paper is organized as follows. First, we provide a brief description of the JMTI and the theoretical rationale for this paper, before proposing a set of hypotheses. Next, we describe the methods used to collect the longitudinal data on the JMTI. Then, we describe the analyses and resultant findings. Finally, we conclude by considering the implications of our findings for strategic management theory and practice.

## BACKGROUND AND VARIABLES

### Background

The JMTI started around the end of the 19th century. It grew as a result of the Japan–Russia War and the two world wars. After World War II, the technological gap between tool makers in Japan and the U.S.A. (and Europe) was large. This gap was so wide in 1954 that the Japanese Automobile Manufacturers Association reported that domestic machine tools commonly malfunctioned and produced output of an inferior quality (JMTBA, 1992). In 1956, the Japanese government passed the 'Extraordinary Measures' law to promote the machinery industry. This law was meant to create an internationally competitive machine tool industry by setting priorities in capital lending procedures, regulating import licenses, and offering tax incentives. Further, the Ministry of International Trade and Industry (MITI), a planning body of the Japanese government, set out to protect the industry by imposing quotas and tariffs on imported machine tools.

During the late 1980s, Japan became the world's leading producer of machine tools. The JMTI, which contributed less than 1 percent of world production in 1955, accounted for 28 percent of world output by 1991. In contrast, the American share of world production declined from about 40 percent in 1955 to 6.6 percent in 1991. Given the dramatic ascent of Japanese machine tool firms to a leadership position, the roles played by the Japanese government and MITI have not gone unnoticed (e.g., Carlsson, 1989; Collis, 1988; Porter, 1990; Sarathy, 1989; USITC, 1983). For example, based on a comparative study of the U.S. Japanese and German machine tool industries, Collis (1988: 111) concluded, 'Japan used industrial policy to correct market imperfections and support firms that were pursuing a viable and dynamic long-term strategy; it succeeded in its goals'. Clearly, the favorable environmental conditions created through a supportive industrial policy played a critical role in the success of Japanese machine tool firms.

The success of Japanese firms competing in domestic and international markets has also drawn scholars' attention to the strategies pursued by firms in this industry, albeit not as extensively as to the role played by governmental policy. For example, based on a study of 17 of the industry's largest firms, Sarathy (1989: 134) concluded, 'A more realistic assessment might point to a symbiotic relationship between industrial policy and corporate strategy. This would help emphasize that nullifying Japanese competitive advantage cannot come through government policy alone'.

Although the works of Sarathy (1989) and others (see Carlsson, 1989; Dertouzos, Lester, and Solow, 1989; MacKnight, 1984) have been helpful in illuminating the roles played by the government and firm-level strategies in this industry, the evidence presented in such studies is based on descriptive cross-sectional data and anecdotal case studies. Therefore, there is still a paucity of studies that systematically examine both the impact of the environment *and* strategies on firm performance using multivariate statistical analyses. We therefore investigate the *relative* roles played by the environment *and* firm-level strategies on performance using objective data for the period 1979–92.

To account for a direct performance effect of both the environmental conditions surrounding the JMTI and the strategies pursued by firms within this industry, we explicitly introduce both sources of variation. We accomplish this by adopting Ackoff's (1970) formulation of a model

of system performance (also see Hansen and Wernerfelt, 1989; Hatten, Schendel and Cooper, 1978: 593):

> Performance of     [Controlled variables or
> system = (*f*)     Strategy variables (C) and
>                    Noncontrollable variables
>                    or Environmental vari-
>                    ables (NC)].

Although strategies employed by firms (i.e., controlled variables) can be captured along many dimensions (e.g., Hambrick, 1983; Miles, Snow, and Meyer, 1978; Porter, 1980), we utilize Hambrick's (1983) classification scheme because the generic constructs that he proposed have been tested extensively in the U.S.A. and have been shown to be appropriate in the Japanese context (Abegglen and Stalk, 1985). Hambrick articulated four generic approaches to *realized* strategy: (1) cost efficiency; (2) asset parsimony; (3) differentiation; and (4) scale/scope.[1]

Cost efficiency measures the degree to which costs incurred per unit of output are low; asset parsimony measures the degree to which assets deployed per unit of output are few. Together these two generic approaches to strategy provide a measure of a firm's efficiency; i.e., the degree to which inputs per unit of output are low (Hambrick, 1983). Differentiation measures the degree to which the product and its enhancements are perceived as unique (Porter, 1980). Finally, scale/scope measures the relative size and range of activities of a business within its industry. An important organizing concept for operationalizing the environment (i.e., noncontrollable variables) is the notion of 'environmental uncertainty'. Following numerous studies in organizational theory (e.g., Dess and Beard, 1984; Scott, 1981; Yasai-Ardekani, 1989), and industrial organization economics (e.g., Caves, 1980; Scherer, 1980), we investigate four dimensions of environment that capture uncertainty: (1) munificence;

(2) competitive interdependence; (3) technological change; and (4) industry concentration.

*Munificence* describes the capacity of the environment to support organizations in the marketplace (Dess and Beard, 1984; Yasai-Ardekani, 1989). *Competitive interdependence* highlights the interrelations between the focal organization and its environment. An ecological conception of this construct indicates that competitive interdependence among firms in an industry will increase environmental uncertainty (Barnett and Carroll, 1987). *Technological change* creates environmental uncertainty, because it redefines competition as technologically superior firms displace firms with outdated technologies (Schumpeter, 1934). The operationalization of the environmental uncertainty construct is not complete without including an industry structure variable. An important variable that measures industry structure is market concentration (Porter, 1980). *Industry concentration* (i.e., power) describes the number and the size distribution of firms competing against each other in an industry. The degree of environmental uncertainty is affected by the extent of realized or potential collusion that results from the number and size distribution of firms in the industry (Scherer, 1980). Finally, we model the effects of the voluntary trade restraints agreement signed between the U.S.A. and Japan as an additional environmental variable to examine its impact on firm-level performance.

Performance is measured in terms of firm profitability and growth. We employ return on sales (ROS) to assess profitability. Several researchers suggest that Japanese firms differ from their American counterparts in their objectives (cf. Abegglen and Stalk, 1985; Kagono *et al.*, 1985). For example, Kagono *et al.* (1985) note that whereas U.S. firms emphasize financial measures such as ROI, Japanese firms emphasize growth. According to Kagono *et al.* (1985):

> [T]hese differences in the choice of objectives correspond to the differences in environment. . . . For instance, the pursuit of a growth objective is more feasible in the high opportunity environment surrounding Japanese firms and the emphasis on profitability is needed in the more competitive environment faced by U.S. firms.

Therefore, we also investigate a growth model, where growth in sales is the dependent variable.

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[1] We focused on *realized* strategy measures because: (1) firms compete on *realized* strategies and not intended strategies (Mintzberg, 1987); (2) longitudinal data on intended strategies are generally unavailable; and (3) some strategy researchers have expressed concerns about focusing exclusively on strategists' perceptions to operationalize strategy constructs, because such perceptions are based on incomplete information, may be biased, and do not readily incorporate evidence from a changing world (Reger and Huff, 1993).

# HYPOTHESES

## Environment and performance

Machine tool makers are the key suppliers of capital equipment to the manufacturing sectors of a nation's economy. Since machine tools are used almost exclusively in the metalworking and engineering industries, the demand for such capital equipment is derived from the demand for consumer goods and services. Based on this derived nature of demand, firms' purchasing decisions regarding industrial machine tool products are made in anticipation of market conditions (Webster, 1990). Moreover, given the general nature of national economies, the demand for machine tools is highly cyclical.[2]

During the 1960s, the fortuitous growth of the steel and automobile industries created a large demand for machine tools. In the 1980s, the demand for Japanese machine tools was driven by the phenomenal growth of the Japanese automobile industry. For example, in 1985, the automotive industry was the largest purchaser of machine tools and accounted for 18 percent of total orders in Japan. Additionally, a growing export market for Japanese machine tools accounted for about one-third of all machine tool orders in 1985.

Beginning in the late 1970s and early 1980s, labor shortages induced automation in various manufacturing sectors which further fueled the demand for machine tools. When the Japanese regulatory agencies enacted environmental regulations, they spurred additional capital investment by various manufacturing firms (mostly outside the automotive sector), which reinforced the demand for machine tools (Sarathy, 1989). Such governmental interventions that influence demand generally have the positive effect of reducing environmental uncertainty. Moreover, growth in demand for an industry's product is often described as environmental munificence (Dess and Beard, 1984). Past research has shown that greater munificence is associated with

increased availability of resources, which enables organizations to generate slack resources (Cyert and March, 1963). Hence:

*Hypothesis 1: Environmental munificence experienced by firms in the JMTI will be positively related to firm performance.*

During the 1960s, the JMTI consisted of numerous small family-owned businesses that produced highly differentiated products for a variety of markets. Given the number of small firms participating in the industry, it was difficult to avoid duplication of R&D or to conserve scarce resources. To remedy this situation, MITI began rationalizing the industry by encouraging consolidation through mergers and product standardization. MITI employed a simple rule: firms were 'encouraged' to drop product lines that constituted less than 20 percent of their sales or commanded less than 5 percent of the domestic market share. Such efforts increased industry concentration. Compared with the market shares of machine tool firms operating in the U.S.A. and Germany, the JMTI is characterized by fewer players with larger market shares.

Traditional industrial organization literature suggests that seller concentration can affect average firm profitability, because higher concentration gives firms a greater degree of control in managing price and, therefore, profits (Bain, 1951). Hill and Hansen (1991: 191) have argued that concentrated industries are associated often with a lack of competition and high returns. Such studies suggest a positive relationship between concentration and profitability. It is also possible that the lack of competition creates inefficiencies and low profits, in which case one might observe a negative relationship. However, Capon and his colleagues (1990), in a meta-analysis of empirical studies investigating strategy–performance relationships, found that industry concentration was positively related to firm-level performance. Hence:

*Hypothesis 2: Industry concentration in the JMTI will be related positively to firm performance.*

The shift to computerized machine tools represented a major technological change in the machine tool industry, because it forced firms to

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[2] The cyclical pattern in demand becomes apparent when one examines the development of this industry in individual countries (Carlsson, 1989: 247). For example, after 1980, markets in the U.S.A. and U.K. showed a declining trend, whereas developing countries (e.g., Taiwan, South Korea, and India) had extremely high growth rates. Above-average growth rates were also found in Japan, West Germany, and Sweden.

develop expertise in electronics and capabilities in computer hardware and software programming (Collis, 1987). For example, designing and manufacturing servomotors that controlled the cutting head in numerical control (NC) machine tools required firms to acquire new and sophisticated electrical and electronic skills. Also, products such as lathes could no longer be designed by a mechanical engineer alone, but required multidisciplinary teams that included mechanical and electronics engineers (Carlsson, 1989). Similarly, new mechanical engineering skills were needed as the physical construction of the machines changed from casting to welding (Sarathy, 1989).

There is broad agreement among theorists that new technology generates competition as technologically superior organizations successfully outcompete firms with relatively inferior technologies (e.g., Abernathy and Clark, 1985; Anderson and Tushman, 1990; Schumpeter, 1934). Haveman (1993) argues:

> [D]uring the orientation period that follows change an organization diverts a considerable portion of its resources from operating to restructuring. . . . The effort involved in developing a structure and system of activities de novo or in restructuring an existing organization lowers the efficiency of operation, which leads to poor performance in the short-term and lower survival chances in the longer-term.

Technological change, too, induces firms to divert substantial resources to adaptation. With the introduction and integration of electronics into an industry previously dominated by mechanical technologies, R&D expenditures increasingly have become important (Carlsson, 1989). This technological shift also resulted in greater product sophistication and dynamism, which in turn required firms to make additional R&D expenditures for new product developments.[3] For example, technological changes in the industry caused

R&D expenditures to rise to about 8 percent of industry value added (Collis, 1987: 7). Whereas the average R&D spending by all Japanese industries was 2.5 percent of net sales in 1987, the machine tool manufacturers alone spent 3.1 percent (JMTBA, 1989: 50). Technological shifts in the environment generate uncertainty because they increase firm-level competition as technologically superior firms attempt to displace firms with outmoded technologies. This is especially true for firms competing in industrial capital goods markets where the replacement of existing capital assets is expensive and barriers to exit tend to be high. Hence:

*Hypothesis 3: Technological change in the JMTI will be negatively related to firm performance.*

As the Japanese machine tool firms adapted to the changing technology, they began to pursue exports vigorously as part of their overall business strategy. Exports grew from 115 billion yen in 1977 to 429 billion yen in 1989 (i.e., 37% of total sales), and Japan's share of imported machine tools in the U.S. market rose from 4 percent in the mid-1960s to nearly 50 percent in 1986 (Dertouzos *et al.*, 1989; JMTBA, 1992). Dertouzos *et al.* (1989: 235) observed that the 'penetration has been greatest in metal cutting machines, which are about three-fourths of the market, especially in CNC lathes and machining centers in the low- and mid-price ranges. That was the first sector of the American market targeted by the Japanese'.

This rapid penetration of the U.S. market by Japanese machine tool firms alarmed many U.S. firms. The U.S. National Machine Tool Builders Association, citing danger to U.S. defense preparedness, requested that total imports of machine tools into the U.S. from Japan be limited to 17.5 percent of total industry sales (Sarathy, 1989). Threatened with possible trade sanctions by the U.S.A., the Japanese machine tool manufacturers voluntarily agreed to restrict their exports to the U.S.A. beginning in 1986 to avoid trade friction and high tariffs. Such restraints curtailed the ability of Japanese firms to export to U.S. markets, thereby reducing the munificence experienced by firms in the industry. Firms were forced to consider capital investments in the U.S.A. and to identify other foreign

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[3] With the emergence of new computer-based machine tool technology, product life cycles for some sophisticated machine tools began to get shorter, thereby increasing product dynamism. Jacobsson (1986: 89) notes: 'According to one of the leading Japanese CNC lathe builders, a design made in 1974–75 had a lifetime of eight years; while a design introduced in 1978 was being phased out in early 1983 and the expected lifetime of a design put on the market in 1983 was around three years' (quoted in Carlsson, 1989: 250).

markets, thereby increasing the complexity of managing the business. This led firms to invest resources in search and promotion activities. Trade restraints increased the intensity of the domestic competition in Japan, thereby further reducing environmental munificence. Hence:

*Hypothesis 4: The implementation of 'voluntary restraints' will be negatively related to firm performance.*

Prior to the 1970s, JMTI was protected from foreign imports by trade tariffs and import restrictions imposed by MITI. Such restrictions may have been instrumental in restricting imports into Japan in the past. The low import penetration by foreign machine tool firms may have been due to both (1) the general nature of the industrial customers and markets and (2) factors unique to the way business transactions are carried out among buyers and suppliers in Japan.

One of the distinguishing characteristics of industrial capital goods markets (as opposed to the consumer goods markets) is the unique nature of the buyer–seller interdependence in these markets. The buyers of industrial products tend to become critically dependent on their suppliers for components or subassemblies, replacement parts and skilled repair/maintenance services (Corey, 1991; Webster, 1990).

Low imports may be partly due to the Japanese manufacturers' preference for relationships with local suppliers, including machine tool manufacturers. Japanese automobile producers, the single largest customer group for machine tools, work in cooperation with machine tool builders to make improvements and innovations in both products and productivity. Carlsson and Taymaz (1993) have argued that Japanese machine tool users tend to buy their capital equipment from those producers who can understand their approach to manufacturing and, consequently, can respond to their needs effectively in a short time without detailed contractual agreements.[4] Additionally, to ensure compatibility of new machine tools with tools and production systems

already in place, and availability of replacement parts over the life of the machine, customers tend to buy products from suppliers who reside in close proximity (Carlsson, 1989: 257). Thus, such practices may have limited the penetration of imports into the Japanese markets.

However, due to increasing pressure upon Japan by its important trading partners, such as the U.S.A. and Germany, the JMTI slowly opened to foreign machine tool producers. Recently, foreign imports have made minor inroads into Japanese markets. Even though competitively priced imports are healthy for the general state of the economy because they increase consumer welfare, imports are nonetheless detrimental to the performance of domestic firms in the short run. This observation is consistent with studies examined by Capon *et al.* (1990) which show that greater import penetration affects performance negatively. Greater penetration of the domestic market by foreign imports indicates greater interdependence between domestic players and foreign firms from other machine tool exporting countries such as the U.S.A. and Germany. Increased interdependence due to machine tool imports signals increased competition and, therefore, greater environmental uncertainty for domestic machine tool producers. In other words, greater interdependence between the JMTI and machine tool industries of other nations will lead to lower firm profits for domestic players. Hence:

*Hypothesis 5: The interdependence between Japanese machine tool firms and foreign firms due to import penetration will be inversely related to firm performance.*

Although the discussion has focused on predicting the impact of environmental factors on firm-level performance, next we examine the impact of firm-level strategies on performance utilizing Hambrick's four strategic dimensions: (1) cost efficiency; (2) asset parsimony; (3) differentiation; and (4) scale/scope. At the outset we point out that marketing and strategy researchers have commonly posited that major differences exist between consumer- and industrial-product settings (e.g., Corey, 1991; Hambrick and Lei, 1985; Hambrick, MacMillan, and Day, 1982; Webster, 1990). For example, Hambrick and Lei (1985) illustrate empirically that businesses that

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[4] Therefore, it is not surprising that the Japanese machine tool builders tend to have a full understanding of the Toyota concept, Nissan concept, and other unique production philosophies of the auto makers and have the know-how and technical expertise to supply machinery and equipment meeting these philosophies (Carlsson and Taymaz, 1993: 310).

vary on the user-sector dimension (i.e., industrial capital goods vs. consumer goods) exhibit different associations between strategic attributes such as cost efficiency, assets mix and utilization, differentiation, and scale and scope and firm-level ROI. Below, drawing on this and other literature pertaining to the JMTI, we propose a set of hypotheses that are then subjected to empirical testing.

## Strategy and performance

As the firms in the JMTI shifted to new computer-based electronics technology, they seriously pursued efficiency gains (Sarathy, 1989) and economies of scale in computerized NC machine tools (e.g., lathes and machining centers). Furthermore, the Japanese Machine Tool Builders' Association (JMTBA) established industry-wide standards for tool-changing mechanisms and size increments to increase technological compatibility and reduce manufacturing costs. To achieve technological compatibility, MITI encouraged a single firm, FANUC, to dominate the production and supply of computer control units (Carlsson, 1989; Porter, 1990). JMTBA also encouraged firms to develop simple, modular designs suitable for a variety of users to gain economies of scale in manufacturing (MacKnight, 1984). These efforts led to a 10–40 percent overlap of parts among models and a 30 percent reduction in the average number of parts per machine tool. For their part, firms improved the efficiency of their operations by reducing the number of employees and overhead costs, and by increasingly subcontracting the manufacture of machine tool components. Many Japanese machine tool makers became assemblers who bought over 70 percent of their components from outside specialized firms (Carlsson, 1989: 254).

Such efforts were similar to the actions of firms in other manufacturing industries (e.g., automobiles). This obsession of Japanese manufacturing firms to increase operations' efficiency has been termed *productivity-based strategy* by Smothers (1990). It refers to a strategy of 'selectively and relentlessly investing with a criterion of creating higher value and eliminating waste (*muda*). This is achieved through continuous, incremental improvements moving toward a goal of applying every bit of labor and capital to its highest and best use' (p. 525). Steps such

as these greatly affect the operational efficiency and, in turn, firm-level profitability by improving gross margins (Porter, 1980). Furthermore, empirical evidence in the U.S. context shows that cost efficiency is positively related to ROI in both consumer and industrial settings (cf. Hambrick and Lei, 1985). Hence:

*Hypothesis 6: A realized cost efficiency strategy will be positively related to firm performance.*

Increased capital intensity suggests a lack of asset parsimony (Hambrick, 1983) that could lead to inferior financial performance, because it often leads to aggressive and destructive competition and, at times, increases the barriers to exit from an unprofitable business (Buzzell and Gale, 1987: 148). Whereas industrial capital goods businesses, such as machine tools, are capital intensive, they tend to be less efficient in their use of assets when compared with less capital-intensive competitors. This is because of the relatively small product volumes (when compared with consumer goods) of machine tools that are produced in sophisticated product segments such as flexible manufacturing systems (FMS). Hambrick and Lei (1985: 778) established empirically that the capital intensity variable was negatively related to ROI in both consumer goods and industrial goods settings. However, the magnitude of the relationship between capital intensity and ROI was larger for firms in industrial settings.[5]

Higher-volume production allowed Japanese firms to simplify product design, thereby permitting the manufacture of standard parts and components and vice versa.[6] Greater volume of production enabled JMTI firms to invest substantially in manufacturing automation. For example, Japanese machine tool firms were the first to develop and apply FMS to their own operations. The introduction of such expensive systems resulted in an increase in the firms' capital

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[5] Relatedly, Hambrick and MacMillan (1984) found that capital intensity was negatively related to ROI in settings characterized by unstable market shares. In general, firms competing in industrial capital goods businesses tend to have relatively stable market shares.
[6] For example, machine tool manufacturers operating in the U.S.A. and Germany produced only five or six units of a given machine per year during the 1980s; the Japanese firms produced 10 times that number in a single month.

expenditures and productivity and, perhaps, improved financial performance (Sarathy, 1989).

Given the growing demand for machine tools, capital expenditures were made by firms in anticipation of an expanding domestic market. For example, capital expenditures increased from 269 to 875 million yen over the period 1975–80, or at 34 percent per year, before slowing down to about 20 percent per year through 1986 (Sarathy, 1989: 144). Such capital expenditures enabled firms to exploit the growth in demand for their products. The broad level of capital investment enabled firms to modernize and renovate their capital equipment. This upgrading of existing capital stock permitted firms to pursue a manufacturing strategy that emphasized increased productivity (Sarathy, 1989) because productivity gains translate into higher financial returns. According to Sarathy (1989: 144) capital expenditures as a percentage of sales rose from 2.3 percent in 1980, to 5.5 percent of sales by 1986. However, supporting increased expenditures required firms to spend financial capital from current sales and profits which may negatively impact firm profitability.

As arguments in favor of or against increased performance (i.e., through improved productivity) are both plausible, we propose the following null hypothesis to guide our empirical analysis:

> *Hypothesis 7: An asset parsimony strategy based on increased capital intensity and capital expenditures will be negatively (positively) related to firm profitability (growth).*

Hambrick (1983) used advertising intensity to capture realized differentiation attempted by firms in the marketplace. An understanding of the role played by advertising in industrial markets requires an appreciation of how industrial machine tool products are sold in Japan and elsewhere. Machine tools are generally sold through three channels: direct selling, regional dealerships, and trading companies.

Direct selling is used mostly to sell high-quality and high-performance machine tools that require technical knowledge and expertise to operate. Leading users (customers) of high-cost machine tools such as flexible machining centers (FMC) and CNC machines prefer to deal directly with the machine tool manufacturers. They do this

because of the complexity involved in the buying process in industrial markets.[7] Also, firms prefer to deal directly with suppliers, because they tend to negotiate the customization required and to buy the machines at the lowest possible price. Hence, there is little need for advertising in such situations, because buyers are knowledgeable and informed about products. Regional dealers are employed to sell simple, low-cost machine tools to small manufacturing firms that are located throughout Japan. Thus, quick delivery and dealer service play more important roles when compared with advertising. However, selling to small firms requires advertising mostly in the form of (1) technical brochures that highlight product features and capabilities, and (2) advertisements in trade publications announcing new product developments. Finally, Japanese Trading Companies (*Sogo Shoshas*) are used by machine tool manufacturers to reach markets outside Japan. Here, the role played by advertising is limited to disseminating technical product brochures to prospective customers.

Japanese manufacturing firms that purchase machine tools are generally conservative and rely on both a machine tool vendor's reputation and past relationships in concluding purchasing agreements (JMTBA, 1989). As explained earlier, once a relationship is established between the buyers and suppliers, repeat orders and long-term contracts are the norm. Thus, due to established relationships between buyers and sellers, negotiations play a stronger role than advertising *per se*.

Such buying patterns are consistent with survey results of machine tool firms. Survey results indicate that the most important marketing device, in order of importance, for selling machine tools include (USITC, 1983): (1) exhibiting products in trade shows; (2) personal calls by sales representatives; and (3) disseminating

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[7] One of the key differences between industrial and consumer marketing is the increased complexity of the buying process in industrial settings. This complexity derives from many unique aspects of the industrial goods markets and products. Due to the technical nature of the product, and the infrequent nature of the capital equipment purchases (that invariably involve capital outlays), many complex technical and economic factors tend to be considered in purchase decisions. Therefore purchase decisions require the involvement of a large number of engineering and technical professionals which in turn complicates the buying process (cf. Corey, 1991; Webster, 1990).

product literature. Finally, despite its limited effectiveness in industrial markets, trade and business publications advertising is still undertaken by machine tool firms to increase product awareness and reputation.

A survey of past strategy research by Capon *et al.* (1990: 1149) indicates that while advertising intensity is positively related to performance at the industry and firm level, it was negatively related to performance at the business level. In sum, given buying patterns for industrial capital goods, the buying habits of Japanese manufacturing firms, and evidence from past studies, we suggest the following:[8]

> *Hypothesis 8: A differentiation strategy based on advertising intensity will be related negatively to firm performance.*[9]

Export sales and market share within an industry are used to capture realized scale/scope dimensions of competitive strategy (Hambrick, 1983). Export sales are a particularly relevant measure for this study for the following reasons. Firms competing in capital goods markets tend to exhibit above-average export levels relative to firms in consumer goods industries (Hambrick, 1983). Further, Japanese machine tool firms target large markets for exports such as the U.S.A. They do so because the domestic market for machine tool products tends to be small and cyclical. Ito and Pucik (1993) have argued that strong domestic competition among Japanese firms is an important reason for export surges by Japanese firms in various industries. Also, because Japanese firms scramble for growth rather than financial returns, they look toward export markets when unable to gain rapid growth in domestic markets (cf. Smothers, 1990).

Overall, the shift to new technology provided the impetus for Japanese firms in the industry

to vigorously pursue exports as part of their business strategy. As a result, CNC machine tool production rose from about 26 percent of all machine tools in 1977 to 67 percent in 1984, and then to 72 percent in 1991. Under MITI's guidance, firms promoted the use of simple NC and CNC machines before the Europeans adopted them and at a time when American NC vendors were still finding few buyers (Dertouzos *et al.*, 1989: 242). This strategy has made the Japanese machine tool firms the largest exporters in the world, especially in the high-dollar value-added segments such as CNC machine tools. It has been noted that '*one of every two CNC lathes sold in the West in 1981 was made in Japan*' (Sarathy, 1989: italics original).

However, foreign markets can be supplied either through export of domestic production or by offshore production. According to the JMTBA (1989), many leading machine tool firms set up wholly owned subsidiaries in the U.S.A. during the 1980s. This growing number of Japanese transplants in the U.S.A. could weaken the relationship between exports and performance. After examining the relationship between exports and financial performance in past empirical studies, Capon *et al.* (1990: 1149) concluded that industry-level and firm/business-level exports are both negatively related to financial performance. However, in a study examining foreign trade and U.S. market performance, Pugel (1980) found some support for the hypothesis that exports enhance domestic profitability. We suspect that these studies have focused on U.S. industries and firms, and little research has been undertaken in the Japanese context. Also, given conflicting results obtained by previous studies, the relationship between exports and performance is open to further empirical testing.

To continue, market share is related to superior performance (e.g., Buzzell, Gale, and Sultan, 1975), because greater share allows firms both to exploit economies of scale and scope, and to travel down the experience curve. Larger market share may also translate into market power which firms can exploit to their advantage via higher pricing and exercising control over distribution channels. However, as industrial firms tend to have fewer distributors relative to consumer goods (Corey, 1991; Webster, 1990; USITC, 1983), their ability to exercise control over distribution channels can be

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[8] Given the general nature of industrial markets and machine tools in particular, 'advertising' expenses reflect monies expended: (1) on participating in trade shows both in domestic and international settings; (2) for designing, developing and printing product literature; and (3) for advertising in trade and business publications to increase product awareness and firm reputation.

[9] The lack of longitudinal data on variables such as product quality, delivery service, and firm reputation prevent us from analyzing the relationship between these fine-grained measures of differentiation and our dependent variables.

limited.[10] Furthermore, the machine tool industry consists of firms competing in many different market/product segments (e.g., turning machines, drilling machines, and special-purpose machines). It is also possible, therefore, that firms can be successful without dominating the industry. Thus, because arguments can be presented in favor of and against a relationship between exports and performance, and market share and performance relationships, we use the following hypothesis to guide our empirical investigation:

> *Hypothesis 9:   A scale/scope strategy based on exports and market share will be positively related to firm performance.*

## METHODS

### Sample and data

We obtained data from the NEEDS financial data base.[11] We selected firms listed under the heading 'machine tools' in this data base and included only those firms for which complete data on the variables of interest were available. This process yielded 25 publicly traded firms listed on the Tokyo, Osaka, and Nagoya Stock Exchanges. These 25 firms are the *only firms* in the JMTI for which complete financial information is available and, together, they account for more than 85 percent of domestic sales in this industry. Data were collected for each firm for the period 1979–92. We chose 1979 as our starting year because the JMTI had by then: (1) completely rebounded from the effects of the 1973 recession created by the oil crisis; and (2) made some headway into the production and sale of CNC machine tools.

The data collected from the NEEDS data base were then cross-checked with the data collected

from the *Analysts' Guide* for 17 of the largest firms. *Analysts' Guide* is published by Daiwa Securities, a leading financial services firm in Japan, and only provides information for the largest 17 firms in the industry (all listed on the Tokyo Stock Exchange). We found no discrepancies between the two data sets for these 17 firms.

### Dependent variables

The dependent variables used in the study are return on sales (ROS) and change in sales (i.e., growth). Although the ROS measure may be distorted due to aggregateness (Venkatraman and Ramanujam, 1986), it is acceptable when the firms are relatively undiversified. In our sample, the average degree of diversification in 1991 was less than 14 percent. Thus, despite its limitations, ROS is an appropriate measure of a firm's financial performance for firms in our sample. ROS is operationalized as the ratio of operating income to total sales. We assess firm growth as change in sales where $\Delta sales_{it} = sales_{it} - sales_{it-1}$.

### Environmental variables

We focused on four dimensions related to environmental uncertainty: munificence, interdependence, technological change, concentration. Munificence, or resource availability, has been operationalized in terms of the industry's growth rate (Dess and Beard, 1984; Yasai-Ardekani, 1989). Also the anecdotal evidence available on machine tool demand indicates that country differences in economic growth rates strongly influence the demand and production of these products (Carlsson, 1989). Therefore, we use *change in gross national product* (GNP) to measure munificence. The measure we adopt accounts for the magnitude of changes in resource availability between periods (cf. Tushman and Anderson, 1986).

We measure competitive interdependence (as opposed to mutualistic interdependence) using import statistics for the JMTI derived from published reports of the JMTBA. The degree of competitive interdependence from 1979 through 1992 is scaled between zero and one depending on the observed level of import penetration. A value of zero is assigned to the year with

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[10] This finding is consistent with results presented by Hambrick and Lei (1985) in that while the relationship between relative market share and return on investment (ROI) was positive in both consumer and industrial sectors, the magnitude was stronger in consumer sector firms.

[11] Nikkei 'NEEDS' is a comprehensive data base operated by Nihon Keizai Shimbun, Inc. (the Japan Economic Journal). It includes over 400 variables, along an array of financial ratios on Japanese public companies listed in the major stock exchanges in Japan. Since firm-level information provided in this data base dates back as far as 1964, access to such data is valuable for researchers interested in conducting longitudinal investigations of the strategy and performance relationships.

the highest number of machine tool imports. Therefore, the greater the observed level of import penetration, the lower the value of competitive interdependence variable.

Also, we measure technological change by calculating the ratio of CNC machines produced to the total units produced for each year. Since concentration describes the number and size distribution of firms in the industry (Scherer, 1980), we operationalize this construct using the $C_4$-Herfindahl index, which is based on the market share of the top four firms. Finally, to model the 'voluntary restraint' agreement between Japan and the U.S.A. as an additional environmental variable, we include a dummy variable '0' from 1979 to 1986 and '1' from 1986 onwards.

### The independent variables

We operationalized strategy dimensions using *realized* strategy measures (Mintzberg, 1978). Cost efficiency is assessed by calculating the ratio of *cost of goods sold* to *total sales*. The smaller this ratio, the greater is the firm's efficiency. Asset parsimony is operationalized using capital expenditures and capital intensity measures from the data base. Capital expenditures are assessed as *net expenditures for plant and equipment*, and capital intensity is assessed as the ratio of *assets to the number of employees* (Hambrick, 1983). The differentiation strategy pursued by firms in the industry is operationalized by examining the advertising expenditures for each firm (Porter, 1980). Using advertising expenditures we estimate each firm's advertising intensity as *the ratio of advertising expenses to total sales* and express it as a percentage. Advertising intensity is an indicator of the importance of market responsiveness (Kobrin, 1991). The scale/scope dimension of strategy is operationalized using two measures: 'export sales' and 'market share'. Exports are assessed as the *percentage of foreign sales to total sales*. Market share is calculated as the ratio of a *firm's sales to total industry sales*. Each of these variables is calculated for all 25 firms for all 14 years beginning in 1979.

### Model specification

The relationships between a firm's profitability (i.e., ROS) and the independent variables are modeled as follows:

$$Y_{it} = \beta_1 Y_{it-1} + \beta' X_{it-1} + \epsilon_i$$

$Y_{it}$ is the ROS (Growth) for firm $i$ in year $t$. $Y_{it-1}$ is the ROS (Growth) of a firm $i$ 1 year earlier. $X_{it-1}$ are independent variables for firm $i$ in the year $t-1$. Jacobson (1990) argues that models investigating the strategy–performance relationship may be misspecified because they fail to account for the impact of 'unobservable' effects on performance. In order to account for such 'unobservable' effects we include the past year's dependent variable (i.e., $Y_{t-1}$) to predict the current year's dependent variable.

Rather than estimating the models for profitability and growth for each year, we pool the data and estimate a single model on the pooled cross-sections of the sample for profitability and growth separately. By pooling repeated observations from the same organization, it is likely that one can violate the assumption of independence from observation to observation because the model's residuals may be autocorrelated. This approach renders OLS estimates inefficient, because autocorrelation generates biased estimates (Netter, Wasserman, and Kutner, 1989).

Two other potential estimation problems are multicollinearity and heteroskedasticity. Multicollinearity exists when independent variables in the model are highly correlated, thereby affecting the accuracy of the regression calculations. When the units of observation differ greatly in size, the random component of the disturbances violates the OLS assumption of constant variance for the error term. Under these conditions, OLS estimates are inefficient (i.e., standard errors are inflated), but not biased (Netter *et al.*, 1989). We discuss the methods employed to deal with such concerns in the section below.

## ANALYSIS

Table 1 provides the descriptive statistics and zero-order correlations among the dependent and independent variables. We estimate eight regression models to investigate the relationships between these independent and dependent variables. Six of these models are baseline or restricted models where either the control, environmental, or strategy variables are regressed independently on the dependent variable. The

Table 1. Means, standard deviations, and zero-order correlations

| | Mean | S.D. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 ROS | 0.08 | 0.08 | 1.0 | | | | | | | | | | | |
| 2 ΔSALES | 0.026 | 0.07 | 0.36 | 1.0 | | | | | | | | | | |
| 3 Interdependence | 0.60 | 0.27 | -0.26 | -0.39 | 1.0 | | | | | | | | | |
| 4 Munificence | 0.06 | 0.01 | 0.19 | 0.38 | -0.39 | 1.0 | | | | | | | | |
| 5 Concentration | 0.07 | 0.02 | -0.31 | -0.39 | 0.31 | -0.76 | 1.0 | | | | | | | |
| 6 Cost efficiency | 0.77 | 0.08 | -0.84 | -0.34 | 0.22 | -0.14 | 0.20 | 1.00 | | | | | | |
| 7 %Exports | 20.2 | 13.2 | 0.28 | 0.10 | 0.06 | -0.01 | 0.04 | -0.36 | 1.0 | | | | | |
| 8 %Advt. intensity | 0.75 | 0.47 | -0.35 | -0.19 | 0.17 | -0.22 | 0.21 | 0.06 | 0.08 | 1.0 | | | | |
| 9 Capital Expenditures | 7.4 | 9.53 | 0.20 | 0.34 | -0.19 | -0.04 | 0.14 | -0.30 | 0.19 | -0.04 | 1.0 | | | |
| 10 Market Share | 0.04 | 0.04 | 0.08 | 0.32 | 0.02 | -0.09 | 0.11 | -0.14 | 0.03 | -0.03 | 0.70 | 1.0 | | |
| 11 %CNC machines | 63.5 | 8.2 | -0.32 | 0.01 | -0.29 | -0.14 | 0.42 | 0.19 | -0.04 | 0.14 | 0.31 | 0.05 | 1.0 | |
| 12 Size (log of employ) | 6.54 | 0.79 | 0.19 | 0.32 | -0.03 | -0.04 | 0.06 | -0.13 | 0.25 | -0.11 | 0.62 | 0.78 | 0.09 | 1.0 |

other two are full models that include environmental and strategy variables. In all models, we use 1-year lagged dependent variables as the control variables.

We checked for multicollinearity in the models by examining the variance inflation factors (VIF) for each independent variable. The VIFs for the 'capital intensity' variable in all our models were well above the acceptable value of 10 suggested by Netter et al. (1989). As the 'capital intensity' variable was highly correlated with the 'capital expenditures' variable, and the 'size' variable was highly correlated with 'market share' variable, we dropped the 'capital intensity' and 'size' variables and reestimated our models. The VIF values in our reestimated models ranged from 1.0 to 8.0 and were well below the upper limit of 10, suggesting that multicollinearity was not a concern (Netter et al., 1989).

Next, we used a generalized least-squares (GLS) cross-sectionally heteroskedastic and time-wise autoregressive model to correct for autocorrelation and heteroskedasticity. The model and procedures used are those described in Greene (1990: 472–475). Using procedures discussed by Greene (1990), we transformed the data to correct the bias due to the effects of serial correlation across time (i.e., autocorrelation) and across cross-sectional units (i.e., heteroskedasticity) and then estimated our regression models using LIMDEP (Greene, 1992). The results in Tables 2 and 3 indicate statistically significant relationships between the independent and dependent variables.

Table 2 reports the results for the profitability models. Here, Model 1 is the baseline model where the control variables are the independent variables. Models 2 and 3 are restricted models where the environmental and strategy variables are the independent variables. Model 4 is the full model where all variables are introduced simultaneously.[12]

Table 3 reports the results for the growth models. Here, Model 1 is the baseline model where the control variables are the independent variables. Models 2 and 3 are restricted models where the environmental and strategy variables are the independent variables. Model 4 is the full model, where all variables are introduced simultaneously.

## DISCUSSION AND RESULTS

The purpose of this study has been to examine the relative roles played by the environment and firm-level strategies in determining the performance of firms in the JMTI using firm-level longitudinal data. We operationalized the environment using four primary measures: munificence, interdependence, technological change, and industry concentration. Additionally, we used a dummy variable that controls for the 'voluntary restraints' agreement signed by Japan and the U.S.A. in 1986. Utilizing Hambrick's

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[12] We also estimated models using ROA as our dependent variable; these results were very similar to the ROS models presented here. This is not surprising because ROA and ROS were found to be correlated at 0.90.

Table 2.  GLS regression results on ROS

| | Dependent variable: ROS | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| Constant | 0.203** | −0.2386** | 0.2768** | −0.0364 |
| | (0.0061) | (0.0519) | (0.0777) | (0.1113) |
| $ROS_{(t-1)}$ | 0.6830** | 0.5200** | 0.3001** | 0.0883 |
| | (0.0548) | (0.0580) | (0.1052) | (0.0134) |
| *Environmental variables* | | | | |
| Munificence | | 2.932** | | 2.604** |
| | | (0.3881) | | (0.4829) |
| Concentration | | 0.0554 | | 0.0492 |
| | | (0.2649) | | (0.2330) |
| %CNC machines | | 0.0010* | | 0.0007 |
| | | (0.0005) | | (0.0006) |
| Interdependence | | 0.0391** | | 0.0152 |
| | | (0.0140) | | (0.0134) |
| Voluntary restraint | | −0.0143 | | −0.0296* |
| | | (0.0137) | | (0.0131) |
| *Strategy variables* | | | | |
| Efficiency | | | −0.2672** | −0.2301* |
| | | | (0.0865) | (0.1071) |
| Capital expenditures | | | 0.0002 | 0.0006 |
| | | | (0.0004) | (0.0005) |
| Advertising intensity | | | −0.0394** | −0.0218* |
| | | | (0.0095) | (0.0093) |
| %Exports | | | 0.0005* | 0.0007* |
| | | | (0.0002) | (0.0003) |
| Market share | | | −0.1468† | −0.0446 |
| | | | (0.0914) | (0.1109) |
| Adjusted $R^2$ | 0.470 | 0.562 | 0.450 | 0.536 |
| Log likelihood | 442.05 | 513.13 | 455.79 | 527.33 |
| N | 300 | 300 | 300 | 300 |

†$p < 0.10$; *$p < 0.05$; ** $p < 0.005$. Standard errors in parentheses. All independent variables lagged by 1 year.

(1983) realized strategy dimensions we focused on: efficiency, asset parsimony, differentiation, and scale/scope.

Using these constructs, we developed regression models to examine the impact of strategy and the environment on firm-level profitability and growth.

**Environment and performance**

Hypothesis 1 predicted that environmental 'munificence' will be positively related to firm-level performance. Results indicate that 'munifi-cence' is positive and significantly related to ROS, and growth. Hence, we find strong support for Hypothesis 1. Hypothesis 2 predicted that industry 'concentration' will be positively related to firm-level performance. Results indicate that this relationship fails to reach statistical significance in both ROS and ΔSALES models. Thus, in the context of this industry we find no support for Hypothesis 2. While arguments have been presented from both a positive and negative relationship in prior studies (cf. Hill and Hansen, 1991), our results suggesting a lack of relationship between 'capital expenditures' and performance

Table 3.  GLS regression results on growth

| | Dependent variable: $\Delta SALES_t$ | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| Constant | −0.0823* | −0.0498** | −0.1597* | −0.5226** |
| | (0.0341) | (0.0721) | (0.0670) | (0.0978) |
| $\Delta SALES_{(t-1)}$ | 0.0020* | −0.0001 | 0.0020* | 0.0001 |
| | (0.0008) | (0.0009) | (0.0009) | (0.0010) |
| Size (log of employees | 0.0149* | 0.0205** | 0.0179* | 0.0234** |
| | (0.0057) | (0.0060) | (0.0082) | (0.0079) |
| *Environmental variables* | | | | |
| Munificence | | 2.685** | | 2.766** |
| | | (0.4529) | | (0.4622) |
| Concentration | | −0.2360 | | −0.3265 |
| | | (0.3782) | | (0.4032) |
| %CNC machines | | 0.0033** | | 0.0031** |
| | | (0.0008) | | (0.0009) |
| Interdependence | | 0.0761** | | 0.0733** |
| | | (0.0221) | | (0.0243) |
| Voluntary restraint | | −0.0268 | | −0.0239 |
| | | (0.0199) | | (0.0214) |
| *Strategy variables* | | | | |
| Efficiency | | | 0.0750 | 0.0203 |
| | | | (0.0663) | (0.0686) |
| Capital expenditures | | | −0.0004 | −0.0003 |
| | | | (0.0012) | (0.0013) |
| Advertising intensity | | | 0.0027 | 0.0071 |
| | | | (0.0093) | (0.0100) |
| %Exports | | | 0.0000 | −0.0001 |
| | | | (0.0005) | (0.0005) |
| Adjusted $R^2$ | 0.077 | 0.265 | 0.052 | 0.258 |
| Log likelihood | 361.11 | 406.28 | 365.24 | 406.80 |
| $N$ | 300 | 300 | 300 | 300 |

$\dagger p < 0.10$; $* p < 0.05$; $** p < 0.005$. Standard errors in parentheses. All independent variables lagged by 1 year.

are perhaps due to the intense competition among firms in the industry. Given the intense rivalry of Japanese domestic markets (Ito and Pucik, 1993), it is difficult for the market leaders to exercise control over prices. Moreover, the segmented nature of this industry is another reason why higher concentration need not necessarily translate into higher performance.

Hypothesis 3 predicted that technological change, from conventional machine tools to CNC machine tools, will be related negatively to firm-level performance. With the exception of Model 2 (Table 2), we find that the technological change

variable '%CNC machines' has no effect on ROS. However, it is significant and positively related to $\Delta SALES$ (see Table 3). Thus, contrary to prior arguments regarding technological change (e.g., Tushman and Anderson, 1986; Anderson and Tushman, 1990), the results found here indicate that the technological change variable is not negatively related to firm-level performance.

Anderson and Tushman (1990) argue technological change may prove beneficial if it is competence enhancing, that is, if it builds on established routines and competencies of the firm. The shift to computer-based machine tools

represents a competence-destroying change (cf. Carlsson, 1989; Sarathy, 1989). However, despite the extinction of established routines and firm-level competencies and increased R&D expenditures for the industry as a whole, technological change has had no negative impact on firm profitability (see Table 2). Moreover, it is positively related to growth (see Table 3).

Perhaps the lack of negative relationships between technological change and ROS, and the positive relationships between technological change and ΔSALES, can be attributed to the actions taken by MITI and JMTBA in orchestrating the movement of firms to a more advanced technology. As previously mentioned, MITI encouraged a single firm, FANUC, to dominate the production and supply of computer control units so that compatibility among the various products offered by the machine tool firms could be achieved. Furthermore, JMTBA established industry-wide standards for tool-changing mechanisms and size increments to increase technological compatibility and reduce manufacturing costs. Additionally, firms in the industry were strongly encouraged by MITI to focus on export markets using standardized but technologically advanced machine tool products. Therefore, it appears that the presence of powerful mediating agencies such as MITI and industry trade associations during periods of technological ferment can be beneficial. Because Japanese firms are often members of semi-formally organized trans-industrial networks (Kumon, 1992), MITI and other agencies are able to utilize their influential positions in these networks both to create mechanisms and to assist firms during periods of change, thereby benefiting the entire industry.

Hypothesis 4 argued that the 'voluntary restraint' agreement signed between Japan and the U.S.A. will be negatively related to firm-level performance. We use a dummy variable, 'voluntary restraint', to examine the impact of a voluntary export trade agreement on performance. Results indicate that this variable is significant and negatively related to the ROS, but fails to reach significance in the growth models. The lack of significance of this variable in the growth models is perhaps due to the growing reliance on transplant production within the U.S.A. Also, the introduction of the trade restrictions by the U.S.A. forced the Japanese

machine firms to increase exports to Southeast Asian and European countries (NMTBA, 1991). Thus, our findings provide some support for Hypothesis 4.

Hypothesis 5 predicted that 'interdependence' due to foreign imports will be negatively related to performance. Given that 'interdependence' is operationalized as a zero/one variable, with a value of zero assigned to the year with the highest number of machine tool imports, the positive signs in the models are in the expected direction. This variable is positive and significantly related to the ΔSALES, but fails to reach significance in the ROS model. In other words, as the amount of foreign imports entering the Japanese market increased, these imports impacted performance of domestic firms negatively. Thus, we find some support for Hypothesis 5.

In summary, these results suggest the strong role played by the environment on firm-level performance. Interestingly enough, the regression results regarding Hypothesis 1 (munificence and performance) and Hypothesis 5 (interdependence and performance) are generally consistent with prior U.S. studies (cf. Capon *et al.*, 1990), suggesting that results found in the context of the U.S.A. are also applicable in the Japanese context. But, the evidence based on U.S. studies regarding industry concentration and technological change seem less applicable to firms in the JMTI. However, more studies examining technological change and its influence on performance in the Japanese context are needed before strong conclusions can be drawn. Finally, the use of voluntary restraints to restrict Japanese imports into the U.S.A. had a negative impact on ROS.

Having investigated the impact of environmental variables on performance, we now discuss the role played by *realized* strategy in influencing firm-level performance.

### Strategy and performance

Hypothesis 6 predicted that an 'efficiency'-driven strategy will be related positively to ROS. Since smaller values suggest greater efficiency, the negative signs in the models are as expected. Results in Table 2 indicate that 'efficiency' is negative and significantly related to ROS. However, the coefficient of this variable is not

significant in the growth models. Hence, we find support for the argument that greater operating efficiency translates into higher financial profitability.

Hypothesis 7 predicted that a lack of asset parsimony due to capital intensity and increased capital expenditures will negatively influence profitability. However, our findings indicate that coefficients of the 'capital expenditures' variable fail to reach statistical significance. Therefore, in comparison with the results in the U.S. context (e.g. Hambrick and Lei, 1985; Hambrick and MacMillan, 1984), results for the JMTI suggest no such negative relationship. As argued earlier, it is plausible that the increased productivity achieved through a combination of efforts (e.g., investments in automation, product standardization, and the greater volume of production) benefited firms in the industry (cf. Sarathy, 1989).

Hypothesis 8 predicted that a differentiation strategy based on 'advertising intensity' is negatively related to ROS. Our results indicate a negative relationship between 'advertising intensity' and ROS. However, even though the relationship between this variable and growth is positive, it is not statistically significant. Therefore, our findings provide partial support for Hypothesis 8. This finding is consistent with the results based on the PIMS studies (based on firms in industrial markets in the U.S.A.) as reported by Buzzell and Gale (1987).

This finding, however, raises the question as to why machine tool firms spend resources on advertising despite a negative relationship. A further analysis on mean advertising intensity ratios over the relevant time period under study indicated that, on the average, advertising intensity ratio for all firms in the sample was low initially (during 1979 and 1980) and then increased during the 1980s, only to taper off in the late 1980s and 1991. For example, in 1980 the mean average advertising expense for all firms in the industry was 0.5 percent of sales, and this amount was doubled and accounted for 1 percent of sales by 1987. However, it dropped to 0.7 percent of sales in 1991. This increase in average advertising intensity during the early 1980s was perhaps due to the intense competition among firms as they attempted to establish themselves as technological leaders in CNC products. Also, during this period exports

(primarily to the U.S.A.) began to increase, and firms were attempting to make greater inroads into the U.S. markets. For example, in 1985, exports accounted for more than 30 percent of all orders received (JMTBA, 1992). Given that much of the advertising expenses for machine tool firms pertain to attending trade shows, the focus on U.S. and other foreign markets forced firms to increase advertising expenses.

It is also possible that the number of models and options offered by Japanese machine tool makers also increased with the emergence of the new machine tool technology, thereby requiring more resources for advertising (i.e., print advertising in trade journals) and product brochures. Perhaps the marginal revenues generated from this increased advertising and promotion were insufficient to generate a positive relationship between advertising intensity and profitability. Finally, it is also likely that firms employ advertising as a defensive strategy. Firms perhaps perceived that the demand for their products was likely to decline relative to competitors without continued resources being allocated for advertising, especially during the period when the technology was changing.

Hypothesis 9 predicted that a scale/scope strategy based on 'exports' will be related positively to both firm profitability and growth. Results suggest that the 'exports' variable is related positively to ROS, but is unrelated to growth. Perhaps the lack of a significant relationship between 'exports' and growth may be due to the growing number of Japanese transplants in the U.S.A. Since the imposition of the voluntary restraint agreement in 1986 there has been a steady increase in the number of machine tool firm transplants into the U.S.A. (JMTBA, 1992).[13]

We also predicted that 'market share' will be positively related to ROS. However, the 'market share' variable is not related to ROS. This result is plausible because the machine tool industry consists of firms competing in many different market/product segments (e.g., turning machines, drilling machines, and special-purpose machines).

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[13] For example, Makino Milling Machine started U.S. production in 1981, followed by Toyoda Machine Works in 1986, Miyano Machinery in 1989, Okamoto Machine Tool Works in 1987, Okuma Machine Works in 1987, Mitsubishi Heavy Industries in 1989, and Mitsubishi Electric in 1989.

Therefore, firms can be financially successful without dominating the industry by pursuing a focused strategy.[14]

In summary, we find that a low-cost strategy based on efficiency and an export-driven scale/ scope strategy are both related positively to ROS. Also, a differentiation strategy based on advertising intensity is negatively related to ROS. An asset parsimony strategy based on capital expenditures and a market-share-based scale/ scope strategy are both unrelated to firm-level profitability and growth. Finally, none of the strategy variables influenced growth.

### A comparison of the relative effects

To highlight the relative importance of the environmental and strategy variables, we compare the full model with the restricted models containing either the set of environment or strategy variables. Specifically, we determine the relative importance of a set of variables over another, by performing $\chi^2$-tests involving both the full and restricted models. Our analyses are consistent with procedures used by other researchers to study the relative importance of one set of variables over another (e.g., Hansen and Werner-felt, 1989).

Figure 1 shows the results for ROS models. The restricted model containing the environmental variables is a significant improvement over the base model ($\Delta\chi^2 = 142.16$, 5 d.f., $p < 0.005$). Further, the restricted model containing the strategy variables is also a significant improvement over the base model ($\Delta\chi^2 = 27.48$ 5 d.f., $p < 0.005$). The inclusion of both the environmental and strategy variables improves the full model significantly over the environmental model ($\Delta\chi^2 = 28.4$, 5 d.f., $p < 0.005$) and the strategy model ($\Delta\chi^2 = 143.08$, 5 d.f., $p < 0.005$).

Figure 2 shows the results for growth models. By including the environmental variables we significantly improve the restricted environment model over the base model ($\Delta\chi^2 = 90.34$, 5 d.f., $p < 0.005$). However, the restricted strategy model is only a marginal improvement over the base model ($\Delta\chi^2 = 8.78$, 4 d.f., $p < 0.10$). Also,
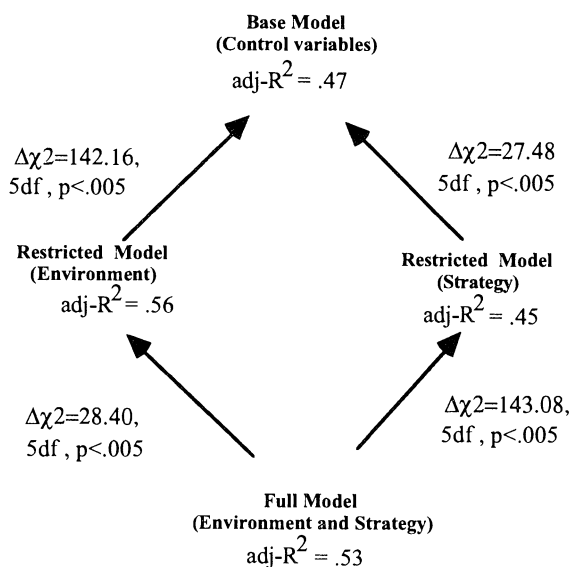
[14] Market share variable was not included in the growth models owing to multicollinearity. This variable was found to be highly correlated with size, our control variable, in Table 3.



Figure 1.   Variance decomposition model: ROS test for presence of factor effects
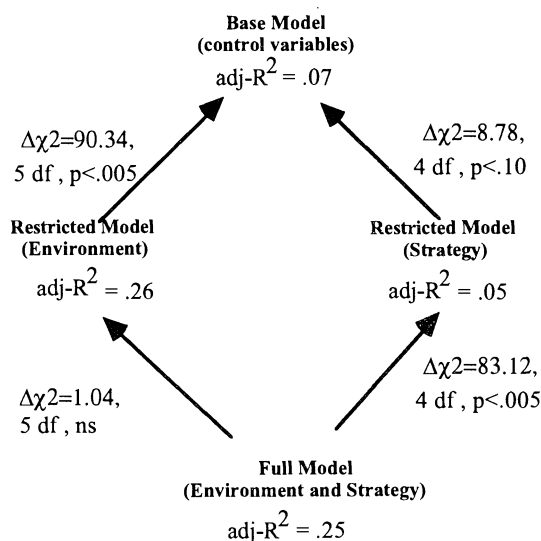


Figure 2.   Variance decomposition model: $\Delta$SALES test for presence of factor effects

whereas the full model is not a significant improvement over the restricted environmental model ($\Delta\chi^2 = 1.04$, 5 d.f., n.s.), it is a significant improvement over the restricted strategy model ($\Delta\chi^2 = 83.12$, 4 d.f., $p < 0.005$).

These results suggest the following conclusions. Firm profitability in the machine tool industry is impacted by both the environment and strategy

variables. However, the relative effects of the environmental variables are stronger than strategy variables in predicting profitability. Growth, on the other hand, is strongly influenced by environmental variables, and the strategy variables have little or no impact on growth.

This lack of relationship between strategy and growth can be explained by the fact that demand for machine tool products is 'derived' from other industries. Specifically, Japanese machine tool firms depend upon the automobile industry for a large proportion of their demand. Starting in the late 1970s, the Japanese automobile industry experienced phenomenal growth and, perhaps, it is this growth that was responsible for environment munificence in the machine tool industry. Also, during this time, Japanese firms had easy access to inexpensive financial capital that made capital equipment expansion relatively less burdensome.[15] As mentioned earlier, labor shortages faced in manufacturing industries in Japan and the enactment of the environmental regulations further increased munificence. Hence, it is plausible that the confluence of such events are responsible for the strong effects of the environment variables, relative to the strategy variables, in our models. Although the role played by strategies (e.g., advertising intensity, exports, and capital expenditures) can impact growth, it is perhaps secondary to the general state of the national economy in industries with 'derived' demand such as the JMTI. Therefore, it is not surprising that environmental variables are highly significant in the growth models, and that the effect of strategy variables is nonexistent.

In contrast, financial profitability ratio, such as ROS, generally measures the ability of a firm to generate profits. Whereas the role played by the environment (e.g., exogenous variables) is significant in the ROS models, the role played by strategy (e.g., endogenous variables) is also quite significant. This is because strategy involves not only the positioning of the firm in a favorable environment, but also the exploitation of opportunities in that environment (Hofer and Schendel,

1978; Porter, 1980). Hence, given a certain demand, the profitability of firms is dependent upon the effectiveness with which they exploit opportunities and minimize threats.

Besides the strategy and environmental variables, we include size and lagged dependent variables as our control variables. We find that 'size' variable is positive and significant, indicating that size does influence growth (see Table 3). However, larger size may not be related to profitability as evidenced by the insignificance of 'market share' variables in the profitability models.

## IMPLICATIONS

First, the findings presented in this paper indicate that firm-level strategies and the environment facing the machine tool industry played significant roles in the performance of JMTI firms. Interestingly, we find that while both strategy and environmental variables are significantly related to firm-level profitability (i.e., ROA), only the environmental variables, such as munificence and technological change, predict growth (see Table 4). In other words, environmental variables are better predictors of firms' growth than the strategies deployed by firms in this industry.

This finding confirms the observations of Kagono *et al.* (1985), who argued that the munificent environment faced by Japanese firms is one of the most important reasons for their impressive growth. Relatedly, one of the advantages experienced by Japanese machine tool firms is that many metal-working firms in a broad range of manufacturing industries did not close down their domestic factories, as American firms did (Dertouzos *et al.*, 1989). In this sense, the results found here also support Porter's (1990) argument that nature of the home demand for an industry's product or service is critical for *national* competitive advantage. According to Porter (1990: 86):

> The most important influence of home demand on competitive advantage is through the mix and character of home buyer needs. . . . Nations gain competitive advantage in industries or industry segments where the home demand gives local firms a clearer or earlier picture of buyer needs than foreign rivals can have.

On the other hand, it is also possible that the

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[15] Japanese machine tool firms typically have debt-to-equity ratios of 150 percent to over 550 percent, indicating that they had easier access to financial capital than U.S. firms (UTSIC, xi). Perhaps the easier access to capital, along with a Japanese emphasis on growth over profitability, suggests that the efficient use of capital assets was of less concern for Japanese firms.

lack of significant relationships between the strategy variables and growth occurs because machine tool sales in Japan are influenced by sources of competitive advantage other than those investigated here, such as distribution channels, supplier relations, and delivery (Abegglen and Stalk, 1985).

Second, we found that technological change is unrelated to ROS, and positively related to growth. These results, along with the fact that Japanese firms are now global market share leaders, suggest that technological change does not always lead to poor performance as discussed in U.S.-based studies (e.g., Tushman and Anderson, 1986). Also, our results indicate that the actions taken by MITI and their insistence that the industry focus on CNC technology has paid off handsomely for the firms in the JMTI. In this context, Dertouzos *et al.* (1989: 236) note:

> In recent years such newly industrialized countries as South Korea, Taiwan, and Brazil have begun to displace Japan in low-cost lathes and drills; most recently these new entrants in the markets have begun to switch more of their production to numerically controlled (NC) machines. The Japanese, meanwhile, have been moving toward higher precision with more advanced computer controls, and they are building highly integrated machining systems.

These developments suggest that Japanese firms are now entering new segments of the market and preparing for future changes in machine tool technology by focusing on manufacturing and marketing turnkey systems and more customized machines, and by developing capabilities in precision machining to challenge the European supremacy in those markets. If the past is any indication, such a shift is likely to be related positively to firm-level performance. Furthermore, Japanese manufacturers may be preparing for 'the next stage in global competition, in which competitive advantage will be based on technological, rather than manufacturing superiority' (Ito and Pucik, 1993: 72). This movement to more advanced machine tool systems has the potential to influence machine tool firms both in the U.S.A. and Germany significantly.

Our findings suggest many new avenues for future research. First, we examined the direct role played by the environment *and* strategy on firm-level performance. Future researchers can use and test the contingency theory argument that firms which match their strategies with the requirements of the environment will achieve superior performance (Hambrick, 1983; Hofer and Schendel, 1978; Porter, 1980). Thus, researchers can examine how a 'fit' between certain strategies and certain environment conditions may lead to superior performance (cf. Venkatraman, 1989).

Second, due to the nature of data sources used, we were unable to investigate more fine-grained strategy constructs such as product quality, firm reputation, delivery performance, and supplier and distribution relations. These variables have been shown to affect firm performance in other Japanese industries (Abegglen and Stalk, 1985; Smothers, 1990). The inclusion of these variables can enhance our understanding of the strategy–performance relationship.[16] Similarly, we suggest the inclusion of additional environmental variables that capture the roles played by Japanese institutions, such as MITI and the Ministry of Finance. These agencies aid firms through industry-wide R&D grants and through changes in depreciation laws that stimulate demand for industrial equipment. The inclusion of such environmental variables might provide a richer explanation of what drives performance.

Third, R&D spending and the commitment of Japanese firms to gain global market share are often cited as reasons for the decline of the American share of the world market (cf. Franko, 1989). R&D investments have played an important role in the JMTI because of technological changes in the industry. Hence, future researchers should incorporate R&D investments in their investigations. As mentioned earlier, we were unable to include R&D measures in our analyses, because such figures are not available in the NEEDS data base for the early years (i.e., 1979–83). However, R&D figures are available from 1984 onwards, so future

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[16] According to Dertouzos *et al.* (1989: 238), customers in the U.S.A. often waited from 18 to 24 months for machine tools ordered during busy periods. Such long delays led to many cancellations if the economy subsequently slowed down. More significantly, this strategy made the domestic suppliers highly vulnerable to machines imported from Japan, which were offered at lower prices on quick delivery schedules.

researchers should include an R&D measure in their analyses of the machine tool industry.[17]

Fourth, given our broad focus, we ignored intra-industry differences in performance. An industry generally consists of many different groups and the strategy–performance relationships across these groups tend to vary (Porter, 1980). Thus, researchers should attempt both to isolate groups within this industry and to examine how strategy–performance relationships vary over time among the groups (e.g., Cool and Dierickx, 1993).

Fifth, we studied the JMTI because it is a spectacularly successful example of Japanese business prowess. However, given the global nature of the machine tool industry and the growing interdependence among the major machine tool-exporting nations (e.g., the U.S.A., Germany and Japan), comparative studies examining the relative impact of strategy and environment variables on performance using firms from multiple nations are also needed. Anecdotal evidence suggests that the Germans and the Japanese have taken quite different approaches to advancing their machine tool industries. For example, German firms stress high precision and special capabilities, whereas the Japanese seem to have concentrated on offering reliable standard machines at low prices (Dertouzos *et al.*, 1989: 233). Thus, a study of the global machine tool industry may provide significant results.

Finally, while the number of studies examining non-U.S. firms is growing (e.g., Tan and Litschert, 1994), none have investigated the relative impacts of strategy and the environment on performance over a long-time horizon. This study is unique in that it identifies the roles of strategy and environmental constructs over time and examines their impact on performance. Future studies are needed to uncover and highlight the roles played by firm-level strategies and the environment in explaining performance.

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[17] Following an anonymous reviewer's suggestion, we incorporated an R&D intensity measure (i.e., R&D/sales) as an additional variable and recomputed our regression models. We had data on R&D expenses for only 14 out of the 25 firms in our sample. Our results indicate no statistically significant relationship between R&D intensity and the dependent variables.

## REFERENCES

Abegglen, J. C. and G. Stalk (1985). *Kaisha*. Basic Books, New York.

Abernathy, W. J. and K. B. Clark (1985). 'Innovation: Mapping the winds of creative destruction', *Research Policy*, 14, pp. 3–22.

Ackoff, R. W. (1970). *A Concept of Corporate Planning*. Wiley, New York.

Anderson, P. and M. L. Tushman (1990). 'Technological discontinuities and dominant designs: A cyclical model of technological change', *Administrative Science Quarterly*, 35, pp. 604–633.

Bain, J. S. (1951). *Barriers to New Competition*. Harvard University Press, Cambridge, MA.

Barnett, W. R. and G. R. Carroll (1987). 'Competition and mutualism among early American telephone companies', *Administrative Science Quarterly*, 32, pp. 400–421.

Buzzell, R. D. and B. T. Gale (1987). *The PIMS Principles: Linking Strategy to Performance*. Free Press, New York.

Buzzell, R. D., B. T. Gale and R. G. M. Sultan (1975). 'Market share, a key to profitability', *Harvard Business Review*, 53(1), pp. 97–107.

Capon, N., J. U. Farley and S. Hoenig (1990). 'Determinants of financial performance: A meta-analysis', *Management Science*, 36(10), pp. 1143–1159.

Carlsson, B. (1989). 'Small-scale industry at a crossroads: U.S. machine tools in global perspective', *Small Business Economics*, 1, pp. 245–261.

Carlsson, B. and E. Taymaz (1993). 'Technological capabilities and international competitiveness in the engineering industries', *Review of Industrial Organization*, 8, pp. 293–313.

Caves, R. E. (March 1980). 'Industrial organization, corporate strategy and structure', *Journal of Economic Literature*, 18, pp. 64–92.

Collis, D. J. (1987). 'The machine tool industry', *Harvard Business School Case Study # 9-388-117*, pp. 1–31.

Collis, D. J. (1988). 'The machine tool industry and

industrial policy, 1955–1992'. In A. M. Spence and H. A. Hazard (eds.), *International Competitiveness*. Ballinger, Cambridge, MA, pp. 75–114.

Cool, K. and I. Dierickx (1993). 'Rivalry, strategic groups and firm profitability', *Strategic Management Journal*, **14** (1), pp. 47–60.

Corey, E. R. (1991). *Industrial Marketing: Cases and Concepts*. Prentice-Hall, Englewood Cliffs, NJ.

Cyert, R. and J. March (1963). *A Behavioral Theory of the Firm*. Prentice-Hall, Englewood Cliffs, NJ.

Dertouzos, M. L., R. K. Lester and R. M. Solow (1989). *Made in America: Regaining the Productive Edge*. MIT Press, Cambridge, MA.

Dess, G. and G. Beard (1984). 'Dimensions of organizational task environments', *Administrative Science Quarterly*, **29**, pp. 52–73.

Franko, L. G. (1989). 'Global corporate competition: Who's winning, who's losing, and the R&D factor as one reason why', *Strategic Management Journal*, **10**(5), pp. 449–474.

Galbraith, C. R. and D. Schendel (1983). 'An empirical analysis of strategy types', *Strategic Management Journal*, **4**(2), pp. 153–173.

Ginsberg, A. (1988). 'Measuring and modeling changes in strategy: Theoretical foundations and empirical directions', *Strategic Management Journal*, **9** (6), pp. 559–575.

Greene, B. (1990). *Econometric Analysis*. Macmillan, New York.

Greene, B. (1992). *LIMDEP*, Version 6.0. Econometric Studies Inc., New York.

Hambrick, D. C. (1983). 'High profit strategies in mature capital goods industries: A contingency approach', *Academy of Management Journal*, **26**, pp. 687–707.

Hambrick, D. C. and D. Lei (1985). 'Towards an empirical prioritization of contingency variables for business strategy', *Academy of Management Journal*, **28**, pp. 763–788.

Hambrick, D. C. and I. C. MacMillan (1984). 'Asset parsimony: Managing assets to manage profits', *Sloan Management Review*, **25**, pp. 67–74.

Hambrick, D. C., I. C. MacMillan and D. L. Day (1982). 'Strategic attributes and performance in the BCG matrix: A PIMS-based analysis of industrial product businesses', *Academy of Management Journal*, **25**, pp. 510–531.

Hansen, G. S. and B. Wernerfelt (1989). 'Determinants of firm performance: The relative importance of economic and organizational factors', *Strategic Management Journal*, **10** (5), pp. 399–411.

Hatten, K. J., D. E. Schendel and A. C. Cooper (1978). 'A strategic model for the U.S. brewing industry: 1952–1971', *Academy of Management Journal*, **21**, pp. 592–610.

Haveman, H. (1993). 'Organizational size and change: Diversification in the Savings and Loan industry after deregulation', *Administrative Science Quarterly*, **38**, pp. 20–50.

Hill, C. W. L. and G. S. Hansen (1991). 'A longitudinal study of the cause and consequences of changes in diversification in the U.S. Pharmaceutical industry, 1977–1986', *Strategic Management Journal*, **12**(3), pp. 187–199.

Hofer, C. W. and D. E. Schendel (1978). *Strategy Formulation: Analytical Concepts*. West Publishing, St. Paul, MN.

Ito, K. and V. Pucik (1993). 'R&D spending, domestic competition, and export performance of Japanese manufacturing firms', *Strategic Management Journal*, **14**(1), pp. 61–75.

Jacobson, R. (1990). 'Unobservable effects and business performance', *Marketing Science*, **9**(1), pp. 74–85.

Jacobsson, S. (1986). *Electronics and Industrial Policy*. Allen & Unwin, London.

JMTBA (1989). *The Japanese Machine Tool Industry: Current Status and Long-Range Outlook*. Report published by Japan Machine Tool Builders' Association, Tokyo, Japan.

JMTBA (1992). *Annual Report, 1992*. Report published by Japan Machine Tool Builders' Association, Tokyo, Japan.

Kagono, T., K. Sakakibara, I. Nonaka and A. Okumura (1985). *Strategic Vs. Evolutionary Management: A US–Japan Comparison of Strategy and Organization*. North-Holland, Amsterdam.

Kobrin, S. J. (1991). 'An empirical analysis of the determinants of global integration', *Strategic Management Journal*, Summer Special Issue, **12**, pp. 17–31.

Kumon, S. (1992). Japan as a network society. In S. Kumon and H. Rosovsky (eds.), *The Political Economy of Japan*, Vol. 3. Stanford University Press, Stanford, CA, pp. 109–141.

MacKnight, S. (September 1984). *US–Japan Competition in Machine Tools: An Update*. JEI Report, No. 36A, Japan Economic Institute, Washington, D.C.

Miles, R. E., C. S. Snow and A. D. Meyer (1978). *Organizational Strategy, Structure, and Process*. McGraw-Hill, New York.

Mintzberg, H. (Fall 1978). 'The strategy concept 1: Five Ps for strategy', *California Management Review*, pp. 11–23.

Mintzberg, H. (1987). 'Crafting strategy', *Harvard Business Review*, **65**(4), pp. 66–75.

Netter, J., W. Wasserman and M. H. Kutner (1989). *Applied Regression Models*. Richard D. Irwin, Homewood, IL.

NMTBA (1991). *1991–1992 Economic Handbook of the Machine Tool Industry*. Report published by the National Machine Tool Builders' Association, McClean, VA.

Porter, M. E. (1980). *Competitive Strategy*. Free Press, New York.

Porter, M. E. (1990). *Competitive Advantage of Nations*. Free Press, New York.

Pugel, T. (1980). 'Foreign trade and U.S. market performance', *Journal of Industrial Economics*, **24**(2), pp. 119–129.

Reger, R. K. and A. Huff (1993). 'Strategic groups: A cognitive perspective', *Strategic Management Journal*, **14**(2), pp. 103–124.

Sarathy, R. (Spring 1989). 'Japan's machine tool industry', *California Management Review*, pp. 132–160.

Scherer, F. M. (1980). *Industrial Market Structure*

and *Economic Performance*. Houghton & Mifflin, Boston, MA.

Schumpeter, J. E. (1934). *The Theory of Economic Development*. Oxford University Press, New York.

Scott, R. W. (1981). *Organizations: Rational, Natural and Open Systems*. Prentice-Hall, Englewood Cliffs, NJ.

Smothers, N. P. (1990). Patterns of Japanese strategy: Strategic combinations of strategies, *Strategic Management Journal*, **11**(7), pp. 521–533.

Tan, J. J. and R. J. Litschert (1994). 'Environment-strategy relationship and its performance implications: An empirical study of the Chinese Electronics Industry', *Strategic Management Journal*, **15**(1), pp. 1–21.

Tushman, M. L. and P. Anderson (1986). 'Technological discontinuities and organizational environments', *Administrative Science Quarterly*, **31**, pp. 439–465.

USITC (1983). *Competitive Assessment of the U.S. Metalworking Machine Tool Industry*. United States International Trade Commission Publication #1428. Government Printing Press, Washington, DC.

Venkatraman, N. (1989). 'The concept of fit in strategy research: Towards a verbal and statistical correspondence', *Academy of Management Review*, **14**, pp. 434–444.

Venkatraman, N. and V. Ramanujam (1986). 'Measurement of business performance in strategy research: A comparison of approaches', *Academy of Management Review*, **11**, pp. 801–814.

Webster, Jr., F. E. (1990). *Industrial Marketing Strategy*. Wiley, New York.

Yasai-Ardekani, M. (1989). 'Effects of environmental scarcity and munificence on the relationship of context to organizational structure', *Academy of Management Journal*, **32**, pp. 131–156.