Examining the penrose effect in an international business context: the dynamics of japanese firm growth in u.s. industries

Danchi Tan
National Chengchi University

Joseph T. Mahoney
University of Illinois at Urbana−Champaign

Abstract

Penrose (1959) theoretically developed the research proposition that the finite capacities of a firm's internally experienced managers limit the rate at which the firm can grow in a given period of time. One empirical implication that follows logically from this line of reasoning is that a fast−growing firm will eventually slow down its growth in the subsequent time period because its firm−specific management team, which is posited to be inelastic at least in the short run, is unable to handle effectively the increased demands that are placed on these internally experienced managers due to increased complexity as well as the time and attention that the new managers require from these internally experienced managers. Consequently, inefficiency in the firm's current operations will follow if the firm maintains its high rate of growth. The research proposition that a firm cannot remain operationally effective if it maintains high rates of growth in successive time periods, and that consequently those firms with foresight typically will slow down their growth in the subsequent time period is known as the "Penrose effect" in the research literature, and this effect of dynamic adjustment costs has been examined and corroborated in a few empirical research studies. However, researchers have not yet examined the Penrose effect in an international business context. The current paper examines the Penrose effect in an international business context by exploring whether Japanese firms achieve high growth in consecutive time periods in the entered U.S. industries. The empirical results indicate that, consistent with Penrose's (1959) resource− based theory prediction, in general, Japanese firms did not maintain high employment growth in two consecutive time periods following their entry into U.S. industries. We also find empirically that for Japanese multinational firms that entered in U.S. industries where the extent of knowledge tacitness, globalization, and unionization was high, rapid expansion growth in one time period had negative impacts on growth in the subsequent time period. Thus, dynamic adjustment costs limit the rate of the growth of the firm and the development of dynamic capabilities in this international business context, which suggests that the Penrose effect may be widely applicable to international business and corporate strategy.

We are grateful to Richard Levin, Alvin Klevorick, Richard Nelson, and especially Sidney Winter for providing us with the data from their paper in Brookings Papers on Economic Activity (1987).
Published: 2003
URL: http://www.business.uiuc.edu/Working_Papers/papers/03−0113.pdf

EXAMINING THE PENROSE EFFECT IN AN INTERNATIONAL BUSINESS CONTEXT: THE DYNAMICS OF JAPANESE FIRM GROWTH IN U.S. INDUSTRIES

BY

Danchi Tan
Assistant Professor
National Chengchi University
64, Chih-nan Rd., Sec. 2
Wenshan, Taipei 11623
Taiwan
Tel: +886 2 2939-3091 ext 81139
Fax: +886 2 2938-7699
Email: **dctan@nccu.edu.tw**

and

Joseph T. Mahoney
Professor of Strategy
Department of Business Administration
College of Business
University of Illinois at Urbana-Champaign
339 Wohlers Hall
1206 South Sixth Street
Champaign, IL 61820
217-244-8257 (office)
217-244-7969 (fax)
josephm@uiuc.edu

We are grateful to Richard Levin, Alvin Klevorick, Richard Nelson, and especially Sidney Winter for providing us with the data from their paper in Brookings Papers on Economic Activity (1987).

EXAMINING THE PENROSE EFFECT IN AN INTERNATIONAL BUSINESS CONTEXT: THE DYNAMICS OF JAPANESE FIRM GROWTH IN U.S. INDUSTRIES

Abstract

Penrose (1959) theoretically developed the research proposition that the finite capacities of a firm's internally experienced managers limit the rate at which the firm can grow in a given period of time. One empirical implication that follows logically from this line of reasoning is that *a fast-growing firm will eventually slow down its growth in the subsequent time period* because its firm-specific management team, which is posited to be inelastic at least in the short run, is unable to handle effectively the increased demands that are placed on these internally experienced managers due to increased complexity as well as the time and attention that the new managers require from these internally experienced managers. Consequently, inefficiency in the firm's current operations will follow if the firm maintains its high rate of growth. The research proposition that a firm cannot remain operationally effective if it maintains high rates of growth in successive time periods, and that consequently those firms with foresight typically will *slow down their growth in the subsequent time period* is known as the "Penrose effect" in the research literature, and this effect of dynamic adjustment costs has been examined and corroborated in a few empirical research studies. However, researchers have not yet examined the Penrose effect in an international business context.

The current paper examines the Penrose effect in an international business context by exploring whether Japanese firms achieve high growth in consecutive time periods in the entered U.S. industries. The empirical results indicate that, consistent with Penrose's (1959*)* resource-based theory prediction, in general, Japanese firms did not maintain high employment growth in two consecutive time periods following their entry into U.S. industries. We also find empirically that for Japanese multinational firms that entered in U.S. industries where the extent of knowledge tacitness, globalization, and unionization was high, rapid expansion growth in one time period had negative impacts on growth in the subsequent time period**.** Thus, dynamic adjustment costs limit the rate of the growth of the firm and the development of dynamic capabilities in this international business context, which suggests that the Penrose effect may be widely applicable to international business and corporate strategy.

Keywords: The Penrose effect, dynamic adjustment costs, dynamic capabilities

Section 1: Introduction

How a firm evolves over time has been an important issue in the fields of strategic management and industrial organization economics (Kor and Mahoney, 2000; Nelson and Winter, 1982). Looking at the historical business record from an organizational capabilities and technology trajectories perspective, Chandler (1990) suggests that modern business enterprises arise from the economies of scale and scope that are made possible by the development of new technologies. Furthermore, a number of researchers who approach these business issues more deductively in economic science come to a similar conclusion to Chandler's (1990) more inductive business history methodology by maintaining that a firm's behavior is best understood as a path-dependent process, and that organizational capabilities develop dynamically (see e.g., Nelson and Winter, 1982; and Teece, Pisano, and Shuen, 1997). All agree that history matters.

In the current paper, we contribute to the dynamic capabilities research literature (Teece, Pisano and Shuen, 1997) and maintain that the history of a firm's strategic moves will matter a great deal in the operational effectiveness of their subsequent moves. In particular, we argue from a resource-based perspective (Penrose, 1959) that a firm that attempts to alter its resource base and to develop its organizational capabilities to meet market change adaptively is likely to incur ***dynamic adjustment costs,*** and we examine empirically to what extent a firm that expands internationally incurs such adjustment costs.

Dynamic adjustment costs occur when adjustments of productive resources (such as hiring new employees and new managers) disrupt current operations (Hamermesh and Pfann,

1994; Lucas, 1967; Mortensen, 1973; Treadway, 1970). Due to dynamic adjustment costs, there are limits to the growth rate at which a firm can increase its resource base at any point in time. Our primary goal in the current paper is to make clear that dynamic adjustment costs need to be in the foreground for both empirical testing and theorizing about the rate of the growth of the firm and the development of firm-specific resources and dynamic capabilities.

We focus on a major source of dynamic adjustment costs: the inability of a firm to adjust its managerial resources to the desired level in a timely way to match adaptively to a change in the market (Hay and Morris, 1991; Ingham, 1992; Penrose, 1959; Rubin, 1973; Slater, 1980). Penrose (1959) argues that a firm's expansion requires the services from managers who have experience internal to the firm. Since such managers must be developed within the firm over time and could not be hired from the outside, a firm that needs to maintain effectiveness in its current operations could only increase its managerial resources in a controlled and incremental fashion. A fast-growing firm is likely to incur managerial problems (Slater, 1980), and consequently can achieve only little growth in the subsequent time period. Otherwise, inefficiencies in current operations would result because the new managers will require too much time and attention from the experienced managers.

Thus, in the current paper we emphasize that the research on dynamic adjustment costs (Hay and Morris, 1991) should be joined with research on the firm building dynamic capabilities (Teece, Pisano and Shuen, 1997). To be even more precise, we argue here that Penrose (1959) is the seminal work that connects the dynamic adjustment cost research literature and the

dynamic capabilities research literature. Indeed, both research literatures cite Penrose (1959) as a seminal contribution (see Hay and Morris, 1991 for dynamic adjustment costs; and Teece Pisano and Shuen, 1997 for dynamic capabilities).

When considering some of the empirical research literature on dynamic adjustment costs, the impact of the managerial constraint on firm growth has been cited as the "Penrose effect" in the research literature (Hay and Morris, 1991), and has been examined in a number of empirical research studies (e.g., Gander, 1991; Orser, Hogarth-Scott and Riding, 2000; Shane, 1996; Shen, 1970; and Thompson, 1994). However, there has been little empirical work in examining the Penrose effect in an international business context, which is the focus of the current paper.

The current paper attempts to fill this research gap by examining the Penrose effect in international expansion. The Penrose effect arises from the lack of suitable management for coordinating increased complexity of an organization during its expansion. However, the use of new organizational innovations, such as a multidivisional organizational structure (Chandler, 1962), may help reduce this complexity and hence the need for managerial resources, which in turn may mitigate the Penrose effect. In addition, the need for closely coordinating subsidiaries might be reduced if the subsidiaries are located overseas (Penrose, 1959). As a result, the time and efforts that managers must spend in managing international operations may be reduced. However, the Penrose effect may still exist as the head office must plan international expansion and may have to maintain a certain level of coordination among its overseas units. The current paper, thus, not only tests empirically for the existence of the Penrose effect that has been

corroborated in previous empirical studies, but also suggests a new path for future business research that explores theoretically the conditions under which the Penrose effect is more likely to prevail, and then tests these conditions empirically.

In the next section, we briefly summarize Penrose's (1959) argument on the limitations to the growth of firms and empirical studies that have examined this proposition. We then explore the applicability of Penrose's (1959) argument in an international business context and we propose several conditions that may moderate the Penrose effect in international expansion. Section 3 provides the theory and hypotheses. Section 4 outlines our methodology and section 5 presents our empirical results. We then provide our discussion and conclusions in Section 6.

Section 2: Background

Penrose suggests that a firm can be viewed as "a collection of productive resources" (1959: 24). No matter what industries a firm is in, the firm relies on its managers to direct and coordinate its productive resources, and to capitalize on production opportunities for the firm. However, to provide proper service to the firm, managers must have experience internal to the firm and experience working with other people within the firm as a team (Becker, 1964; Castanias and Helfat, 1991; Penrose, 1959). Consequently, the capacities of these managers (henceforth, *internal managerial capacities*) shape the scope and complexity of activities that a firm can undertake. Since internally experienced managers cannot be hired from outside and must be developed within the firm over time, there are limits to the rate at which a firm can

expand its activities at any time. A fast-growing firm is thus likely to encounter managerial problems because it cannot adjust its managerial resources to the desired level in a timely fashion. To express these ideas compactly: managerial time and attention are the scarce resources that are the binding constraint on the rate of the growth of the firm (Penrose, 1959; Slater, 1980). In other words, dynamic adjustment costs place a limit on the rate of developing and deploying dynamic capabilities

The impact of this managerial constraint on the growth of the firm has been cited as the "Penrose effect" in the research literature and has been empirically examined in a number of studies (Hay and Morris, 1991). One strategic management implication of the Penrose effect is that a fast-growing organization tends to stagnate in the subsequent time period due to managerial limitations. Shen (1970) finds empirically that the Penrose effect was responsible for the negative correlation coefficients between growth rates of 4000 Massachusetts manufacturing plants in 1948-53 and in 1953-57. Shen's (1970) study shows empirical evidence of the Penrose effect at the plant level.

Nevertheless, a firm can also grow via establishing new plants. The use of organizational innovations, such as a multidivisional organizational structure (Chandler, 1962; Williamson, 1975), may help reduce organizational complexity that potentially arises from increased organizational size. Orser, Hogarth-Scott and Riding (2000) report that among the 1,004 small and medium-sized Canadian firms studied, fewer than one quarter of these firms had two consecutive years of revenue increases. However, this empirical study does not provide reasons

why there were firms that were not subject to the Penrose effect and were able to achieve growth in consecutive time periods.

Gander (1991) examines empirically the managerial limitations on firm growth by investigating whether there are decreasing (growth) returns to managerial resources (i.e., managerial diseconomies). Gander (1991) suggests that as the firm doubles its size, the firm has to utilize more than double its managerial resources to maintain effective coordination. Hence, Gander (1991) expects that managerial intensity in an industry (proxied by the ratio of managerial employment to industry asset size) should increase with the size of firms in the industry. Gander (1991) tests this hypothesis using aggregate two-digit SIC U.S. industry data, and finds this hypothesis supported empirically for the 1977-1980 period, but not for the 1983-1986 period.

Two studies explored empirically the Penrose effect of firm expansion by franchising. Thompson (1994) suggests that different forms of firm expansion require different levels of managerial resources. Thompson (1994) expects that a firm is likely to expand via franchising initially in order to economize on its managerial resources. As the managerial limit decreases with experience, the firm will replace its franchised outlets by hierarchical ones. Based on a sample of 200 franchise chains in 15 U.S. industries, Thompson (1994) finds empirically that the proportion of hierarchical outlets of these firms had a convex relationship with franchise experience. Similarly, Shane (1996) suggests that contractual organizational forms such as franchising economize on the costs of monitoring employees. Since such monitoring costs

increase with firm size in the process of growth, the use of contractual forms help relieve managerial limits to firm growth. Based on a sample of 138 firms in the United States, Shane (1996) finds empirically that firms following a franchise strategy did enjoy a higher growth rate of establishing outlets.

In general, empirical research studies exploring the "Penrose effect" provide supportive, but not robust, empirical evidence that dynamic adjustment costs are important for understanding the rate of growth and the development of dynamic capabilities. In addition, the extent to which a firm's expansion is subject to managerial limits seems to vary with the types of expansion considered in these empirical studies (e.g., plant expansion, franchise, etc.). Given the current state of empirical research concerning the Penrose effect, it is unclear to what extent a firm that expands into a foreign market incurs managerial constraints on its rate of growth. The current paper is, to our knowledge, the first empirical paper to look at the Penrose effect in an international business context. In the next section, we develop the theory and hypotheses.

Section 3: Theory and Hypotheses

According to Penrose (1959), planning and executing expansion projects require the services of internally experienced managers. The reason being that the process of decision-making and coordination is too complex to be codified as a management "blueprint" that newly-hired managers could implement, and consequently the firm must, to some extent, rely on managers' experience internal to the firm and on their experience working with other

people within the firm as a team (Penrose, 1959). Since internally experienced managers could not be hired from managerial labor markets and could only be developed within the firm over time, there are limits to the rate at which a firm can grow at any time. A firm that expands faster than it can increase its internal managerial capacities is likely to incur managerial problems and reduced effectiveness in its current operations (Ingham, 1992; Slater, 1980). These managerial problems then may hamper the firm's growth and the development and deployment of dynamic capabilities in the subsequent time period.

International expansion via direct investments is a corporate-level strategy that allows a firm to deploy and develop its organizational capabilities (Chang, 1995), but it also requires the services of a firm's experienced managers. Specifically, planning an overseas investment involves a series of complex decisions. For example, managers must decide the location and the scale of (sunk cost) investments, the mode of entry, the methods of financing, and so forth. To evaluate different alternatives properly, the managers must understand the firm's resources profile and the strategic goals of the firm's international expansion. Such knowledge is firm specific and could only be embodied in managers who have experience within the firm.

While planning international expansion requires the services of internally experienced parent managers, whether and to what extent *managing* international operations requires such managerial services does not have a clear theory-based answer. Because countries differ in cultures, languages, infrastructures, and so forth, managing foreign operations may require skills and knowledge different from what parent managers have learned from their domestic operations

(Luo and Peng, 1999). Consequently, the experience of parent managers may not be as economically valuable in international operations, and the multinational firm could solicit help from local personnel to manage effectively its foreign operations. Given that a multinational firm could expand in a foreign market through acquiring existing operations and hiring local managers, to understand how managing international operations is subject to finite internal (parent) managerial capacities, we next explore what experienced parent managers could bring to the management of international operations that is unique and cannot be replaced by the services of new-hires.

Let us first examine what managers of a multinational parent firm may do in managing overseas operations. Managers of a multinational parent firm facilitate, as well as manage, the interdependencies among the firm's subunits (including the headquarters) so that the firm can achieve operational and strategic synergies. Managers provide proper coordination and control to the foreign affiliates by collecting and evaluating the feedback from these foreign affiliates. In addition, these managers may sometimes directly involve (as expatriates) the daily operations of the foreign affiliates. If fulfilling these managerial tasks does not require managers to be equipped with parent-specific knowledge and skills (that can only be accumulated over time through working within the multinational headquarters), the multinational firm can utilize effectively newly-hired managers from local or home managerial labor markets and the multinational firm should encounter less serious managerial constraints on the rate of growth as it expands in the foreign market.

By this logic, the key theoretical question then is under what conditions will a multinational firm's international expansion require substantial parent-specific managerial skill? We argue that the level of interdependencies and the type of control systems employed within the multinational firms dictate how much parent-specific skill is required for managing international operations. Specifically, a multinational firm can implement three types of control over its foreign operations – output control, behavior control, and social control (Eisenhardt, 1985; Hennart, 1991; Ouchi, 1979).

Output control involves parent managers evaluating foreign affiliates' performance based on financial reports, and does not require substantial time and efforts from internally experienced parent managers (Lord and Ranft, 2000). However, output control is not effective when an affiliate's individual performance is costly to measure. One such condition is a team production situation, in which an individual subunit's contribution to the whole organization is difficult to measure accurately (Eisenhardt, 1985). In this case, individual subunits, if evaluated based on measurable outcome, may under/over-produce unmeasured goods/bads. To alleviate this positive/negative externality problem, a firm may implement behavior and/or social control (Ouchi, 1979). Doing so often requires the parent firm to transplant and to diffuse corporate policies, practices, and culture in the foreign operations (Hennart, 1982, 1991). Such tasks call for internal managerial capacities because only people who have experience within the parent firm for a sufficient period of time can understand the relationships between the headquarters and foreign subsidiaries and can appreciate and adhere to such corporate practices and culture.

The nature of coordination among subunits within the multinational firm therefore influences the extent to which a firm is subject to the Penrose effect during the process of international expansion. Compared with domestic expansion, international expansion might be less subject to dynamic adjustment costs that are due to finite internal (parent) managerial capacities. First, while a firm in general applies coherent and consistent business policies over its domestic operations and maintains close coordination between them, it does not necessarily do so for its overseas operations (Penrose, 1959) because: (1) the interdependencies between domestic and overseas markets may be low as the firm may deal with different competitors and customers in each market; and (2) national differences in cultures, languages, and institutions may make such close coordination very costly. In addition, geographical distance between headquarters and foreign subsidiaries makes it difficult for the multinational parent firm to monitor closely its foreign operations, increasing the contractual hazards that are due to agency problems (Shane, 1996).

To resolve such business problems the multinational parent firm can implement a multidivisional structure and organize its overseas operations into autonomous profit centers. Holding each operation accountable for its own economic performance reduces the need of the multinational parent firm for monitoring the overseas operations, allowing the parent managers to concentrate on longer-term strategic planning for further expansion (Chandler, 1962; Williamson, 1975). In this case, firm growth in international business markets may be less vulnerable to the Penrose effect.

Of course, an important premise underlying the use of an autonomous, multidivisional organizational structure within a multinational firm is that the activities between autonomous units can be effectively separable and that there is little interaction required among these units (Williamson, 1975). However, this premise of low economies of scope between subsidiaries does not always hold true. For example, individual subsidiaries may share common technologies or may involve joint production (Chandler, 1990). To maintain autonomous status of individual subsidiaries is likely to stifle exchanges among the subsidiaries and to produce suboptimal results (Lord and Ranft, 2000). To deal with this high interdependency among subunits, the multinational parent firm may attempt to coordinate subunits more closely and to impose behavior and/or social control over its foreign operations (O'Donnell, 2000). Doing so requires parent-specific knowledge and capabilities. Since managers with such knowledge and skills could only be developed within the multinational firm over time through training and learning-by-doing on the job (Kuemmerle, 1997), if growing fast in a foreign market, such a firm is likely to encounter the Penrose effect as the coordination complexity within the multinational firm is likely to increase at a rate faster than its internal managerial resources can handle effectively.

Therefore, *in industries where close coordination within a multinational firm is required and where foreign subsidiaries cannot be effectively managed as autonomous, independent sub-units, the Penrose effect is expected to occur*. Industries that are characterized by a high extent of knowledge tacitness are likely to be international business contexts where foreign

subsidiaries cannot be effectively managed as autonomous, independent sub-units because well-codified "blueprints" for management cannot be readily provided. Therefore, dynamic adjustment costs are more likely to limit the rate of the growth of the multinational firm and its development of dynamic capabilities in industries that are characterized by a high extent of knowledge tacitness.

The tacitness of knowledge is a matter of degree (Nelson and Winter, 1982). Much knowledge remains tacit because it cannot be articulated in a complete and synchronous fashion (Nelson and Winter, 1982; Polanyi, 1962). Since tacit knowledge cannot be made explicit completely and thus must be partially learned through the process of trial and error (Winter, 1987), its transfer relies on the initiative of knowledge receivers to engage actively in the learning process, and on the willingness of knowledge transferors to demonstrate their knowledge on the job and to mentor knowledge receivers (Hitt, Bierman, Shimizu, Kochhar, 2001; Szulanski, 1996).

Organizing overseas subsidiaries as autonomous, independent sub-units is likely to suppress the interaction between knowledge transferor and receiver that is typically crucial in the transfer of tacit knowledge (Winter, 1987), and hence may stifle the flow of tacit knowledge within a multinational firm (Hedlund, 1994; Lord and Ranft, 2000). To facilitate the sharing and the transfer of tacit knowledge among the subunits within the multinational firm, the managers often need to build up lateral integrating mechanisms (such as inter-subsidiary meetings and committees) to increase contacts between managers from different subsidiaries (O'Donnell, 2000;

Rugman and Verbeke, 2001; Subramaniam and Venkatraman, 2001). These managers may also need to institute in the overseas subsidiaries a corporate culture that values learning and sharing (Liker, Fruin, and Adler, 1999).

Such managerial tasks require the services of internally experienced parent managers (Kuemmerle, 1997). New hires do not have the intra-firm social relationships to facilitate the interaction among subsidiaries (Bartlett and Ghoshal, 1992), and these new hires have not yet been acculturated to appreciate and adhere to the corporate culture (Edström and Galbraith, 1977). A firm that grows fast in industries that are characterized by a high extent of knowledge tacitness is likely to lack sufficient managerial capacities to facilitate the flow of tacit knowledge within the firm. Thus, the Penrose effect is expected to occur. This theoretical reasoning leads then to our first hypothesis:

H1: The Penrose effect is more likely to occur in industries characterized by a high extent of knowledge tacitness.

Another industry where a multinational headquarters is likely to coordinate its overseas subsidiaries closely is global industries. In a global industry, a multinational firm's "competitive position in one country is significantly influenced by its position in other countries" (Porter, 1986:113). This competitive influence may be due to global configuration of production activities (i.e., a joint production situation), or the sharing of the same brand names among subsidiaries in different locations. In such an industry, the productivity of a subsidiary is likely to be significantly influenced by that of other subsidiaries, and high non-priceable inter-

dependencies among subsidiaries are expected to occur (Kobrin, 1991). Since in global industries the individual performance of subsidiaries does not accurately reflect their contribution to the multinational firm as a whole, managing the highly interdependent overseas subsidiaries as autonomous, independent subunits will be problematic (Hennart, 1982, 1991; O'Donnell, 2000).

Instead, the multinational firm must coordinate the behaviors (such as service standards, purchases of common inputs, and marketing) of the subsidiaries worldwide (Porter, 1986; Roth, Schweiger, and Morrison, 1991). The close coordination of subsidiary activities is likely to require the service of managers who have a comprehensive understanding of the nature of interdependence among subsidiaries and the role of individual subsidiaries in the firm. Such knowledge is firm specific and could be embodied only in internally experienced managers. Since internally experienced managers must be developed within the multinational firms over time and new hires cannot replace their services in the short-term, we therefore expect that the Penrose effect is more likely to occur in global industries.

H2: The Penrose effect is more likely to occur in (highly interdependent) global industries.

We have argued that in industries where close coordination among subsidiaries is desired, managing foreign subsidiaries requires the services of managers who have experience within the multinational firm. A multination firm that grows fast in such industries is likely to incur the Penrose effect because the firm cannot adjust its managerial resources fast enough to manage increased coordination and complexity in international operations. Here the source of dynamic

adjustment costs arises from the market frictions in managerial labor markets (Becker, 1964; Williamson, 1975) – internally experienced managers cannot be recruited from the outside.

Sometimes a firm cannot adjust its managerial resources effectively due to institutional barriers (a structural market friction). One such condition is when a multinational firm enters into a highly unionized foreign industry. Specifically, managing international operations sometimes requires a multinational firm to influence the behaviors of employees in the foreign subsidiaries. For example, maintaining coordination and implementing control within a subsidiary involves directing employee behaviors (Hennart, 1991). Transferring production technologies sometimes will require increasing the job responsibility of workers (Liker, Fruin, and Adler, 1999). These practices might be at odds with the demands from the union, and thus their implementation is likely to require substantial managerial time and efforts within the multinational firm (Beechler and Yang, 1994). In addition, local managers from highly unionized industries might be accustomed to the institutional norms in their industries and these local managers might need to be re-acculturated (Hopkins, Hopkins and Thornton, 2002).

Since managing foreign operations in unionized industries is likely to require a good deal of managerial services and a multinational firm cannot increase its managerial resources effectively by recruiting local managers, a firm that grows fast in highly unionized industries is more likely to be subject to dynamic adjustment costs due to a managerial constraint. Hence, we expect that:

H3: The Penrose effect is more likely to occur in unionized industries.

Now that we have developed theoretically our three main hypotheses concerning the Penrose effect, we turn next to the methodology.

Section 4: Methodology

The initial population consists of all Japanese manufacturing affiliates in which the parent firm owns more than 10 percent share and were established in the United States between 1978 and 1998 that meet the following three criteria: (1) the Japanese parent firms were listed in the first or second section of the Japanese stock exchange, (2) the parent firm established its first manufacturing subsidiary in a particular four-digit SIC US business between 1978 and 1990, and (3) the Japanese parent firm is not a trading company. Japanese investments are particularly appropriate for studying growth because the main objective of Japanese companies is generally believed to be to maximize long-term growth rather than short-term profitability (Abegglen and Stalk, 1985; Kaplan, 1994; Odagiri, 1992). The U.S. market was chosen because the United States was the leading destination of foreign direct investment outflow from Japanese firms over the study period. The sample is compiled from annual issues of *Japan's Expanding Manufacturing Presence in the United States: A profile* and *Kaigai Shinshutsu Kigyo Soran*.

In the current paper we examine whether, and under what conditions, a Japanese firm experiences dynamic adjustment costs due to the Penrose effect when expanding in a given U.S. industry. Because a firm can grow by enlarging its existing plant or by establishing new plants, we focus on growth at the line of business instead of at the plant level. Thus, we take into

account the impact of organizational innovations (such as multi-divisional organizational structure), which may alleviate the managerial diseconomies at the plant level, and we focus on managerial constraints that may arise from managing business abroad. We choose to limit our level of analysis at the line of business instead of the whole firm because the nature of coordination is likely to differ across industries. As many multinational firms are highly diversified in products provided, the growth of a firm as a whole in a foreign country would be too broad to unveil the relationship between managerial constraints and growth. Overall, there are 578 Japanese investments (at the line of business level) in the raw database, which consist of 310 Japanese firms in 211 four-digit SIC industries. Lack of industry, parent and subsidiary data reduces our sample to 157 investments made by 120 Japanese parent firms in 94 industries.

The growth rate is measured as the percentage of the change of size over a three-year period. Common measures for firm size in previous empirical studies in the research literature include employment and assets. We measure firm size by its employment of a foreign industry because (1) the theoretical interest of the current paper concerns the managerial constraint on the rate of growth and the majority of managerial tasks will be related to the management of employees; (2) employment as the size measure is rightfully the common practice in empirical research studies investigating managerial constraints to firms; and (3) other size measures in this international business context are not readily available to researchers.

In the current paper, we add up the total employment of a firm's manufacturing subsidiaries in a particular 4-digit U.S. industry at the *t*th year after its initial entry into that

industry. If a Japanese firm has multiple plants in an industry, and some of them have been closed or sold by time *t*, then the employment size is the sum of the employment of all its subsidiaries that are still going concerns at time *t*. If a Japanese firm has exited from a U.S. industry and no longer has any subsidiaries, its employment is recorded as zero. We prorate the employment of joint ventures by the equity share of their parents.

Japanese firms' growth rates (in a given U.S. industries) of two consecutive three-year periods are used for analysis. The dependent variable is the percentage change in a Japanese firm's total employment in a given U.S. industry between the fourth and the seventh years after entry (**GROWTH**). The key explanatory variable (**PREGROW**) is the percentage change of the employment in the preceding period (i.e., between the first and the fourth years). A positive estimate of the coefficient of this variable provides contradictory evidence to the Penrose effect in the sense that it shows that a fast-growing firm can achieve fast growth in the subsequent time period. An insignificant or negative coefficient provides consistent evidence to the Penrose effect. To examine whether industry characteristics moderate the Penrose effect, we enter the interaction terms between the preceding growth rate and the industry characteristics in the regression.

The industry characteristics that are hypothesized to moderate the Penrose effect include the extent of knowledge tacitness, globalization, and unionization in the entered U.S. industries. **TACIT** is a proxy for the extent of knowledge tacitness in a given U.S. industry. This proxy is taken from the survey of Levin, Klevorick, Nelson and Winter (1987). **TACIT** is the average

score of the following items from their questionnaire: (1) the extent to which patents secure royalty income for product and process innovations (inversely coded), (2) the importance of moving quickly down the learning curve as a means to appropriate product and process innovation, and (3) the extent of limitation on the patentability of new processes or products. Japanese firms are expected to incur a more serious Penrose effect when expanding in an industry characterized by a high extent of knowledge tacitness.

We follow Makhija, Kim, and Williamson (1997) to measure globalization of a U.S. industry by the extent of an industry's international linkages (**LIT**). **LIT** is the proportion of international trade (import plus export) to the total consumption of the industry. The data on the import and export of US industries are obtained from Feenstra (1997). Japanese firms are expected to incur a more serious Penrose effect when expanding in a global industry.

We measure the extent of unionization of a given U.S. industry by **UNION**. **UNION** is the ratio of unionized labor over the total employment in a particular US industry. The data are taken from the US *Union Membership and Earnings Data Book.*

Control variables include: (1) **ACQ**, a dummy equal to one if a firm follows an acquisition strategy to enter into a particular 4-digit industry during the first three years. If a firm has more than one entry in an industry, we classify a firm's entry as an acquisition strategy when the percentage of acquisition in a firm's entries is greater than 50 percent, and as a greenfield strategy if this percentage is less than 50 percent; (2) **FRD**, a proxy for a firm's technological competencies. It is the R&D intensity of the Japanese parent firm (the ratio of R&D expenditure

to sales); (3) **FADV**, a proxy for a firm's marketing competencies. It is the advertising intensity of the Japanese parent firm (the ratio of advertising expenditures to sales), (4) **LIQUID**, a proxy for a firm's financial support to international expansion. This proxy is the ratio of the parent firm's working capital to sale; (5) **INDGROW**, the average annual growth rate of total employment of a four-digit SIC US industry over the observation period; and (6) **INITIAL**, the (logarithm) employment size of subsidiary in the beginning of the observation period (i.e., at the end of the third year after entry). Finally, we enter a time dummy indicating Japanese firms' entry prior to 1986 (Geringer, Tallman and Olsen, 2000).

The hypotheses are tested using regression models, which are comparable to previous empirical studies (Weinzimmer, Nystrom, and Freeman, 1998) that studied firm growth. We next present our empirical results from these regression models.

Section 5: Results

Table 1 presents descriptive statistics and a correlation matrix. The highest correlation was between parent firm R&D intensity and parent firm liquidity ($r = 0.25$). The largest variance inflation factor in the model was 1.26, suggesting that multicollinearity does not threaten the validity of our coefficient estimates (Neter, Kutner, Nachtsheim, and Wasserman, 1999).

Place Table 1 about here

Table 2 presents empirical results. The dependent variable is the percentage change in a Japanese firm's total employment in a given U.S. industry between the fourth and the seventh years after entry. The key explanatory variable (PREGROW) is the percentage change of the employment in the preceding period (i.e., between first and the fourth years). Column 1 shows only the regression results based on the main effect of variables. Columns 2-4 report the regression results based on the regression models that incorporate the interaction terms between PREGROW and three industry characteristics, TACIT, LIT, and UNION. All models are significant with $p<0.02$. The R-squares of the models are comparable to those of previous empirical work in the research literature that studied employment growth.

Place Table 2 about here

The first column shows the empirical results with only main effects. The coefficient of PREGROW is insignificant, suggesting that in general, Japanese firms that grow fast in the U.S. industries for the first three years did not achieve higher growth rates for the following three years, an empirical finding that is consistent with dynamic adjustment costs due to the Penrose effect. It suggests that the need for close coordination in international operations is generally high in our sample firms.

The main thesis of our paper is that the likelihood of the occurrence of dynamic adjustment costs due to the Penrose effect is expected to be contingent on industry characteristics.

In industries where close coordination is needed and costly, we expect that a fast-growing firm is more likely to incur a managerial constraint. We enter the interaction terms between PREGROW and industry characteristics (TACIT, GLOBAL, UNION) in turn in the model. A negative coefficient of the interaction term provides supporting evidence to the hypothesis. As shown in Columns 2-4 of Table 2, all three of the interaction terms (TACIT*PREGROW, LIT*PREGROW, UNION*PREGROW) are negative and significant (at the 0.05, 0.05, and 0.1 levels respectively) as expected.

We follow Aiken and West (1991) and plot the simple slope of the interaction terms (Figures 1-3). Figure 1 reveals a negative relationship between previous growth and current growth for entrants in industries characterized by knowledge tacitness, and a positive relationship in industries with low knowledge tacitness. Figure 2 presents a similar result. Such a result indicates that it is possible for firms to achieve consecutive growth when they are located in industries where cross-border coordination is not crucial, and that when coordination within a multinational firm is important, high growth in one time period is likely to lead to low growth in the subsequent time period. Figure 3 shows that the negative sign of the interaction term between PREGROW and UNION is the product of a steeper (more positive) slope for the relationship between previous growth and current growth when industry unionization is low, and a less steep slope when industry unionization is high. On the whole, we conclude that all three hypotheses are supported. Our empirical findings are consistent with what we have argued earlier: when a multinational firm needs to coordinate its overseas operations closely, managerial

services of new hires cannot effectively replace those of internally experienced managers. As a result, a fast-growing firm is not likely to adjust its managerial resources fast enough to meet the managerial requirement for the increased complex organization, and this managerial problem will hamper subsequent growth of the firm. Thus, we find empirical support that dynamic adjustment costs due to the Penrose effect limit the rate of growth of the firm and the development of its dynamic capabilities.

Place Figures 1-3 about here

Turning to our control variables, the coefficient of ACQ is negative and significant in all columns, suggesting that Japanese firms that expand into the U.S. industries by acquisitions achieved lower growth at the seventh year after entry. One potential reason for this empirical finding is that Japanese firms that entered the U.S. via acquisitions engaged in restructuring or had subsequent integration problems, leading to a smaller increase in employment. The coefficient of R&D is positive in all columns and is statistically significant in Column 1, suggesting that R&D intensive Japanese firms achieved higher growth rates in the U.S. industries. This empirical result may be due to the fact that expansion into the U.S. market allows Japanese firms that invest heavily into R&D to spread their investments on a larger market and hence enables these firms to capture greater economic returns from their current innovations. The firm can then use the return to reinvest in their current business (Hitt, Hoskisson, and Kim, 1997).

Although it is often suggested that a firm's R&D and advertising intensities are related to a firm's economic performance (Caves, 1996), our empirical findings provide only partial support to such expectations, as the coefficient of ADV is insignificant. It may be possible that unlike technological competencies, marketing competencies of Japanese firms are strongly embedded in cultural understanding and hence are difficult to transfer across borders due to cultural barriers (Simonin, 1999). Hence, perhaps expanding in the U.S. market did not allow advertising intensive Japanese firms to yield a greater economic return from their U.S. investment in the observation period.

A firm's initial size (INITIAL) in a foreign market is found to be generally negatively associated with its growth rate in the market. Firms that entered into the United States by 1986 are found to have greater rates of growth in their respective industries. Perhaps these Japanese firms enjoyed early mover advantages (Lieberman and Montgomery, 1988) over their Japanese counterparts. All other control variables are insignificant.

Section 6: Discussion and Conclusions

In her seminal book, *The Theory of the Growth of the Firm*, Penrose (1959) argues that because a firm is in its nature an administrative organization, corporate expansion must be planned and implemented by managers who have substantial experience working within the firm and with the people in it. Because such managers cannot be hired from outside, the capacities of internally experienced managers limit the rate at which a firm can grow in a given period of time. Consequently, a fast-growing firm is likely to slow down in the subsequent time period because its management, inelastic at least in the short run, is not able to handle the increased complexity effectively. The research proposition that a firm is not likely to achieve consecutive time periods of high growth is known as the "Penrose effect" in the research literature. The Penrose effect is an important type of dynamic adjustment cost that limits the rate of growth of the firm and the development of dynamic capabilities.

The current paper presents one of the first empirical studies examining dynamic adjustment costs due to the Penrose effect in an international business context. Compared with domestic expansion, international expansion might be less subject to finite internal (parent) managerial capacities because the multinational parent firm may organize its overseas operations into autonomous and independent sub-units, may maintain loose coordination among them, and may employ local hires to manage the overseas operations. In the current paper, we have argued that the nature of coordination among overseas subunits within the multinational firm influences the extent to which a firm will be subject to dynamic adjustment costs due to the

Penrose effect in the course of international expansion. When the multinational firm needs to coordinate overseas operations closely, managing overseas operations effectively requires managers who have been trained and socialized within the firm for a period of time. A fast-growing firm is likely to incur a managerial constraint because the firm could increase its managerial resources only incrementally. *Based on a longitudinal sample of Japanese manufacturing entries in the U.S., our empirical results show that the Japanese firms in general did not achieve growth in consecutive time periods in the U.S. industries, providing supporting evidence to Penrose's (1959) theory of the limits to the rate of growth of the firm – i.e., the Penrose effect.*

The current paper also identifies several conditions where dynamic adjustment costs due to the Penrose effect are greater. *Our empirical results indicate that the higher the extent of tacitness of knowledge, globalization, and unionization of the U.S. industry entered, the greater the negative impact of fast growth on a Japanese firm's subsequent growth in that industry*. In these industries, the need and the cost of coordination among overseas operations for Japanese firms are likely to be high, and hence managing foreign operations requires substantial time and efforts from internally experienced managers. As a consequence, a fast-growing firm incurs more serious dynamic adjustment costs due to a managerial constraint.

Our paper sheds some light on the emerging dynamic capability perspective on strategic management. The dynamic capability perspective focuses on the capability of a firm in changing its resource base adaptively to meet changing market conditions (Teece, Pisano, and Shuen,

1997). The current paper examines one major barrier that a firm encounters when attempting to change/increase its resource base: dynamic adjustment costs that are due to a managerial constraint (Slater, 1980). Managers play a key role in developing, utilizing, and renewing the productive resources within a firm. A strategic management implication from our empirical research is that a key reason why a firm cannot respond quickly to market change is the lack of internally experienced managers, who could only be developed within a firm over time.

Our empirical work is consistent with a key tenet in the resource-based theory of the firm. Resources that yield sustained competitive advantages are immobile and cannot be bought easily from the market (Barney, 1991; Dierickx and Cool 1989). Our empirical study focuses on one such strategic resource: internally experienced managerial resources, which could only be accumulated within a firm incrementally. The empirical result indicates that a firm's inability to increase this strategic resource in a speedy fashion limits the rate at which a firm can grow in international markets. A firm that attempts to achieve faster growth than its current managerial resources could handle is not likely to sustain such growth. In other words, dynamic adjustment costs limit the rate of the growth of the firm and the development of dynamic capabilities.

Our empirical work contributes to the international business research by being one of the few attempts at studying empirically the dynamics of firm growth in an international business context. We identify three conditions (tacit knowledge intensive, global, and unionized industries) in which rapid expansion is likely to be followed by stagnation. Our empirical study has also important implications for developing managerial resources within a multinational firm. We have

argued that in industries characterized by knowledge tacitness and globalization, facilitating knowledge flow and managing overseas operations within the firm require managers who have intra-firm social relationships and who have been acculturated within the firm. Such managers are strategic resources that need to be developed over time within the firm. Multinational firms should invest in the development of such managers.

Although our empirical research study presents one of the first supportive evidences to the Penrose effect in an international business context, the empirical results are based on Japanese direct investment in the U.S. industries, and may be moderated by Japanese firms' noted propensities to closely control overseas operations. Future research could provide insight into the applicability of the empirical results of this study by examining data from other national settings. In addition, our empirical findings show that the extent to which a firm incurs dynamic adjustment costs due to the Penrose effect is contingent on the characteristics of the industries that a firm chooses to enter. Future research could extend this idea and explore other factors that might magnify or mitigate the Penrose effect for business, corporate and international-level strategies.

References

Abegglen, J. C., and G. Stalk Jr. 1985. *Kaisha, The Japanese Corporation*. NY: Basic Books.

Aiken, L.S. and S. G. West 1991. *Multiple Regression: Testing and Interpreting Interactions.* London: Sage.

Barney, J. B. 1991. Firm resources and sustained competitive advantage. *Journal of Management*, 17(1): 99-120.

Bartlett, C. A. and S. Ghoshal. 1992. *Transnational Management: Text, Cases, and Readings in Cross-Border Management*. Boston: Irwin.

Becker, G. S. 1964. *Human Capital*. New York: National Bureau of Economic Research.

Beechler S, and J. Z.Yang. 1994. The transfer of Japanese-style management to American subsidiaries: contingencies, constraints, and competencies. *Journal of International Business Studies*, third quarter: 467-491.

Castanias, R. P. and C. E. Helfat. 1991. Managerial resources and rents. *Journal of Management*, 17(1): 155-171.

Caves, R. E. 1996. *Multinational Enterprise and Economic Analysis*. 2nd edition. Cambridge, England: Cambridge University Press.

Chandler, A. D. Jr. 1962. *Strategy and Structure*. Cambridge, MA: The MIT Press.

Chandler, A. D. Jr. 1990. *Scale and Scope: The Dynamics of Industrial Capitalism*. Cambridge, MA: Belknap/Harvard University Press.

Chang, S. J. 1995. International expansion strategy of Japanese firms: capabilities building through sequential entry. *Academy of Management Journal*, 38(2): 383-407.

Dierickx, I. and K. Cool. 1989. Asset stock accumulation and sustainability of competitive advantage. *Management Science*, 35(12): 1504-1511.

Edström, A. and J. R. Galbraith. 1977. Transfer of managers as a coordination and control strategy in multinational corporations. *Administrative Science Quarterly*, 22: 248-63.

Eisenhardt, K. M. 1985. Control: Organizational and economic approaches. *Management Science*, 31:134-49.

Feenstra, R. C. 1997. *NBER Trade Database, Disk 3: U.S. Exports, 1972-1994, with State Exports and other U.S. Data*. NBER Working Paper no. 5990.

Gander, J. P. 1991. Managerial intensity, firm size and growth. *Managerial and Decision Economics*, 12: 261-266.

Geringer, J. M., S. Tallman, and D. M. Olsen. 2000. Product and international diversification among Japanese multinational firms. *Strategic Management Journal*, 21: 51-80.

Hamermesh, D. and G. Pfann 1994. Adjustment costs in factor demand. Journal of Economic Literature, 34: 1264-1292.

Hay, D. A., and D. J. Morris. 1991. *Industrial Economics and Organization: Theory and Evidence*. NY: Oxford University Press.

Hedlund, G. 1994. A model of knowledge management and the N-form corporation. *Strategic Management Journal*, 15(special issue): 73-90.

Hennart, J.-F. 1982. *A Theory of Multinational Enterprise*. Ann Arbor: University of Michigan Press.

Hennart, J –F. 1991. Control in multinational firms: the role of price and hierarchy. *Management International Review*, 31: 71-96.

Hitt, M. A, L. Bierman , K. Shimizu, and R. Kochhar. 2001. Direct and moderating effects of human capital on strategy and performance in professional service firms: A resource-based perspective. *Academy of Management Journal*, 44(1): 13-28.

Hitt, M. A., R. E. Hoskisson, and H. Kim. 1997. International diversification: Effects on innovation and firm performance in product-diversified firms. *Academy of Management Journal*, 40: 767-798.

Hopkins, S. A., W. E. Hopkins, and B. Thornton. 2002. Transforming low-tech environments into high-tech environments: Strategies and developmental barriers. *S.A.M. Advanced Management Journal*, 67(1): 14-21.

Ingham, H. 1992. Organizational structure and firm behavior: An intertemporal perspective. Journal of Economic Studies, 19 (5): 19-35.

Kaplan, S. N. 1994. Top executive rewards and firm performance: A comparison of Japan and the United States. *Journal of Political Economy*, 102(3): 510-546.

Kobrin, S. J. 1991. An empirical analysis of the determinants of global integration. *Strategic Management Journal*, 12:17-31.

Kor Y. Y., J. T. Mahoney. 2000. Penrose's resource-based approach: The process and product of research creativity. *Journal of Management Studies,* 37(1): 109-139.

Kuemmerle, W. 1997. Building Effective R&D Capabilities Abroad. *Harvard Business Review*, 75(2): 61-70.

Levin R, A. Klevorick A, R. Nelson , and S. Winter. 1987. Appropriating the returns from industrial research and development. *Brookings Papers on Economic Activities,* 3: 783-820.

Lieberman M. B., and D. B. Montgomery. 1988. First-mover advantages. *Strategic Management Journal,* 9: 41-58.

Liker, J. K., M. Fruin, and P. Adler (eds.) 1999. *Remade in America: Transplanting and Transforming Japanese Management System*s. New York: Oxford University Press

Lord, M. D. and A. L. Ranft. 2000. Organizational learning about new international markets: Exploring the internal transfer of local market knowledge. *Journal of International Business Studies*, 31(4): 573-589.

Lucas R. E. 1967. Adjustment costs and the theory of supply. *Journal of Political Economy,* 75: 321-343.

Luo Y. and M. W. Peng. 1999. Learning to compete in a transition economy: Experience, environment, and performance. *Journal of International Business Studies*, 30(2): 269-96.

Makhija, M. V., K. Kim and S. D. Williamson. 1997. Measuring globalization of industries using a national industry approach: Empirical evidence across five countries and over time. *Journal of International Business Studies*, 28(4): 679-710.

Mortensen D.T. 1973. Generalized costs of adjustment and dynamic factor demand theory. *Econometrica,* 41: 657-665.

Nelson R.R, and S. G. Winter (1982). *An Evolutionary Theory of Economic Change*. Belnap/Harvard University Press: Cambridge, MA.

Neter J, M. H. Kutner, C. J. Nachtsheim, and W. Wasserrman (1999). *Applied Linear Statistical Models*. Fourth edition. New York: McGraw-Hill.

Odagiri, H. 1992. *Growth Through Competition, Competition Through Growth*. NY: Oxford University Press.

O'Donnell, S. W. 2000. Managing foreign subsidiaries: Agents of headquarters, or an independent network? *Strategic Management Journal*, 21: 525-48.

Orser, B. J., S. Hogarth-Scott, and A. L. Riding. 2000. Performance, firm size, and management problem solving. *Journal of Small Business Management,* October: 42-58.

Ouchi W. 1979. A conceptual framework for the design of organizational control mechanisms. *Management Science,* 25(9): 833-849.

Penrose, E. 1959. *The Theory of the Growth of the Firm*. New York: Oxford University Press.

Polanyi, M. 1962. *Personal Knowledge.* Chicago, IL: University of Chicago Press.

Porter, M. E. 1986. *Competition in Global Industries*. MA: Harvard Business School Press.

Roth, K., D., M. Schweiger, and A. J. Morrison. 1991. Global strategy implementation at the business unit level: Operational capabilities and administrative mechanisms. *Journal of International Business Studies*, Third quarter: 369-402.

Rubin P. H. 1973. The expansion of firms. *Journal of Political Economy,* 81: 936-949.

Rugman, A. and A. Verbeke. 2001. Subsidiary-specific advantages in multinational enterprises. *Strategic Management Journal,* 22: 237-50.

Shane, S. A. 1996. Hybrid organizational arrangements and their implications for firm growth and survival: A study of new franchisors. *Academy of Management Journal*, 39(1): 216-234.

Shen, T. Y. 1970. Economies of scale, Penrose-effect, growth of plants and their size distribution. *Journal of Political Economy*, 78(4): 702-716.

Simonin, B. L. 1999. Ambiguity and the process of knowledge transfer in strategic alliance. *Strategic Management Journal*, 20: 595-623.

Slater M. 1980. The managerial limitations to a firm's rate of growth. Economic Journal, 90: 520-528.

Subramaniam, M. and N. Venkatraman. 2001. Determinants of Transnational New Product Development Capability: Testing the Influence of Transferring and Deploying Tacit Overseas Knowledge. *Strategic Management Journal,* 22: 359-78.

Szulanski, G. 1996. Exploring internal stickness: Impediments to the transfer of best practice within the firm. *Strategic Management Journal*, 17(winter special): 27-43.

Teece, D.J., G. Pisano, and A. Shuen. 1997. Dynamic capabilities and strategic management. *Strategic Management Journal*, 18(7): 509-533.

Thompson, R. S. 1994. The franchise life cycle and the Penrose effect. *Journal of Economic Behavior and Organization*, 24: 207-218.

Treadway A. B. 1970. Adjustment costs and variable inputs in the theory of the competitive firm. *Journal of Economic Theory*, 2: 329-347.

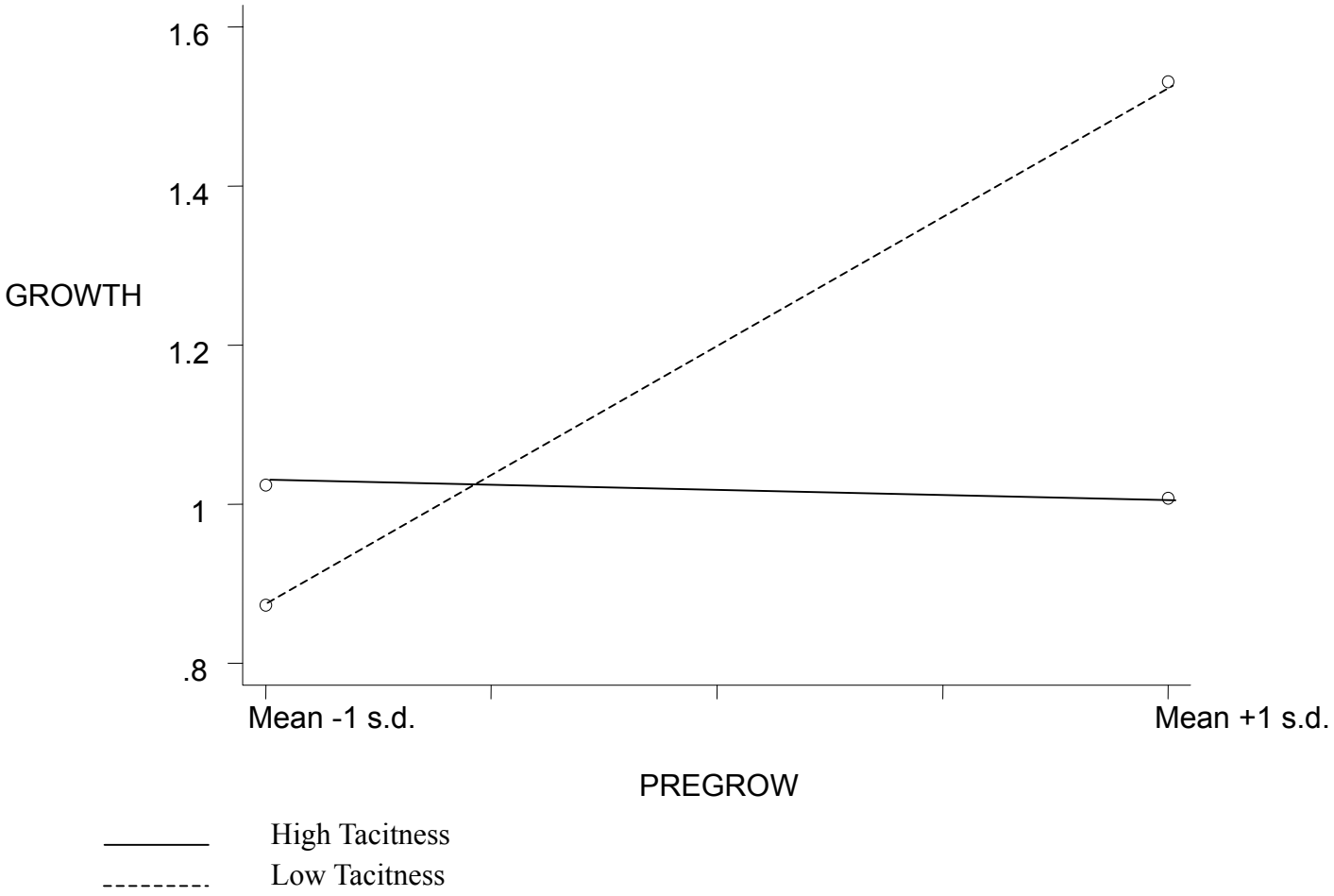
Weinzimmer, L. G., P. C. Nystrom, and S. J. Freeman. 1998. Measuring organizational growth: Issues, consequences, and guidelines. *Journal of Management*, 24(2): 235-262.

Williamson, O.E. 1975. *Market and Hierarchies: Analysis and Antitrust Implications*. New York: Free Press.

Winter, S. 1987. Knowledge and competence as strategic assets. In David Teece, editor, *The Competitive Challenge – Strategies for Industrial Innovation and Renewal* (pp.59-84). New York, NY: Harper & Row.

Figure 1

Plot of Hypothesis 1: The Effect of Knowledge Tacitness on the Relationship between Firm Growth and Previous Firm Growth



As we can see in Figure 1, there is a (slight) negative relationship between previous growth and current growth for entrants in industries characterized by knowledge tacitness, and a positive relationship in industries with low knowledge tacitness.

Figure 2

Plot of Hypothesis 2: The Effect of Industry Globalization on the Relationship between Firm Growth and Previous Firm Growth

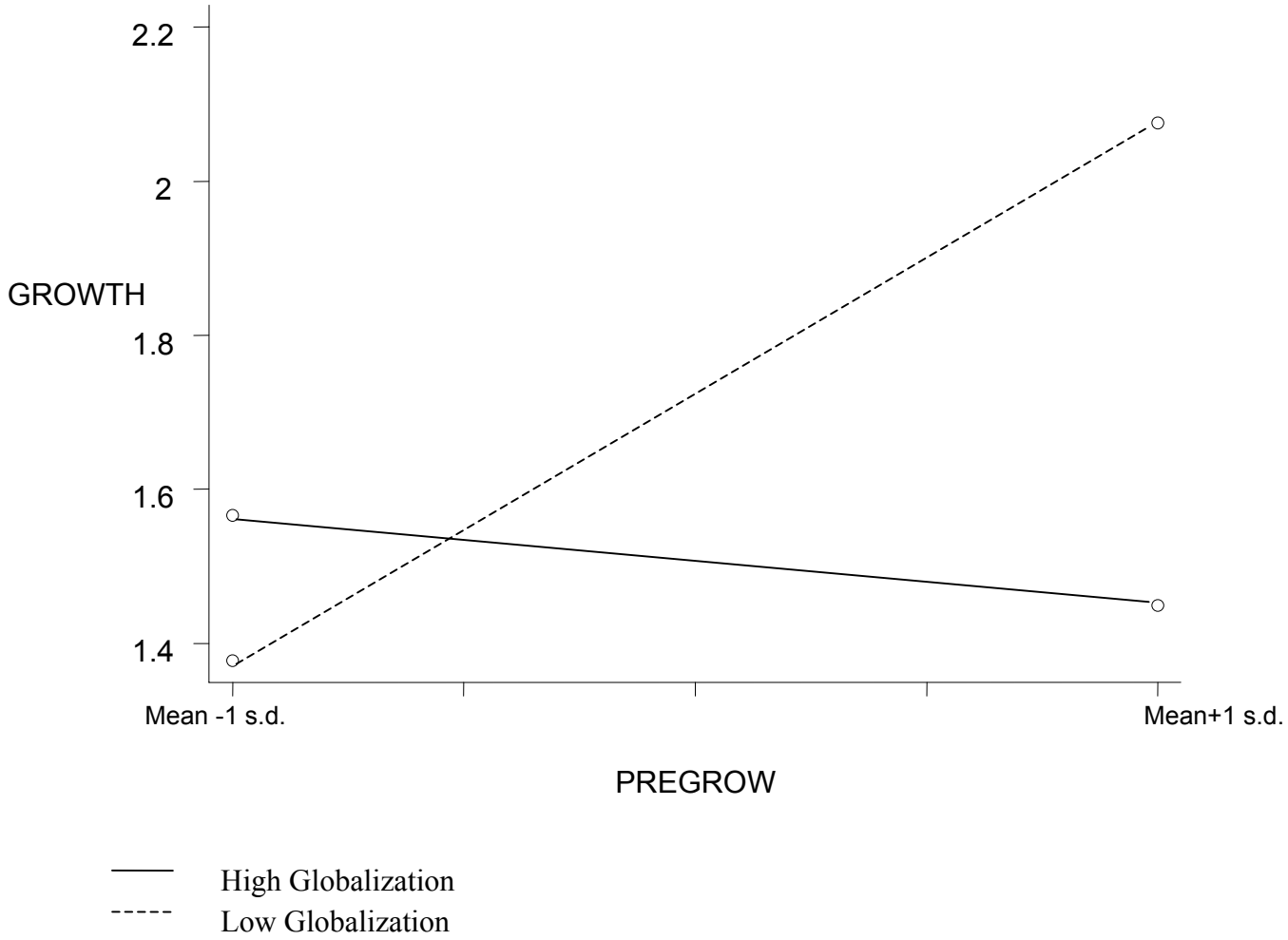


Figure 2 shows that there is a negative relationship between previous growth and current growth for entrants in industries characterized by a high extent of globalization, and a positive relationship in industries with a low extent of globalization.

Figure 3

Plot of Hypothesis 3: The Effect of Industry Unionization on the Relationship between Firm Growth and Previous Firm Growth

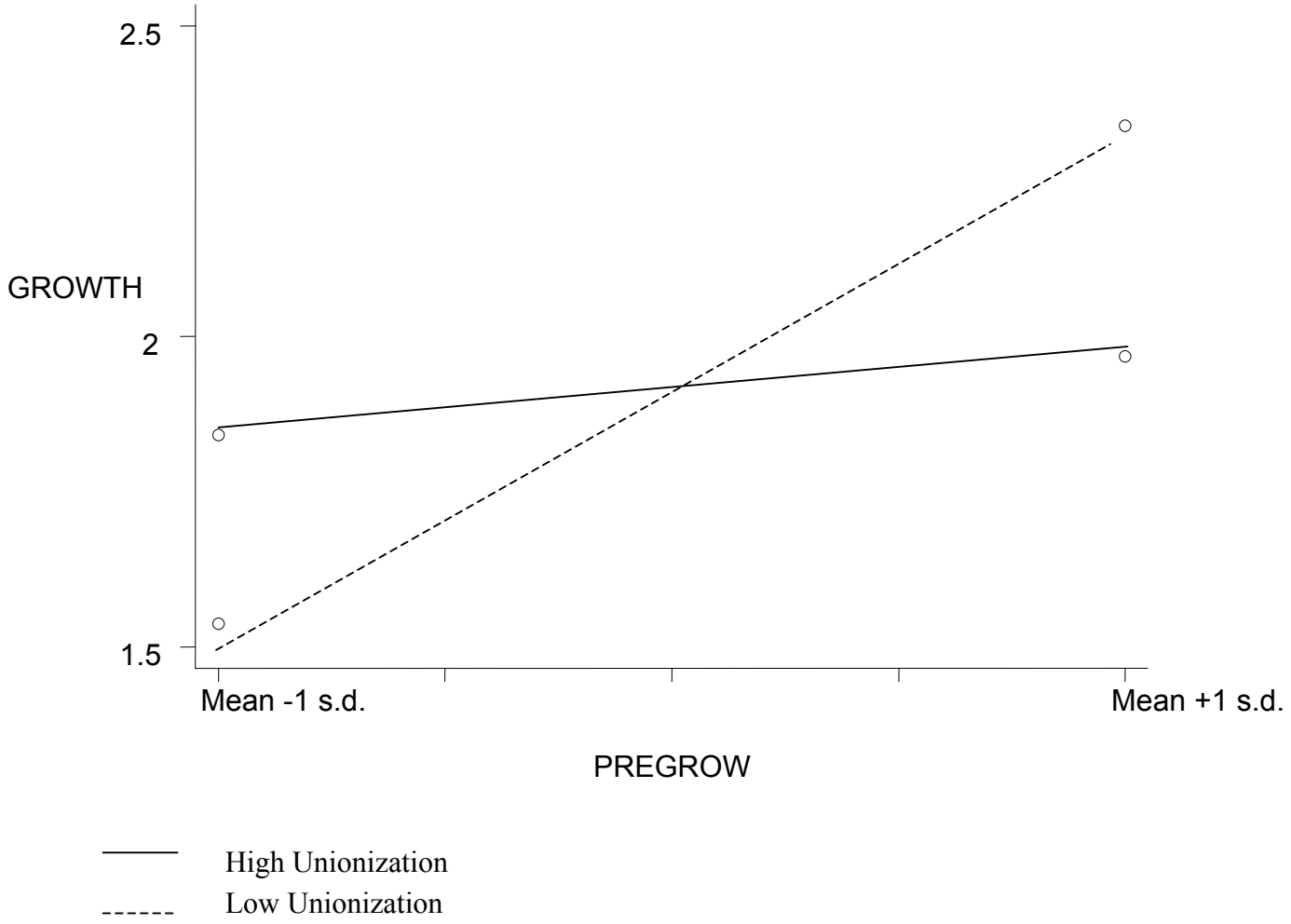


Figure 3 shows a steeper (more positive) slope for the relationship between previous growth and current growth when industry unionization is low, and a less steep slope when industry unionization is high.

Table 1

Correlations, Means, and Standard Deviations[1]

Variable	Mean	s.d.	1	2	3	4	5	6	7	8	9	10	11	12
1. GROWTH	0.50	1.09	1											
2. PREGROW	1.75	4.18	0.13	1										
3. LIQUID	0.53	0.34	0.04	0.15	1									
4. FRD	1.54	1.69	0.19	0.17	0.25	1								
5. FAD	0.62	0.93	0.04	-0.02	-0.05	0.14	1							
6. INITIAL	4.81	1.33	-0.15	0.14	-0.02	0.08	0.09	1						
7. ACQ	0.36	0.48	-0.17	-0.10	0.10	-0.05	-0.04	0.21	1					
8. INDGROW	0.00	0.06	0.05	0.00	-0.09	-0.03	-0.07	-0.18	0.09	1				
9. TACIT	27.04	2.52	-0.10	0.01	0.01	-0.12	-0.07	0.02	-0.13	-0.22	1			
10.UNION	24.46	13.48	0.00	0.23	-0.19	-0.12	-0.16	0.06	-0.15	0.10	0.00	1		
11.LIT	0.29	0.21	-0.07	-0.01	0.07	0.06	-0.02	0.20	-0.07	-0.16	0.11	-0.19	1	
12.TIME	0.34	0.47	0.15	-0.03	0.06	0.10	0.20	0.15	0.06	-0.14	0.00	-0.14	0.22	1

[1] N = 157; correlations greater than 0.16 or smaller than -0.16 are significant at the 0.05 level.

Table 2
Regression Results[2]

Variables	Model 1			Model 2			Model 3			Model 4		
TACIT*PREGROW				-0.016	(0.007)	**						
LIT*PREGROW							-0.232	(0.111)	**			
UNION*PREGROW										-0.003	(0.002)	*
PREGROW	0.031	(0.022)		0.471	(0.199)	**	0.102	(0.040)	**	0.129	(0.056)	**
LIQUID	-0.042	(0.269)		0.026	(0.267)		0.144	(0.281)		-0.101	(0.269)	
FRD	0.100	(0.053)	*	0.068	(0.055)		0.087	(0.053)		0.076	(0.054)	
FAD	-0.027	(0.096)		-0.046	(0.095)		-0.025	(0.095)		-0.046	(0.096)	
INITIAL	-0.121	(0.070)	*	-0.120	(0.069)	*	-0.114	(0.069)		-0.126	(0.069)	*
ACQ	-0.359	(0.190)	*	-0.389	(0.188)	**	-0.368	(0.188)	*	-0.391	(0.189)	**
INDGROW	0.691	(1.581)		0.713	(1.560)		0.709	(1.563)		0.666	(1.567)	
TACIT	-0.034	(0.035)		-0.009	(0.036)		-0.029	(0.034)		-0.026	(0.035)	
UNION	-0.002	(0.007)		-0.001	(0.007)		-0.001	(0.007)		0.004	(0.008)	
LIT	-0.486	(0.428)		-0.391	(0.424)		-0.116	(0.459)		-0.386	(0.427)	
TIME	0.455	(0.188)	**	0.422	(0.186)	**	0.436	(0.186)	**	0.423	(0.187)	**
CONSTANT	1.997	(1.034)	*	1.285	(1.069)		1.590	(1.040)		1.726	(1.034)	*
N	157			157			157			157		
F	2.16			2.44			2.38			2.31		
Prob > F	0.02			0.01			0.01			0.01		
△R-square[3]				0.03			0.03			0.02		
R-squared	0.14			0.17			0.17			0.16		
Adj R-squared	0.08			0.10			0.10			0.09		

[2] Cell entries are unstandardized coefficient estimates. Numbers in parentheses are standard errors.
[3] The R-squares of Models 2-4 are compared with that of Model 1.
*p<0.1 **p<0.05 ***p<0.01