

# Complexity as a Constraint on Firm Expansion Within and Across Industries

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**With this paper, we want to shed light on factors influencing a firm's rate of expansion. We argue that expansion is a complex task and complexity associated with expansion projects in one period can negatively impact rate of expansion in the following period. Moreover, we argue that firm portfolio complexity also slows down further expansion. Using longitudinal data on the expansion path of 91 German companies, we show that added product scope of expansion and degree of internationalization characterizing expansion in one period as well as level of product and international diversity have a significant impact on slowing down rate of expansion in the subsequent period. Copyright © 2008 John Wiley & Sons, Ltd.**

## INTRODUCTION

The expansion of firms is a topic of considerable interest in both management research and business. Managers often say that growth is an important goal for their firms (e.g. Brush *et al.*, 2000). However, firms face constraints on their growth and development paths (e.g. Cyert and March, 1963; Mahoney and Pandian, 1992). Firms are limited by their resources, capacity, and capabilities to cope with the complexity inherent in growth. The more complexity a firm faces due to its expansion in one period of time, the more likely its future rate of expansion will be slowed down. So far, scholars have analyzed this effect for expansion rates in successive periods (Mahoney and Pandian, 1992). To our knowledge no study has distinguished between different types of complexity that cause a slowdown in future firm expansion. Moreover, while researchers have studied the above-mentioned effect in a number

of contexts (e.g. Shen, 1970; Tan, 2003; Tan and Mahoney, 2005), none have addressed it in regard to expansion within and across industries. We address these issues and attempt to shed light on how complexity constrains a firm's rate of expansion.

First, we test the aforementioned effect from a different perspective on expansion in an effort to show that firm expansion is path-dependent. Second, in contrast to previous studies we do not simply use an expansion rate as an independent variable; rather we introduce different variables that determine complexity, which place a strain on firm resources. In addition to variables describing the complexity of the process of expansion, we add variables describing the level of complexity associated with managing a diversified portfolio. Specifically, we test the impact of *added product scope of expansion* and *degree of internationalization* in one period (complexity from the expansion process) as well as of the level of *product* and *international diversity* (level of complexity) on firm development in the next period.

We test our hypotheses using longitudinal data on 3503 expansion steps taken by 91 German

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companies within and across industries of over a period of 20 years.

## THEORETICAL BACKGROUND

### Complexity and Firm Expansion

According to the resource-based view, a firm is a collection of physical, human, and intangible assets (Penrose, 1959; Mahoney and Pandian, 1992). To manage and expand these assets is a difficult endeavor since a firm is limited by its resources, capacities, and capabilities (Simon, 1957; Penrose, 1959). Several scholars have followed this logic and specifically analyzed the impact of the amount of expansion in one period on the rate of expansion in the subsequent period. This constraint on a firm's growth rate is known as the Penrose effect (Marris, 1963) and has been studied in a number of contexts (Shen, 1970; Tan, 2003; Tan and Mahoney, 2005). It suggests that firms that grow quickly in one period tend to show lower growth rates in the subsequent period. In this paper we argue that it is complexity that is associated with managing and expanding assets. Consequently, it is the ability to handle complexity that limits a firm's growth potential.

In order to understand the impact of complexity on a firm's growth potential the different sources of complexity must be systematically analyzed. The notion of complexity is itself complex. There is no clearly articulated, let alone universally accepted, definition. As complexity is seen differently between fields, and also carries different connotations even within the same field, it is not surprising that its operationalization is somewhat difficult (Morel and Ramanujam, 1999). Simon (1969) has characterized a system as complex when it consists of a large number of interacting elements. Organization theory has treated complexity as a structural variable applied to both organizations and their environments (Anderson, 1999). In organizations, complexity can pertain to the number of activities or subsystems such as the number of hierarchical levels, number of job titles, or number of geographic locations within the organization (Daft, 1992). When used to characterize environments, it refers to the number of different external elements that must be dealt with simultaneously (Scott, 1992). Firm's resources and capabilities are either being used to manage the existing firm or to expand it. Thus, we

make a distinction between complexity stemming from managing the firm in its current state, that is managing the firm portfolio, and complexity stemming from expansion. Different organizational units or foreign subsidiaries must be dealt with in managing the firm portfolio, ergo complexity arising from firm portfolio management relates to complexity with respect to organizations. Analogous to this, as the process of expansion is associated with new environmental settings, complexity stemming from expansion is complexity with respect to environments. Furthermore, the process of expansion can also be associated with internal organizational complexity when company structures are being changed.

#### *Level of complexity*

Running a firm's current operations and managing its current status means running existing routines. However, 'just keeping an existing routine running smoothly can be difficult' (Nelson and Winter, 1982, p. 112), so managers must spend a good part of their time keeping the organization in conformity with its routinized standards (Mishina *et al.*, 2004). Organizational structures differ in their ability to manage complexity of running current operations (Chandler, 1962). Given a particular organizational form, the more diverse the firm is the more routines are installed and so more complex it is to run the current operations. Diversity is a function of the different businesses a firm operates. Managers that run businesses under different conditions need different knowledge. Hence, they not only require business-specific but also industry-specific knowledge. Moreover, with increasing diversity, coordination within the organization becomes even more complex and difficult. Firms face higher coordination costs and intrinsic diseconomies of scale when expanding their hierarchical structure (Keren and Levhari, 1983). Similarly, Leontiades and Tezel (1981) show that at higher levels of diversity firms spend more time on corporate-level planning. Moreover, when firms consist of both related and unrelated entities, inconsistent control systems may emerge (Hill *et al.*, 1992).

#### *Process complexity*

The expansion process is a particularly complex task since it is associated with the replication, addition, and recombination of existing routines

(Nelson and Winter, 1982). Complexity results from the disruption of tacit coordination mechanisms for routines (Mishina *et al.*, 2004) and from embedding routines in a system or context new to the firm (Winter, 1987). If the expansion takes place in industries or countries that already exist in the firm portfolio, then the firm already has knowledge about these environments and so has set up specific routines. In that case, expansion involves replication of existing routines within a familiar system. On the other hand, if the firm expands into unfamiliar environments, existing routines must be creatively recombined or new ones built adding even more complexity to firm expansion.

Furthermore, when expanding a firm to the new settings, changes in structures, systems, and processes might be necessary (e.g. Smith *et al.*, 1985; Hoskisson, 1987; Kazanjian and Drazin, 1987). For example, it is necessary to adapt reward systems, methods of decision making, and mechanisms to monitor, control, and coordinate the workforce (Markman and Gartner, 2002). Organizational systems tend to be more similar within a given industry than across industries (Finkelstein and Haleblan, 2002). Thus, existing knowledge about an industry may support effective integration of processes and, as a consequence, reduce the potential for conflict within organizational systems (Finkelstein and Haleblan, 2002). When expanding into new environments, however, administrative diseconomies of coordination and control might arise (Coase, 1952). Excessive diversification can lead to a loss of control and misallocation of corporate resources (Hoskisson *et al.*, 1991).

Managers expanding into new industries will be confronted with environmental settings that may differ from those of the established business entities. They must cope with that new situation and its associated unfamiliarity. This makes expansion a more difficult task for them as more time and attention is required. Managers involved in such expansion projects not only require business-specific knowledge but also must acquire knowledge and capabilities that are specific to the new setting in order to do business in the new environment. They have to learn to deal with different customers, compete against new rivals, execute different processes, and interpret strategic signals in the new setting. New knowledge can be acquired through experimental learning by doing business in the new

environment. The learning process can be supported by existing knowledge (Huber, 1991); however, the less similar the new situation is to the settings a firm has already experienced the less feasible it is that there will be knowledge transfer and application of appropriate behavior (Cohen and Levinthal, 1990; Haleblan and Finkelstein, 1999; Finkelstein and Haleblan, 2002). Stern and Henderson (2004) argue that effectively transferring knowledge between two businesses is unlikely unless their external environments are similar. If the newly established entity is in an industry in which the firm is not yet active, it will be difficult for managers to understand and interpret unfamiliar knowledge and routines and so to absorb and apply previous experience (Huber, 1991; Barkema *et al.*, 1997; Vermeulen and Barkema, 2001). Thus, when expanding into new industries dissimilar to those in which the firm is already active, managers have to acquire additional and specific knowledge about the new industry. However, it is complex and requires time to acquire such knowledge. Consequently, all other things being equal, the lower the level of similarity between a firm's existing businesses and a new one, the more resources and capabilities are required to develop industry-specific knowledge.

Moreover, a comprehensive picture of the impact of process complexity first becomes apparent when analyzing a set of expansion steps. A firm is often able to handle one expansion step but not able to handle several steps within a limited period of time. Consequently, when analyzing a single expansion step it is possible to detect an influence after one step that is originally due to the joint influence of several steps undertaken directly before. Thus, when we analyze the influence of process complexity during the course of this study, process complexity will be measured by the number of expansion steps along a firm's expansion path during a certain period of time.

### **Dynamic Perspective on Complexity and Firm Expansion**

There are several ways to explain the relationship between complexity and subsequent expansion. First, a firm expanding extensively will inevitably face high levels of complexity as new knowledge and capabilities must be acquired to cope with the

new situation. However, if the intervals between expansion steps are short and there is too much residual complexity during a certain period of time, the firm might not be able to adequately absorb lessons learned and consolidate them for utilization in the future (Eisenhardt and Martin, 2000; Hayward, 2002). It follows then that a firm that expands in one period of time with both (a) more expansion steps, and (b) into less familiar industries and thus with a higher added product scope, will face even more complexity making it more difficult for managers to develop and consolidate new knowledge (Vermeulen and Barkema, 2002). Those managers are less capable to manage all interdependencies between different businesses and to operate in different industries. Therefore, managers must then spend more of their scarce capacity in the next period on the development of new capabilities. Consequently, fewer resources will be available for future expansion projects, thus reducing the rate of expansion. Moreover, if less experience and competencies are garnered by learning from prior expansions, the firm's resources may be stretched thin in future expansions.

Second, if a firm expands extensively in one period of time, the complexity associated with the expansion is more likely to tax beyond their capacity the available resources of the firm (Mishina *et al.*, 2004). This leaves managers with less time to devote to their tasks. Overextended managers will be unable to pay sufficient attention to each individual task, in essence they will be less thorough (Gary, 2005) and as a consequence there will be coordination bottlenecks and quality problems (e.g. Oliva and Sterman, 2001). The higher information processing demands due to complexity eventually overwhelm the cognitive abilities of managers (Simon, 1957). Managers will make hurried decisions that may prove hard to reverse. This will hamper the firm's subsequent expansion (Tan, 2003). In summary, overextending leads to poor adaptation of structures, systems, and processes and a proportion of the firm's resources must be devoted to correcting this in subsequent periods so that future firm development is not constrained. At the same time, those limited resources are not available in the subsequent period for expansion.

A third explanation for the negative relationship between complexity in one period and expansion in a subsequent period has to do with

the development of new resources. The availability of resources is both an accelerator and a brake on firm growth (Penrose, 1959; Starbuck, 1965). A firm can develop new internal resources in order to support future expansion and counteract the obstacles we have described. However, this is also a complex task (Castanias and Helfat, 1991) and requires time as 'time compression diseconomies' (Dierickx and Cool, 1989) occur (Vermeulen and Barkema, 2002). The firm-specific knowledge they have to gather is either explicit knowledge, which they can obtain in formal seminars, or tacit knowledge that has to be transferred by face-to-face interaction from experienced managers. However, experienced managers can only train a limited amount of new personnel. If too many new managers are trained, experienced managers may not effectively transfer tacit knowledge due to insufficient interactions (Hitt *et al.*, 2001; Tan, 2003). Moreover, whereas mentoring and training new managers is necessary for the development of new resources, which can be used for future expansion, it takes the time that managers might otherwise have spent on other tasks (Penrose, 1959). If a firm extensively expands and simultaneously develops new resources in one period, integration demands time and effort in subsequent periods. This additional strain reduces their services available for expansion (Mahoney and Pandian, 1992). Moreover, during a period of extensive expansion managers have less time to devote to bringing in new resources and as a result there are fewer new resources in the next period. However, due to the expansion and a corresponding increase in size, more resources are required in subsequent periods simply to run the firm at its current size. If this higher demand for resources cannot be offset by new resources, there may be fewer resources available for expansion.

In addition, competitive dynamics in business segments influence how and why a firm expands. For example, geographic market entry and growth strategy of a firm within an industry are influenced by extent of contact with rivals in other geographic markets (Haveman and Nonnemaker, 2000). Product diversity is negatively influenced by increased foreign-based competition (Bowen and Wiersema, 2005). In our paper, however, we focus on the firm level and thus do not further emphasize the effect of competition in certain product or regional markets.

## HYPOTHESES

The expansion of firms is a difficult and complex task. As we have shown, there are many reasons why complexity may have a negative influence on a firm's subsequent rate of expansion. Although other studies have analyzed the impact of complexity from prior expansion, especially from prior rates of expansion, on a firm's growth in the subsequent period, we argue that different sources and dimensions of complexity exist that can impact a firm's future rate of expansion. Following this logic, we will generate different hypotheses. We distinguish between complexity stemming from the process of expansion and complexity resulting from the management of a diverse firm portfolio. We introduce two dimensions of process complexity: (1) the added product scope of expansion and (2) the degree of internationalization. We also introduce two dimensions for level of complexity: (1) the level of product diversity and (2) the level of international diversity.

### Process Complexity and Rate of Expansion

#### *Added product scope of expansion and rate of expansion*

There is a certain amount of complexity associated with an expansion step. The more expansion steps a firm takes on per period, the higher the complexity it faces. Different expansion steps, however, can be associated with different amounts of complexity. The degree of familiarity (relatedness) or lack of familiarity to already existing businesses is the main driver of differences in complexity. The amount of complexity arising from expansion that an expanding firm must handle within a given time period depends on both the number of expansion steps and their associated levels of unrelatedness to already existing businesses. We label the amount of complexity associated with expansion *added product scope of expansion*.

Expansion across industries presents a firm with new and unfamiliar settings that require new capabilities that are specific to the new industry. A firm's managers have to understand critical success factors of the new business and might also have to learn new business logics (Prahalad and Bettis, 1986). Therefore, when expanding into new businesses, a firm has to cope with higher

complexity. Existing knowledge and experience that has been garnered during previous expansion steps can support acquisition of the requisite new knowledge and capabilities. Clearly, a firm knows more about related industries than about unrelated ones (Park, 2003) and thus existing knowledge will be more useful, the more similar the new situation is from experiences that the firm has made before (Cohen and Levinthal, 1990; Halebian and Finkelstein, 1999). The greater the degree of unfamiliarity, that is the higher the level of unrelatedness to the existing business portfolio of the firm, the more new knowledge must be gained and so more time is needed. Consequently, *ceteris paribus*, the complexity to be handled is greater and the more business-specific knowledge must be developed, the higher the product scope of an expansion step.

Moreover, managers need to integrate a new business into the firm. Therefore, they need to adapt systems, processes, and structures to new settings (Calvo and Wellisz, 1978; Smith *et al.*, 1985). Sometimes, the systems and structures of the new business are very different from those of the established organization, and yet they are crucial to the new business and so must remain in place (Campbell *et al.*, 1995). Their adaptation and reorganization requires the creation of new and recombination of existing routines (Nelson and Winter, 1982). This leads to a disruption of tacit coordination mechanisms for routines that entails complexity. It follows then that a firm that expands in one period of time with both more expansion steps and a higher added product scope of expansion will face a higher degree of complexity. As we have said, different effects exist that explain the negative impact of complexity on a firm's subsequent rate of expansion. This suggests the following hypothesis:

#### **Hypothesis 1:**

Everything else constant, the higher the added product scope of expansion a firm faces during the initial time period, the lower its rate of expansion in the subsequent period.

#### *Degree of internationalization and rate of expansion*

In addition to complexity stemming from expansion into unrelated businesses, a firm must cope with additional complexity when the expansion step involves internationalization. A firm that expands into other countries, is an outsider (Hennart, 2005). It has to set up

operations in an unfamiliar environment. This environment might differ from its home turf in terms of social, legal, and economic structures (Wagner, 2004). Moreover, managers must interact with people with different values and attitudes. Thus, management practices need to be adapted to the specific national culture (Newman and Nollen, 1996) and managers of the expanding firm need to learn to do business in that new setting. Especially, managers must learn about local habits and preferences and other external conditions influenced by national culture (Barkema *et al.*, 1996). Expatriate managers are confronted with a new environment and new tasks that they need to adjust to (e.g. Bhaskar-Shrinivas *et al.*, 2005). Moreover, new international subsidiaries have to be integrated into the overall network of the company and thus represent further complexity. Therefore, firms need to adapt structures, systems, and processes to specific national settings (Newman and Nollen, 1996). In summary, expansion projects that are international are associated with additional complexity. Consequently, a firm that is conducting more of its expansion steps abroad faces more complexity. This in turn increases the negative relationship between added product scope of expansion and rate of expansion. Our second hypothesis is therefore:

**Hypothesis 2:**

Everything else constant, the higher the degree of internationalization during the initial time period, the greater the negative impact on the relationship between added product scope of expansion (initial time period) and the rate of expansion in the subsequent period.

**Level of Complexity and Rate of Expansion**

*Level of product diversity and rate of expansion*

A firm's resources and capabilities are not only used for expansion projects but also for the management of the existing firm. Controlling and coordinating a diverse business portfolio that includes the management of interdependencies and interactions between different businesses is a complex task that requires distinctive skills (Pralhad and Bettis, 1986). A firm's managers have to understand the different businesses within the portfolio in order to set objectives and make strategies. Therefore, they must garner information from each business in the portfolio

as well as from the aggregate of all businesses and they must process that information. Moreover, managers have to make decisions regarding the allocation of resources, draft budgets and also control and coordinate operating units. Furthermore, they may have to initiate synergy projects and control their implementation (Grant *et al.*, 1988). Prahalad and Bettis (1986) argue that the more diverse a firm, the more complex it is to handle these tasks. A greater diversity of businesses increases complexity and due to their cognitive limitations it is more difficult for managers to interpret signals and assimilate information. For example, managers have to understand different types of customers, competitors, and operations. Therefore, different objectives and strategies must be set and other approaches are required to manage the various businesses of the firm's portfolio. At times, managers must learn additional dominant logics. Hence, managers might need to handle different systems and structures within the firm. In summary, a more diverse business portfolio in terms of product diversity requires the firm to handle a higher level of complexity. This in turn influences the ability to implement and execute further expansion projects. Interestingly, a higher level of complexity that is coped with by further decentralization and decomposition leads to higher organizational rigidity (Simon, 1969). Higher organizational rigidity would also slow down growth. Therefore, we hypothesize:

**Hypothesis 3:**

Everything else constant, the higher the level of a firm's product diversity, the lower the rate of expansion in the subsequent period.

*Level of international diversity and rate of expansion*

In addition to the complexity of managing an existing business portfolio, further complexity occurs if a firm manages different international business entities. When managing an internationally diversified portfolio, a firm needs different location-specific knowledge in order to understand the different markets in which it is active. As we have said, the firm requires knowledge about different location-specific settings, such as local habits and preferences, as well as other external conditions influenced by national culture (Barkema *et al.*, 1996). Only by having different location-specific

knowledge, managers can set adequate objectives and formulate appropriate strategies. Therefore, managers need to gain knowledge from each of the countries in which the firm is active. Moreover, just as we have seen in the case of multiproduct management, controlling and coordinating a diverse portfolio of subsidiaries in different countries is a complex task requiring distinctive skills from managers. Specifically, the network of different foreign subsidiaries must be handled, that is interdependencies and interactions between the parent firm and its subsidiaries and between the subsidiaries themselves must be managed (O'Donnell, 2000). Therefore, parent firm managers need to make sure that they receive the necessary information from subsidiaries as they depend on that knowledge and the expertise of the subsidiaries (Gomes-Mejia and Palich, 1997). In summary, a higher degree of subsidiary diversity makes it more difficult for managers to interpret the signals and process the information received from subsidiaries. A firm that has a portfolio that is internationally diverse has to handle a higher level of complexity and this can have an impact on its future growth potential. Therefore, our fourth hypothesis is:

**Hypothesis 4:**

Everything else constant, the higher the level of a firm's international diversity, the lower the rate of expansion in the subsequent period.

## METHODOLOGY

### Data and Sample

#### *Sample*

To test our hypotheses, we collected longitudinal data on the expansion path of 91 German companies listed on the German Stock Exchange from 1985 to 2004. We started our sample selection with all companies that had been included in the exchange's HDAX index<sup>1</sup> during at least one point in time between the initial composition of this index in 1994<sup>2</sup> and the end of 2004. We chose this approach to capture companies that were excluded from the index as well as companies that were established or grew and so were included. From the resulting list of 195 companies, we eliminated financial institutions, real estate companies, and purely financial holdings, a total of 34 companies.

We also excluded retailers, another 15 companies, and 11 cross-listed non-German firms (e.g. Vermeulen and Barkema, 2002).<sup>3</sup> Among the remaining 135 companies, there were 30 that had gone bankrupt, merged with other firms, or been taken over and so they could not be contacted directly. We contacted all of the 105 companies remaining and requested historical annual reports dating back to 1985. We also tried to compile historical annual reports for both active and non-active companies from different public sources for the same period of time. We ended up with 91 companies, some of which were still active and others that had gone out of business during our period of analysis, but for which we were nonetheless able to compile annual reports for a satisfactorily long enough period of time of at least 6 years. We were able to include a considerable number of non-surviving firms; nonetheless, we were constrained by data availability and so were able to gather data on only 11 of the 30 non-surviving companies. A means test of secondary data from different financial databases (Compustat, Thomson Financial) showed no significant differences in employees, total liabilities, total assets, or EBIT between the excluded firms and the final sample (see Carpenter and Fredrickson 2001 for a similar procedure).

#### *Data collection*

In this study, we analyzed individual expansion steps taken by the sample companies during the period of analysis. We define an expansion step as a majority or full investment made by the firm into an organizational entity in which it had no, or a minority, equity.<sup>4</sup> Thus, we included only investments into majority owned entities.<sup>5</sup> We extracted data on new subsidiaries from the annual reports of the companies (Barkema *et al.*, 1996, 1997; Vermeulen and Barkema, 2002). Moreover, we collected a complete list of subsidiaries for each firm during the first year and it is included in our panel. We also tracked all disinvestments of subsidiaries, so that we were able to determine the complete portfolio of subsidiaries for each year a firm is included in our panel, as well as all changes to this portfolio within the time it is included. We sourced this information originally from announcements of expansion steps and dissolutions in the management report of the annual report, as well as from changes in

the list of affiliates reported in its appendix. Since the HGB, the German accounting standard requires companies to report all affiliates in which they own at least 20%,<sup>6</sup> we were able to create a comprehensive database of expansion steps. This complex and time-consuming approach of extracting expansion steps from annual reports was necessary as similar comprehensive data are not available for German companies from any commercial database. After having collected these data, we checked them using two sources. First, we compared the information on acquisitions, which we had gathered with information on acquisitions, from the Thomson One Banker Deals database. This showed that we had missed no acquisition that was included in that database and that indeed our data were more comprehensive than the data found there. As acquisitions are only a subset of the expansion steps undertaken by the firms in our panel, we contacted the companies again and asked them to verify our data. Eight companies were willing to check our data for completeness and accuracy. This check revealed that we had only missed some minority holdings, but had included all investments into majority owned entities. In the end, we were able to track a total of 3503 expansion steps, of which 1996 were acquisitions and 1507 greenfield investments. We found that 2124 new affiliates, 61% of the total, were located abroad. On average, companies conducted 3.6 expansion steps per year.

### Variables

#### *Dependent variable*

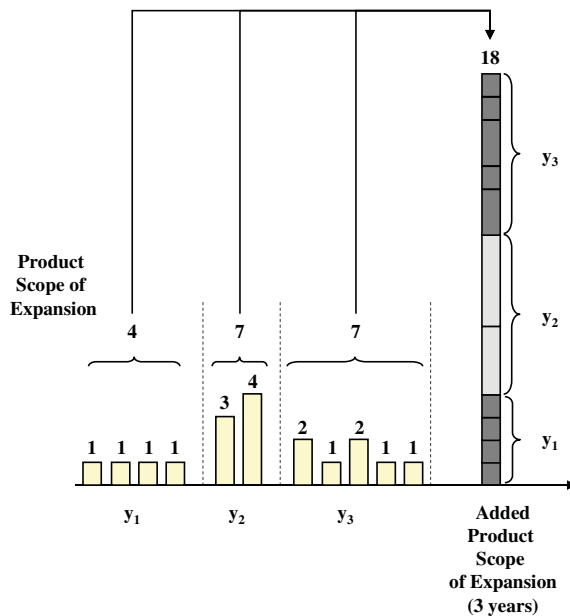
Our dependent variable is a firm's *rate of expansion*. We measure it as the number of expansion steps in a certain period of time divided by the number of entities the firm owns at the beginning of that period. We used this relative variable to account for different abilities of firms to absorb new entities depending on their size.

#### *Independent variables*

The added product scope of a given expansion step measures the relatedness of that expansion step to the business portfolio of the expanding firm. We measured relatedness using 4-digit SIC-codes. In order to capture the scope of product expansion, we applied a measure already used by Halebian and Finkelstein (1999) and adapted it to our requirements. Although Halebian and Finkelstein

(1999) used the measure to capture the relatedness between two acquisitions, we use it to capture the complexity involved in one expansion step. Since less relatedness is associated with higher complexity, the measure fulfills our requirements. We compared the 4-digit SIC-code(s) of the expansion step with those of the existing businesses and constructed a weighting scheme.<sup>7</sup> Matches on more levels of the SIC-code indicate higher relatedness and hence lower complexity. Thus, in order to measure complexity, greater weight was assigned to any case of no match, followed by 1-digit SIC-code matches, 2-digit, 3-digit, and then 4-digit matches indicating that a no match case has the lowest relatedness and hence the highest complexity. For the calculation of the scope of product expansion we applied the following weighting scheme: We assumed a linear increase in complexity over different SIC-code matches. If the SIC-code(s) of the new expansion step and those of the firm's already existing businesses matched, the expansion step was assigned a 1 at the 4-digit level, a 2 at the 3-digit level, a 3 at the 2-digit level, and a 4 at the 1-digit level.<sup>8</sup> A no match was assigned a score of 5. Thus, the higher level of complexity associated with unrelated businesses was assigned a higher score. To measure the amount of *added product scope of expansion* within a given time period, we summed the complexity scores of all expansion steps within the period of analysis. This procedure is visualized in Figure 1. The sample firm represents the average firm of this study that expands with 11 steps and an added product scope of expansion of 18 per 3-year period. In year 1, the sample firm expands with four expansion steps, each in an industry where it has already been active (added product scope = 4). In the second year, it expands with two steps—one matching at the 2-digit level and the second matching at the 1-digit level (added product scope = 7). In year 3, it expands with five expansion steps. Two of these steps match at the 3-digit level whereas all other steps are into industries where the firm is already been active (added product scope = 7). Over 5 years, the complexity scores of the 11 expansion steps sum up to the added product scope of expansion of 18. We decided to measure added product scope over a period of 3 years in order to homogenize our research setting with already existing studies in this stream of research (e.g. Tan, 2003; Tan and Mahoney, 2005).





**Figure 1.** Example of construction for variable 'added product scope of expansion'.

Although the measurement of relatedness using measures based on SIC classification is a common practice in strategic management research (e.g. Palepu, 1985; Morck *et al.*, 1990), the use of these measures has been widely criticized (Nayyar, 1992; Farjoun, 1994; Robins and Wiersema, 1995; Silverman, 1999). To overcome this criticism, several scholars have constructed alternative measures that are closer to the concept of relatedness and thus have better content validities (e.g. Farjoun, 1994; Robins and Wiersema, 1995; Fan and Lang, 2000). In response to these criticisms, we followed two alternative approaches to measure relatedness presented by Fan and Lang (2000) and Robins and Wiersema (1995). Based on their approaches, we constructed alternative measures for added product scope of expansion, a vertical relatedness, and a measure of complementarity based on Fan and Lang (2000) as well as a measure of technology based on Robins and Wiersema (1995).<sup>9</sup>

We calculated the variable *degree of internationalization* as the percentage of expansion steps into foreign geographic markets over all expansion steps within the period of analysis. The variable *level of product diversity* measures the spread of a firm's businesses at a point in time and indicates the complexity with which managers have to cope when managing the

diversified portfolio of firm activities.<sup>10</sup> We calculated the level of diversity by applying the entropy measure of Palepu (1985). This measure is based on the reported business segments in which the firm is active and on their respective sales. *Level of international diversity* measures the average cultural distance between the subsidiaries of a company. We calculated for every company the sum of the cultural distances between each pair of subsidiaries and divided it by the number of pairs. The cultural distance between subsidiaries was measured by Kogut and Singh's (1988) index based on Hofstede's four dimensions (1980).

#### *Control variables*

We employed several sets of control variables. First, we controlled for *size* effects. As prior research indicates, initial size may influence a firm's rate of expansion (e.g. Samuels and Smyth, 1968). Size was measured as the average sales (in million euros) at the beginning of each year during the initial time period. Second, we controlled for the firm's *capital structure* since this may affect its ability to expand (Hitt *et al.*, 1997; Vermeulen and Barkema, 2002). This variable was measured as the debt ratio of the firm, which is defined as total liabilities over total assets in the specific year. We also measured it as an average during the period of analysis. Third, as others have done, we controlled for the *degree of acquisition* since learning effects might occur if a firm repeats a specific entry mode (e.g. Barkema *et al.*, 1997; Barkema and Vermeulen, 1998). We calculated this measure as the percentage of acquisitions in all expansion steps within the period of analysis. We also entered the square of this measure. Fourth, we controlled for the *level of ownership*. Several studies have found both positive and negative influences associated with this factor (e.g. Kogut, 1988; Pennings *et al.*, 1994; Lane *et al.*, 2001). The variable level of ownership was calculated as the average percentage of ownership in all expansion steps the firm conducted during the period of analysis. Fifth, we introduced the variable *slack* to account for different availabilities of excess resources to handle expansion. Lead by the research of Bourgeois (1981), we measured available slack with data retrieved from the balance sheet of the firms. We used the current ratio that measures the extent to which current assets cover current liabilities as a proxy for

financial slack (e.g. Cho and Hambrick, 2006; Herold *et al.*, 2006). Sixth, since the estimated effects may change over time, we also included *year* dummy variables.

### *Analysis*

We computed our independent and control variables for moving 3-year period and the dependent variable for each subsequent 3-year period, a length of time that has been used in previous research on a similar topic (Tan, 2003; Tan and Mahoney, 2005). Thus, we had 454 observations, the number of companies times the number of consecutive time periods in our panel, for which all variables were available.

Since the use of ordinary least squares without any specification to estimate panel data, i.e. sampling observations from a single company over more time periods, may result in biased estimates (e.g. Bergh, 1993), we used several specifications. First, we used a fixed-effects model to control for unobserved heterogeneity (e.g. Greene, 2003). The application of Hausman's specification test led us to use a fixed-effects model as the assumption of random-effects models, namely that the firm-level random effects are not correlated with the other regressors, was violated ( $p < 0.001$ ) (Hausman, 1978). Fixed-effects models control for all constant unmeasured differences across firms that may explain differences in the dependent variable.<sup>11</sup> Second, a modified Wald statistic for group-wise heteroscedasticity in the residuals (Greene, 2003) suggested that heteroscedasticity affects our fixed-effects models ( $p < 0.01$ ). Therefore, when estimating our models we applied Huber–White sandwich estimators of variance in order to improve the efficiency of estimators and to reduce heteroscedasticity problems (White, 1980). Third, to test for serial correlation, we used a test for panel data models discussed by Wooldridge (2002). This test gave no evidence of serial correlation. Moreover, in hypothesis 2 we postulate that degree of internationalization of expansion negatively interacts the relationship between added product scope and rate of expansion. We accounted for this effect by adding an interaction term to the regression models 2 and 4. Based on suggestions by Aiken *et al.* (1991), we mean centered all continuous independent variables in models testing interactions. This facilitated interpretation

of our model coefficients and mitigated possible collinearity problems typically associated with interaction terms.

## RESULTS

Table 1 shows the descriptive statistics for all variables as well as the correlations between them. The firms in our sample are relatively large with average sales of 7.5 billion euros. We controlled for outliers and they can be ruled out as a reason for the high standard deviation. The pooling of data primarily explains the high standard deviation. Some firms showed exceptionally high growth rates during the sample period resulting in a high variance. Firm-specific differences result in high standard deviations for the other variables. Thus, the companies in our sample show relatively heterogeneous expansion patterns. On average they expanded with 11.1 new establishments per 3-year period, though some did not expand at all during this time interval and others started or acquired many new entities—up to 145. Some companies in the sample more than doubled their initial number of subsidiaries, in one case 600%, and on average, they increased their initial base of entities by 23% per 3-year period. Expanding firms owned 85% of their new entities and 59% of expansion steps were international.

### Test of Hypotheses

Table 2 shows the regression models used for testing our hypotheses. The measurement of the dependent variable, a firm's rate of expansion, is based on expansion steps conducted by the firm during a given period relative to the number of entities the firm owns at the beginning of that period. The entire set of control variables was included in all models. Model 1 shows the control variables only. In model 2, we include variables dealing with the influence of process complexity on rate of expansion. Thus, model 2 includes the variables added product scope of expansion as well as the interaction term between degree of internationalization and the added product scope of expansion. Model 3 sums up the results for all our hypotheses related to status complexity. It includes the variables level of product diversity as

**Table 1. Descriptive Statistics and Correlations<sup>a</sup>**

Variables	Mean	SD	1	2	3	4	5	6	7	8	9	10
1. Rate of expansion	0.23	0.34	1.00									
2. Added product scope of expansion	17.51	24.31	-0.07	1.00								
3. Degree of internationalization	0.59	0.35	-0.13	0.00	1.00							
4. Level of product diversity	0.80	0.56	-0.20	0.26	0.11	1.00						
5. Level of international diversity	1.24	0.72	-0.09	-0.06	0.67	0.04	1.00					
6. Size <sup>b</sup>	7542.78	13950.07	-0.15	0.18	0.11	0.40	0.04	1.00				
7. Capital structure	0.62	0.19	-0.32	0.11	0.09	0.23	0.06	0.25	1.00			
8. Degree of acquisition	0.57	0.32	-0.17	0.07	0.08	0.26	-0.10	0.05	-0.04	1.00		
9. Level of ownership	0.85	0.21	-0.01	0.18	0.41	0.01	0.18	0.07	0.00	0.26	1.00	
10. Slack	2.14	1.19	0.02	-0.08	0.03	-0.08	0.10	-0.20	-0.35	0.05	0.03	1.00

Correlations with absolute value >0.070 are significant at the 5%.

<sup>a</sup>The mean values are for non-centered variables. Centering has no impact on standard errors and correlation coefficients.

<sup>b</sup>In million euro.

**Table 2. Results of Regression<sup>a</sup>**

Independent variables	Model 1		Model 2		Model 3		Model 4	
	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE
<i>Test of hypotheses</i>								
Added product scope of expansion			-0.004	(0.001)**			-0.004	(0.001)**
Added product scope of expansion × Degree of internationalization			-0.007	(0.002)***			-0.006	(0.002)**
Level of product diversity					-0.256	(0.126)*	-0.265	(0.116)*
Level of international diversity					-0.341	(0.109)**	-0.302	(0.107)**
<i>Control variables</i>								
Size <sup>b</sup>	-0.222	(2.320)	-1.680	(2.400)	2.390	(2.440)	1.050	(2.400)
Capital structure	0.102	(0.184)	0.150	(0.185)	0.221	(0.192)	0.251	(0.193)
Degree of internationalization	-0.057	(0.066)	0.004	(0.066)	0.064	(0.070)	0.095	(0.070)
Slack	-0.018	(0.033)	-0.018	(0.032)	-0.040	(0.035)	-0.040	(0.034)
Level of ownership	0.172	(0.157)	0.174	(0.161)	0.197	(0.175)	0.207	(0.179)
Degree of acquisition	-0.525	(0.239)*	-0.458	(0.232)*	-0.492	(0.248)*	-0.428	(0.239) <sup>†</sup>
Square rate of acquisition	0.389	(0.185)*	0.328	(0.178)*	0.319	(0.190) <sup>†</sup>	0.264	(0.182) <sup>†</sup>
Intercept	0.271	(0.160) <sup>†</sup>	0.246	(0.159)	0.817	(0.208)***	0.766	(0.205)***
Time dummy variables	Included		Included		Included		Included	
R-squared	0.165	***	0.216	***	0.236	***	0.277	***

<sup>†</sup> $p < 0.10$ , \* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ .

<sup>a</sup>Models with robust standard errors. Year dummies are omitted.

<sup>b</sup>Parameter estimates and standard errors are multiplied by 10<sup>6</sup>.

well as level of international diversity. Finally, model 4 displays the full model.

In our first hypothesis, we proposed that the added product scope of expansion with which a firm has to cope following expansion in one period negatively influences the rate of expansion in the subsequent period. This hypothesis is further supported by the significant negative coefficient of added product scope of expansion in each of the models where it is included. The coefficient of added product scope of expansion in model 2 implies that a one-unit increase in the variable in one 3-year period results on average in a 0.004 decrease in the rate of expansion in the subsequent

period. For example, our average firm that established 11 new entities over a period of 3 years would increase its added product scope of expansion by 18. Such an increase in period one would result in a decrease in the rate of expansion in the subsequent period by 0.072, or the equivalent of seven less expansions for a firm that had 100 entities at the beginning of the period.

Hypothesis 2 predicts that a high degree of internationalization has a negative moderating effect on the relationship between added product scope of expansion in one period and the rate of expansion in the subsequent period. Models 2 and 4 include the interaction term that is relevant for

testing this hypothesis. The estimates are consistently negative and significant. Thus, hypothesis 2 receives further support. This implies that a higher degree of internationalization during a first period of time negatively moderates the negative impact on a firm's added product scope of expansion in the subsequent period. However, the estimates of the degree of internationalization are not significant throughout all models suggesting that it has no direct effect on rate of expansion. The interaction effect can be illustrated as follows: Our sample firm establishes 11 more new entities over a period of 3 years. If 7 of the 11 are in a foreign country, a degree of internationalization of 0.6, the firm will reduce its rate of expansion in the following period by 0.076 ( $= -0.004 * 18 - 0.007 * 0.6$ ). However, if all of the expansions are in the firm's home country, a degree of internationalization of 0.0, the rate of expansion in the subsequent period will be reduced by only 0.072 ( $= -0.004 * 18 - 0.007 * 0.0$ ).

In hypotheses 3 and 4, we argued that the level of product and international diversity negatively influence rate of expansion. We found support for both hypotheses. Coefficients for the level of product diversity (see models 3 and 4) and those for the level of international diversity (see models 3 and 4) are both consistently negative and significant corroborating hypotheses 3 and 4. A higher level of product and international diversity both negatively influence the rate of expansion. An increase by one unit in the level of product diversity in one period would reduce the rate of expansion in the following period by 0.256; a one-unit increase in the level of international diversity would reduce it by 0.341.

Turning now to the control variables, size, capital structure, slack, and level of ownership have no significant influence on the rate of expansion. The coefficient for the degree of acquisition is negative and significant. Furthermore, the coefficients for the degree of acquisition squared are positive and significant. This suggests a U-shaped relationship between degree of acquisition and rate of expansion. The minimum point is located between 0 and 1 in all four regression models: in model 1 it is located at  $x = 0.67$ , in model 2 it is  $x = 0.70$ , in model 3 it is  $0.77$ , and in model 4 the minimum point is  $x = 0.81$ . This means that expansions that consist only of acquisitions (degree of acquisition = 1.0) or only of greenfield investments (degree of

acquisition = 0.0) show the highest rates of expansion. A possible explanation for this finding can be found in the literature of organizational learning (Levitt and March, 1988; Huber, 1991) and acquisition experience (e.g. Halebian and Finkelstein, 1999; Hayward, 2002), which suggests consistently using the same mode of expansion results in specialized learning and that firms benefit from the experience acquired and that firms benefit from the experience acquired from similar expansions. Thus, if a firm is able to learn from what it has done previously, it becomes more efficient and needs fewer resources in the present to accomplish a similar task (e.g. Argote *et al.*, 1990). This in turn saves resources that can be used for further expansion. Firms that mix their modes of expansion are less able to apply their past experience and so do not enjoy these savings.

### Robustness of Results

We conducted several alternative analyses<sup>12</sup> to test the robustness of our results. First, as the use of SIC-based measures has received substantial criticism, we repeated our analysis with alternative measures for added product scope of expansion based on input-output data (Fan and Lang, 2000) and found results similar to those of our base analyses. Neither the sign of regression coefficients nor their levels of significance changed substantially further supporting our hypotheses. We also repeated our analyses with a added product scope measure based on data by Robins and Wiersema (1995) and were able to replicate our findings.

Second, we tested an alternative-weighting scheme for our SIC-based measure. Although we applied a linear scheme for the base case, the alternative measure was constructed with over-proportional higher scores for code matches on lower levels of the SIC hierarchy representing more unrelated expansion steps. Thus, the difference between scores assigned to a step-portfolio-combination matching on the first level and that matching on the second level is greater than the difference between scores assigned to step-portfolio-combinations matching on the second and third level of the SIC hierarchy, respectively. Results were in-line with our base case and thus replicated our basic findings.

Third, we tested the robustness of our results for different period lengths, namely 2 years

( $N = 546$ ), and 4 years ( $N = 343$ ). Hypothesis 1 was supported for both periods. However, hypotheses 2, 3, and 4 were only supported for periods of 2 and 3 years. This indicates that the proposed relationships are fading over time.

## DISCUSSION

### Process Complexity, Level of Complexity, and Expansion Path

We started our argumentation with the notion that expansion is a complex and difficult task. Expanding firms are constrained in their expansion by their ability to handle complexity as there are limits to a firm's resources, capacities, and capabilities. We assumed that firms that face considerable complexity in one period might not be able to cope with it, thus causing a slow down in expansion in the subsequent period. Our results support this view. We considered in our study different characteristics of expansion that influence the complexity of expansion steps. Specifically, our results show that added product scope of expansion, which is the relatedness of newly established entities to already existing businesses in the firm portfolio, and degree of internationalization of expansion steps over a given period of time, both have a significant negative impact on a firm's expansion in the subsequent period. We can derive several implications from our results: First, they show a negative effect of a high level of expansion in a previous period on expansion in the subsequent period. This is in-line with previous studies (e.g. Shen, 1970; Tan and Mahoney, 2005). However, in contrast to these studies that use only the expansion rate as the independent variable, we modeled several different kinds of process complexity. We were able to capture complexity from expansion within and across industries. Thus, our research contributes to the dynamic perspective on the diversification phenomenon and can help to develop a richer picture of the expansion and diversification paths followed by firms. Second, our results indicate that focused expansion, that is using the same means of expanding repeatedly, allows for higher growth rates. This in turn has implications for a firm's valuation, as expected growth rates are a factor in estimating firm value. Consequently, firms that use the same means of expanding are able to show

higher growth rate and this increases firm value. Third, our findings cast light on how companies grow and thus whether their expansion process is continuous or cyclical. Our results clearly suggest a discontinuous expansion path. This is consistent with older models analyzing a firm's growth process and proposing discontinuity in growth (e.g. Greiner, 1972; Tushman and Romanelli, 1985). A study by Maitland *et al.* (2005) analyzed initial foreign investments over time and found clustering behavior and thus discontinuity in many expansion paths. A later study by Vermeulen and Barkema (2002) found a negative performance impact of irregular internationalization steps. Fourth, our results relating to process complexity imply that a firm's growth and expansion is a path-dependent process. Firms with the same level of diversity do not necessarily expand at the same rate. Their prior expansion path is equally relevant to further expansion. Consequently, the level of diversification and internationalization reached by a firm is not a perfect predictor of its future development as how that level was reached is also relevant. Fifth, our results suggest that added product scope of expansion and degree of internationalization are major sources of complexity that can influence a firm's future growth potential. Too much complexity within a given time period can exceed a firm's available resources, capacities, and capabilities. Some research indicates that maintaining and monitoring slack is relevant for firm growth (Mishina *et al.*, 2004).

Furthermore, in addition to including variables that measure complexity stemming from the process of expansion itself, we also included variables that measure the level of complexity arising from the diversity of a firm's portfolio. We were able to show that both the level of product diversity, i.e. the diversity of the portfolio of industries in which a company is doing business, and the level of international diversity, which is the diversity of the portfolio of countries in which a company is active, have a negative effect on a firm's ability to expand. Our results suggest that complexity from diversity can strain resources and as a result their supply becomes insufficient for further expansion. The strain put on management by complexity generated by a diverse portfolio has been shown in previous research. Several studies in the diversification literature suggest a negative

influence of product diversity. Grant *et al.* (1988) point to the growing strain on resources as a firm tries to manage an increasingly disparate business portfolio. The costs of managing such a portfolio, which can increase demand for resources, have also been addressed in studies looking at the optimal level of diversity (e.g. Markides, 1992; Palich *et al.*, 2000). Rugman and Verbeke (2004) write about the cost of managing a geographically spread portfolio of businesses. Our results can help explain their findings that most of the firms in their sample do not expand globally but concentrate primarily on their home region. If the complexity of managing a widespread geographic portfolio exceeds their resources and capabilities, firms will limit their focus to their home region.

Moreover, as our research framework maps different types of complexity it could be used to address further influences of complexity stemming from expansion. We have argued that complexity resulting from expansion may overstretch resources (Gary, 2005) and that the consequence of an overextension of resources is likely to lead to reduced performance. Vermeulen and Barkema (2002) have already shown that in an international context speed of expansion and the spread of markets entered negatively affect the relationship between the number of foreign subsidiaries and performance.

Although our study shows that diversity has a negative impact, there is literature suggesting positive effects of diversity and complexity. In innovation research, findings indicate that greater structural complexity is positively associated with innovation (e.g. Damanpour, 1996). Greater complexity might increase the depth of the knowledge base. In turn, an increase in depth can lead to an increase in the development of new ideas (Kimberly and Evanisko, 1981). Groups develop a greater capacity to identify, assimilate, and apply new opportunities if they are made up of individuals that are diverse with regard to their prior experiences (Cohen and Levinthal, 1990). In addition, greater multinational diversity might have a positive effect on resources as managers have more opportunities and incentives to develop competencies in different environments (Tan, 2003).

#### **Limitations and Suggestions for Future Research**

Our independent variables captured the factors determining the level of complexity that has to be

handled by the firm. Another aspect we only treated by introducing a financial slack variable is the availability of resources, capacities, and capabilities with which the firm might cope with this complexity. That availability can vary between firms and over time. Although such a variation between firms is captured using fixed-effects models, we could not incorporate the variation over time. However, there are resources, capacities, and capabilities that can only be increased incrementally (e.g. Penrose, 1959; Tan, 2003; Tan and Mahoney, 2005). For example, managers need to acquire specific knowledge and capabilities internal to the firm and doing so takes time. Thus, we would not expect to see major increases in availability of resources in the short term. In addition to this, not only is the volume of resources available important but their quality is as well. Qualitative attributes, like management team characteristics, are worthy of examination in this regard (Eisenhardt and Schoonhoven, 1990). The level of experience of managers also plays a crucial role. Literature on acquisitions, for example, showed the positive results of experience (Hitt *et al.*, 1998). Furthermore, the expansion process requires a firm to detect opportunities for growth, process information, and initiate projects. Therefore, a firm needs capabilities to identify and acquire knowledge, to assimilate this knowledge, to transform it, and to exploit it to commercial ends, a capability that has been called 'absorptive capacity' (Cohen and Levinthal, 1990; Zahra and George, 2002). Factors like different organizational forms (Van Den Bosch *et al.*, 1999) or learning structures (Lane *et al.*, 2001) can facilitate the assimilation and transformation of new knowledge and thus influence a firm's absorptive capacity. Unfortunately, these data were not available for our longitudinal research setting. Gathering of such data entails severe problems since the constructs are either difficult to measure or hard to survey. Annual reports only provide limited information on the amount of resources, e.g. the number of board members. They do not give information on the quality of resources nor on the availability and quality of certain capabilities. This information might be captured through a detailed survey but, given that there may be non-respondents, this might well lead to a reduction in the size of the sample. Moreover, such an approach would be unlikely to provide historic data for 20 years. This

could possibly be done with a detailed case study based on comprehensive interviews though doing that, in turn, is not feasible for the entire sample of 91 firms. Other scholars faced the same problems and followed a similar line of argumentation that led them to not include the availability perspective into their studies (Vermeulen and Barkema, 2002; Tan and Mahoney, 2005).

We included the variable added product scope of expansion and degree of internationalization in our analysis to address complexity resulting from expansion. However, there are other characteristics of expansion steps that can influence the level of complexity as well. The relationship, as postulated in hypothesis 1, between added product scope of expansion in one period and rate of expansion in the subsequent period might be influenced by competition. Whether the managerial intentionality of expansion is to imitate a move of a firm considered being a competitor or whether it is to innovate might influence the associated complexity (Hutzschenreuter *et al.*, 2007). However, due to our longitudinal research setting, we were not able to obtain reliable data on the construct managerial intentionality or on the competitive environment of the product and geographic segments. Future studies might incorporate the size of steps relative to company size for example. A relatively small and unimportant step may add less complexity than an expansion step that accounts for a large fraction of the overall firm. Nevertheless, each expansion step is associated with a basic level of complexity that strains resources to some extent. Some tasks, implementation for example, are size-related while others, such as the search for investment opportunities, the evaluation of what is entailed in each step, and the many decisions that must be made during the expansion process itself are independent of step size. Firm characteristics can also facilitate the handling of complexity. The organizational form can have an influence. For example, multidivisional structures may lower the need for coordination between subsidiaries as each may have its own business unit specific resources and capabilities (e.g. Hoskisson and Johnson, 1992). We have addressed this in part by comparing each newly established entity with the one that is the most similar to it in the firm's portfolio. Moreover, different coordination mechanisms will require different levels of attention by management (Tan and Mahoney,

2005). While output control will not require substantial time and effort by headquarters, behavior or social control will (March and Simon, 1958; Mintzberg, 1979). These factors are worthy of consideration in future research though we ourselves were bound to secondary data that did not permit their inclusion in our study.

We incorporated alternative relatedness measures and in so doing, made two assumptions: First, we used data originally calculated for US industries as we did not have access to adequate German data. We assumed that the relatedness between two industries using US data could be applied to German companies. However, it can be argued that our sample firms do not solely compete within Germany but rather internationally. Second, we used input-output data for the year 1992, assuming the relatedness measure remained constant over the time of our study. Future studies could calculate the measures based on German data and for other years.

## CONCLUSION

In this study, we showed that firm development in one period of time influences its development in the subsequent period. This indicates that a firm's expansion is a path-dependent process. Our view that complexity of expansion steps in one period of time negatively influences the rate of expansion in a subsequent period is strongly supported. Specifically, we were able to show that added product scope of expansion and degree of internationalization are major sources of complexity in the expansion process. Moreover, both the existing level of complexity of a firm's portfolio of activities and complexity that stems from expansion itself have an influence on a firm's future rate of expansion. This study is an attempt to contribute to the small, but growing literature on the expansion path of firms. Specifically, it helps to enrich the discussion on a firm's diversification process. Hence, it ties in with Gary's request that 'there is clearly a need to build a richer theory about diversification [...] capturing the dynamic nature of diversification profiles' (Gary, 2005, p. 644). However, further dynamic research is needed if we are to have a comprehensive understanding of a firm's expansion and diversification path and on the factors that influence this path.

We can draw a number of implications from our study of interest to scholars, managers, and investors. Scholars should continue to explore the dynamic nature of the diversification phenomenon. Therefore, more longitudinal research on this topic is required. Specifically, the performance impact of different expansion paths seems to be a promising area of research as research on the performance impact of diversification has not so far produced conclusive results (e.g. Datta *et al.*, 1991; Palich *et al.*, 2000). Research to date has addressed the issue primarily by analyzing the relationship between a firm's level of diversity at a certain point in time and its performance. Although the literature on diversification has pointed to the dynamic nature of the diversification phenomenon, neither the way in which firms diversify and reach their levels of diversity nor the performance impact of the expansion path have received adequate attention. To date the literature has stressed that a firm's diversification program is a path-dependent process (Kim and Kogut, 1996), that it can take several years before the full performance impact of a diversification step can be assessed (Biggadike, 1979), that diversification profiles change extensively over short periods of time (Gary, 2005), and that other factors that can only be analyzed over time such as process mechanisms and implementation issues (Nayyar, 1992; Larsson and Finkelstein, 1999) are essential for performance evaluation. In spite of the fact that scholars have questioned the possibility of gaining new empirical insights from the cross-sectional examination of the relationship between different measures of diversity and performance (e.g. Ramanujam and Varadarajan, 1989; Gary, 2005) little longitudinal research has been done. Our results have some practical implications. Given the limited nature of a firm's resources and capabilities and the implication of this for future expansion, managers must judiciously decide the number and the type of expansion steps the firm should undertake. This is in line with the findings by Gary who concluded that 'management's role is to choose the appropriate time path of investment' (2005, p. 652). As resources and capabilities can only be increased incrementally, their expansion should be planned in advance with strategic foresight. Furthermore, managers must consider the path dependency of expansion decisions. Today's decisions regarding expansion projects

will influence the future size of the firm and thus also the demand for resources to run operations. Finally, our results are relevant for investors as the expansion path may influence firm performance. Firms with a moderate rate of expansion in the present period are less likely to overextend their resources leading to reduced quality and thoroughness that ultimately may have negative performance implications. Moreover, focused firm expansion favors continuously high expansion rates. Since future expansion rates are one element used in the evaluation of firm performance, firms that are able to maintain high growth rates are more likely to receive high market valuations.

## NOTES

1. The HDAX is a combined index consisting of the segments DAX30, MDAX, and TecDAX and thus contains the most important firms of the Prime Standard of the German Stock Exchange.
2. For those companies belonging to the HDAX in 1994 we collected data back to 1985 where possible.
3. We excluded financial holdings, real estate companies, retailers, and financial institutions since they differ significantly in their business models. Moreover, we excluded cross-listed firms with headquarters outside of Germany in order to homogenize the sample and to avoid mediating effects of external factors such as different taxes and labor costs (McDougall and Oviatt, 2000).
4. We have chosen 50% for our study since this determines the border of the company. Managers are usually not able to exercise control over minority-owned subsidiaries. This in turn influences the kind of decisions and tasks managers are able to undertake. Ultimately, complexity associated with these tasks and decisions is also reduced. Moreover, minority-owned subsidiaries are, in the majority of cases, financial and not strategic investments, which by definition influences complexity and demand for resources and capabilities.
5. We included all new affiliates regardless of whether they were greenfield investments or acquisitions or whether they were domestic or foreign subsidiaries.
6. With the introduction of the KonTraG (regulatory standard) in 1998, listed companies in Germany must include in their list of affiliates in which they own five% or more.
7. We compared the SIC code of the new subsidiary with that of the most similar subsidiary in the portfolio. This approach is similar to the WARN measurement described by Teece *et al.* (1994). We have chosen this approach rather than a comparison to all existing businesses since a firm can use knowledge spill over from existing businesses to run a new business. The amount of newness and the



- amount of new knowledge that has to be acquired depends upon the knowledge embedded in the most similar business and its distance. Consequently, we computed for every new subsidiary the distance to all already existing businesses and took only the smallest one into account. Thus, we were able to incorporate learning effects from prior expansion steps and the knowledge inherent in existing businesses.
8. The concentric index (Caves *et al.*, 1980), which is a common measure for company diversity, uses a weighting scheme that distinguishes between different levels of the SIC hierarchy in a similar way.
  9. In order to capture complexity per step and to make the measure comparable with the SIC-based measure, we inverted the scores and transformed them into a 1–5 point range. To calculate added product scope of expansion we applied the same aggregation logic as in the SIC-based approach.
  10. We measured product diversity in the last year of period 1, which is in the base case year 3. Thus, this variable represents the status at the end of the final year of period 1 and correspondingly at the beginning of the first year of period 2, hence, at the beginning of the period of analysis of the dependent variable. The independent variable level of international diversity as well as the control variables sales and capital structure were measured for the same point in time. Although sales figures measure a flow, in our framework sales is used as a status variable at the end of the year.
  11. With the use of fixed-effect models industry dummies are not necessary, as industry membership did not vary among our sample firms during the time period studied and fixed-effect models control for variance due to time-invariant characteristics (Carpenter and Fredrickson, 2001). Consequently, industry dummies were not included in our models. The same holds true for a possible variable controlling for attrition. We could not survey data for 20 years for all of our sample companies. Thus, our data sample has an unbalanced panel structure that could cause serious biases. One possibility to check for sample selectivity bias in panel data is to perform an Added-Variable procedure (or Quasi-Hausman test) as suggested by Verbeek and Nijman (1992). However, since the attrition variable is constant for each firm and does not change over time, the inclusion of fixed-effects firm dummies already controls for this and the adding of another such variable would not change the estimation results.
  12. Tables with results of regression for these alternative analyses can be provided on request.
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