ORGANIZATIONAL SLACK AND NEW PRODUCT TIME TO MARKET

Gregory N. Stock, College of Business, University of Colorado at Colorado Springs, Colorado Springs, CO 80918, 719-255-3359, gstock@uccs.edu

Noel P. Greis, Kenan Institute of Private Enterprise, University of North Carolina Chapel Hill, NC 27599, 919-962-8201, noel_greis@unc.edu

William A. Fischer, IMD, Ch. de Bellerive 23, P.O. Box 915, CH-1001 Lausanne, Switzerland, +41 (0)21 618 0111, Email: bill.fischer@imd.ch

ABSTRACT

Using archival data from the computer modem industry over a 24-year period, this paper examines the relationship between organizational slack and new product time to market performance. In particular, this paper uses Cox regression to test the hypothesis that greater levels of slack will be associated with earlier time to market for a firm’s products. Time to market performance is measured as the time between the start of a product generation and the introduction of a firm’s products. The results support the hypothesized relationship. We conclude by discussing the implications of these results for research and practice.

BACKGROUND

Organizational slack is often viewed as harmful and wasteful to a firm (Leibenstein, 1969). Slack can represent unused resources that increase costs and potentially reduce the profits of a firm. However, organizational slack may instead be a positive for a firm (Bourgeois, 1981; Cheng and Kesner, 1997). One manifestation of slack is more time that is uncommitted and available. Extra time might be used for learning and creativity, and in some cases, will allow a firm’s employees to be more innovative. In particular, slack can allow a firm to develop a greater number of innovative products, as well as products that are more innovative. For example, 3M and Google, which are known as a very innovative companies, allow their workers to devote 15% and 20% of their time, respectively, to projects of their own choosing, which can be considered to be a form of slack (Baldwin, 2012). Moreover, the scholarly literature has provided evidence that slack can be associated with greater levels of innovation (Bourgeois, 1981; Cheng and Kesner, 1997; Mohr, 1969; Singh, 1986).

Product innovation can be critical to a firm, and in particular, the stream of new products that a firm introduces to the market over time may play an important role in a determining a firm’s competitive success (Rosenthal, 1992). One of the key variables in the management of new product development is the timing of the introduction of new products (Bayus et al., 1997). In this paper, we investigate how new product time to market might be related to the level of organizational slack within a firm, and in particular, we employ archival data from the computer modem industry in our analysis of this relationship.
The literature on new product development has considered the effects of introducing products more quickly and earlier than competing firms. Particularly in fast-growing markets, introducing a product early to market can result in greater profits (Blackburn, 1990). There is a large body of research that adopts the perspective that faster new product development is better and focuses on managerial approaches to reducing the time it takes to develop new products. Some of these factors include human resource management, cross-functional integration, closer supplier relationships (Droge et al., 2000), defining stable goals and using a rigorous design process (Lynn et al., 1999), management style (Clift and Vandenbosch, 1999), tenure of development team members (Kessler and Chakrabarti, 1999), the organizational structure of the product development team (Datar et al., 1997). Although the literature provides somewhat contradictory evidence on whether being early to market is positive or negative, it is clear that the issue is important and has generated interest among researchers in a variety of disciplines.

The timing of product introductions has also been examined from a strategic perspective. This stream of literature, which we will refer to as the first-mover literature, focuses on the merits of being first to adopt an innovation or introduce a product to market. Related literature considers not just the first mover but those organizations that are early to adopt or introduce an innovation. The principal issue of interest is whether being a first mover or early mover provides a competitive advantage to the firm. The evidence is mixed on this question. In some cases, first movers may realize benefits from being first to market by capturing learning curve effects before competitors (Lieberman, 1988); however, in other cases, firms that choose to wait and become a “fast second” may avoid the market risks first movers take and enjoy the greatest advantage (Shepherd, 1990; Scherer, 1990). Research specifically examining new product development has found that delays in new product introduction are negatively related to profitability (Hendricks and Singhal, 2008). This literature rarely, if ever, suggests that introducing products late to the market confers any advantages.

Organizational slack has been defined to be resources in an organization that are in excess of the minimum actually required to produce a given level of output (Nohria and Gulati, 1996). Organizational slack can take many forms, including excess financial resources (Cheng and Kesner, 1997; Sharfman et al., 1988; Nystrom et al., 2002), excess inventory, excess machine capacity (Sharfman et al., 1988), and excess labor (Sharfman et al., 1988; Nystrom et al., 2002; Kidd and Richter, 2001). Two opposing views of the role of slack in an organization can be found in the literature. One perspective views slack as positive. Slack provides excess resources and allows managerial controls to be relaxed, which allows managers more freedom in deciding which activities a firm may pursue (Geiger and Cashen, 2002). Slack also encourages a firm to engage in more risky projects because the excess resources afforded by slack enables the organization to absorb the failure associated with potentially uncertain outcomes (Geiger and Cashen, 2002; Nystrom et al., 2002). Slack has also been found to encourage creativity and experimentation (Nystrom et al., 2002). Although it was not the focus of their research, Atuahene-Gima (2005) and Atuahene-Gima et al. (2005) found that slack was positively related to new product development performance. As a result, slack may promote innovation (Geiger and Cashen, 2002; Nystrom et al., 2002; Damapour, 1987) or enhance a firm’s ability to respond to shifts in its environment (Cheng and Kesner, 1997).
We examine in particular whether there is a relationship between organizational slack and the timing of new product introductions relative to competing products. Speed in new product development is typically considered to be desirable and indicative of a greater level of competency in a firm’s new product development capabilities. As a result, time to market is often viewed an important measure of product development success (Brown and Eisenhardt, 1995). Therefore, to the extent that earlier product introduction is viewed as an indication of better product development, we would expect a positive relationship between organizational slack and the earlier timing of new product innovations to lead to better business outcomes.

New product introduction time to market performance is often assessed relative to a particular product generation. A product generation refers to a group of products that share a basic technological characteristic which makes them relatively similar. For example, generations of DRAM integrated circuits may be delineated on the basis of storage capacity, with 4 kilobit DRAMs in one generation, 16 kilobit DRAMs in another generation, 64 kilobit DRAMs in a third generation, and so on. Successive generations occur over time, although they generally overlap to some extent (Norton and Bass, 1992). Therefore, time to market performance is measured in this paper as the time from the start of a generation to the time a new product is introduced.

In developing our research hypothesis, we start with findings in prior literature that suggests that organizational slack is positively related to business performance (Daniel et al., 2004) and innovation (Bourgeois, 1981; Nystrom et al., 2002; Damampour, 1987). It would stand to reason that the characteristics of organizational slack that allow a firm to develop more innovative products would also provide the firm with the ability to develop and introduce those products more quickly. For example, slack provides excess resources that might be devoted to speed up the innovation and development process. The project management literature in particular, has generally recognized that excess resources provided by organizational slack can lead shorter project completion times when used appropriately. In fact, there is an implicit assumption in basic project management models that there is a trade-off between resources and completion time, where greater levels of resources allocated to a project will result in a shorter finishing time (Meredith and Mantel, 1995). Because new product development is inherently a project-based activity, shorter project completion times enable a firm to introduce its products more quickly, all other factors held equal. In addition, elementary queuing theory suggests that lower levels of resource utilization, which is equivalent to greater slack, will lead to faster task completion times (Cachon and Terwiesch, 2009; Karmarkar, 1987; Rajagopalan and Yu, 2001).

To summarize, we would expect that greater levels of slack would enable a firm to develop and introduce its new products earlier than the products of competing firms. Therefore, our research hypothesis follows:

\[ H1: \text{There is negative relationship between organizational slack and the time between the start of a product generation and the introduction of a firm's products in that generation. That is, greater organizational slack will be associated with better new product time to market performance.} \]
METHODOLOGY

Data

To examine this topic, we focus on a single industry, namely the computer modem industry. A *modem* (modulator-demodulator) is a device that converts (modulates) digital data signals used in computers to analog signals transmitted over telephone lines. At the receiving end, another modem converts (demodulates) the analog telephone line signals back into digital signals to be used by the receiving computer. The modem was invented in 1957 at AT&T (Bunch and Hellemans, 1993). However, until the middle 1980s, the modem was primarily an industrial product, used to connect remote terminals and computers to central mainframe machines. In the later 1980s and early 1990s, there was considerable speculation that the modem had reached the limits of its technical performance, and perhaps its life cycle. However, two related developments gave the modem new life and fueled the growth of the market in this product. First, the boom in personal computer sales drove the market for new products that could be used with personal computers. The second major development was the explosive growth of the Internet. Although dedicated broadband connections have become ubiquitous, telephone line modems were still in wide use through the middle of the first decade of the new millennium.

The telephone modem industry provides an attractive setting for this study for a number of reasons. The industry was technology-intensive, meaning that the technological performance of a firm’s products is probably a key determinant of the firm’s market success. There was also a fairly wide range of electronic technologies embodied in a modem (i.e., both analog and digital circuitry; both hardware and software; large, complex integrated circuits such as microprocessors as well as simpler integrated circuits). The technical performance of modems increased many-fold over the industry’s lifetime. The underlying technology itself in this industry has undergone substantial change as well. In particular, the basis for technological competence for firms in this industry has evolved from the design and use of proprietary, dedicated hardware to the design and use of proprietary software running on general-purpose hardware. This evolution has mirrored similar changes seen in computers and peripheral products such as printers and disk drives. From an organizational perspective, there was a diverse group of large and small firms developing and manufacturing modems. The industry included well-known firms such as IBM and Motorola, as well as lesser-known companies such as Boca Research.

The data set was constructed by combining data from several separate archival sources. Data were collected for the period from 1970 through 1993. One data subset, which measures product innovation timing, was constructed from yearly modem industry overview reports from Datapro Research, Inc (*Datapro, Inc.*, 1976-1993). Datapro, a subsidiary of McGraw-Hill, Inc., is a firm that collected information and published reports on many segments of the information technology industrial sector, including software, computers, and data communications equipment. This series of publications provides detailed information about modem manufacturers on a yearly basis. Each of these overview reports provides a discussion of the technical operation of modems, new technical advances in the industry, activity by leading firms in the industry, and most importantly for this study, a comprehensive listing of modem products offered for sale during the year of the report. A set of reports listing products introduced in the years 1970 through 1993 was purchased from Datapro. The information for each product

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included the company selling the product, the model name or number, technical specifications, the year the product was first sold, and other information. The technical specification of data transmission rate in bits per second and the year of introduction were the two items that were used to determine the timing of product innovation for the firms in this study. The details of how this measure was constructed are provided below.

Data for each firm’s number of employees and sales, which were used to create a measure of organizational slack, were obtained from a variety of archival sources, including Standard and Poor’s Compustat data base of information on publicly traded firms and industry directories such as Standard and Poor’s Register of Corporations, Corporate Technology Directory, and Ward’s Directory of Corporations (Corporate Technology Directory, 1986-1994; Ward’s Directory of Private and Public Corporations, 1987-1994; Standard and Poor’s Register of Corporations, 1975-1994). Both the product data set and the firm variable data set were constructed on a year-by-year basis and included firms in the industry in each year. We also note that there are a number of limitations of our data set. Restricting the study to a single industry and product type may limit the extent to which its results can be generalized. However, limiting the study to modem manufacturers allows us to control for industry effects that might otherwise confound our analysis.

**Variables**

We conceptualize new product time to market performance as the length of time a firm’s products are introduced after the start of a product generation. We define two distinct but related measures. The first measure, TIME_MEAN, is defined to be the difference between the mean year of introduction for a firm’s products in a product generation and the starting year of that generation. The second measure, TIME_FIRST, is the difference between the year of introduction for a firm’s first product in a generation and the starting year of that generation. One measure (TIME_MEAN) reflects the time to market performance for a firm’s overall set of products during a generation, while the other (TIME_FIRST) reflects the time to market performance for a firm’s earliest product in a generation.

The dominant technological performance parameter for a modem is its data transmission rate in bits per second (bps). In order to maintain compatibility of data communication among modems of different manufacturers, modems use standard data transmission rates, and standard methods for transmitting and receiving data. Therefore, we have categorized seven product generations in our sample by these standard data transmission rates: 300 bps, 1200 bps, 2400 bps, 4800 bps, 9600 bps, 14400 bps, and greater than 14400 bps. The products introduced cover the years from 1970 through 1993. For each generation, the starting point is defined to be the year in which the first new product was introduced during that generation. The next step was to calculate TIME_MEAN and TIME_FIRST for each firm in each generation as described above.

The explanatory variable in which we are interested is organizational slack. As we noted above, slack has been defined as a “pool of resources in an organization that is in excess of the minimum necessary to produce a given level of organizational output” (Nohria and Gulati, 1996, p. 1246). Slack has been operationalized in several different ways in the literature. A common approach is to use financial measures, such as the quick ratio; selling, general, and administrative
expenses divided by sales; or debt to equity ratio (Geiger and Cashen, 2002; Cheng and Kesner, 1997). However, in our sample, most firms are privately held and these types of financial measures are not available. Other literature has included excess or redundant labor as components of organizational slack (Kidd and Richter, 2001; Sharfman et al., 1988; Nohria and Gulati, 1996). Our sample does provide data for firm sales and the number of employees in the firm. We therefore draw on this excess labor conceptualization to construct a measure of organizational slack. We measure slack as the number of employees divided by the firm’s sales, which is consistent with the definition of slack as resources (in this case, employees) in excess of what is required to produce a given level of organizational output (in this case, sales). This measure has also been used in prior literature (Azadegan et al., 2013). Although this measure does not directly capture the level of excess labor for a given level of sales, it does differentiate among slack between the firms in the sample in a relative sense. A firm with a larger value of this measure would have a larger pool of employees for a given level of sales, which reflect greater levels of slack. This measure is calculated by dividing the number of employees by the sales in constant 1987 dollars. Constant 1987 dollars were computing by dividing yearly sales by the appropriate yearly GDP deflator value (Economic Report of the President, 1994). The yearly slack value is then averaged to provide a mean value of slack over each generation. A log_{10} transformation for the slack variable was used to reduce the skewness in the data for this variable.

We also include several control variables in our analysis. The first is firm size (FIRM_SIZE), measured by the log_{10} of the number of employees. Firm size was included because firm size has often been hypothesized to be related to technological innovation in prior literature (Acs and Audretsch, 1991; Kamien and Schwarz, 1982; Damanpour, 1987). In addition, other literature has found that organizational size is related to the order of entry into a market (Schoenecker and Cooper, 1998). The second control variable we consider is the number of products introduced by a firm within a generation. Prior research has suggested that the breadth of a firm’s product line is related to whether a firm is a “market pioneer” (Kalyanaram et al, 1995), and this measure provides a surrogate of product breadth within a generation. We also included product generation dummy variables to account for any systematic effects that might be related to a particular generation. There are seven product generations, so we included six product generation dummy variables, where the seventh generation is the reference group. These dummy variables are named GEN1, GEN2, GEN3, GEN4, GEN5, and GEN6. The variable has a value of 1 if the observation takes place during the corresponding generation and 0 otherwise. Table 1 provides descriptive statistics and correlations for these variables. Table 2 lists the starting, ending, and midpoint years, as well as the number of products introduced in each generation.

**RESULTS**

We employed Cox regression to evaluate our research hypothesis, where the measure of new product time to market performance was the time interval between the start of a product generation and the introduction of a firm’s products, as described above. The Cox regression models the effects of predictor variables on the probability that an event has occurred, and the dependent variable is the time until that event occurrence. This analytical approach has been used to examine similar relationships in prior literature. For example, Puranam et al. (2007) used Cox regression to examine factors affecting the launch of new products, and Prieger (2007) used
Cox regression to examine delays in the introduction of product innovations by regulated firms. In our case, the event is the introduction of a firm’s products during a generation. A positive coefficient would indicate a higher probability that the event has occurred, so a positive coefficient would show that the predictor variable would be associated with earlier product introduction. We have used a fixed effects model to account for time-invariant firm effects in the data (Allison, 2010).

**TABLE 1**

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>S.D.</th>
<th>1.</th>
<th>2.</th>
<th>3.</th>
<th>4.</th>
<th>5.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. FIRM_SIZE</td>
<td>2.74</td>
<td>1.16</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. SLACK</td>
<td>1.01</td>
<td>0.22</td>
<td>0.29**</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. N_PRODUCTS</td>
<td>4.41</td>
<td>4.37</td>
<td>-0.16*</td>
<td>0.05</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. TIME_MEAN</td>
<td>12.07</td>
<td>5.50</td>
<td>-0.28**</td>
<td>-0.29**</td>
<td>0.24</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>5. TIME_FIRST</td>
<td>10.36</td>
<td>6.08</td>
<td>-0.24**</td>
<td>-0.33**</td>
<td>0.01</td>
<td>0.91**</td>
<td>1.00</td>
</tr>
</tbody>
</table>

* p < 0.05 level, ** p < 0.01
N = 232

**TABLE 2**

<table>
<thead>
<tr>
<th>Generation</th>
<th>Transmission Rate</th>
<th>Start</th>
<th>Midpoint</th>
<th>End</th>
<th>Number of products</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>110 – 300 bps</td>
<td>1970</td>
<td>1979</td>
<td>1987</td>
<td>139</td>
</tr>
<tr>
<td>3</td>
<td>1400 – 2400 bps</td>
<td>1970</td>
<td>1987</td>
<td>1993</td>
<td>573</td>
</tr>
<tr>
<td>4</td>
<td>3200 – 4800 bps</td>
<td>1970</td>
<td>1985</td>
<td>1993</td>
<td>134</td>
</tr>
<tr>
<td>5</td>
<td>7200 – 9600 bps</td>
<td>1974</td>
<td>1989</td>
<td>1993</td>
<td>169</td>
</tr>
<tr>
<td>7</td>
<td>16800 – 28800 bps</td>
<td>1986</td>
<td>1993</td>
<td>1993</td>
<td>23</td>
</tr>
</tbody>
</table>

As described above, we employed two different measures of product innovation timing as dependent variables. The first, TIME_MEAN, is the difference between the average year of a firm’s product introductions during a generation and the first year of the generation. The second measure, TIME_FIRST, is the difference between first year in which a firm introduces a product in a generation and the first year of the product generation. The independent variables were the N_PRODUCTS, FIRM_SIZE, product generation dummy variables, and SLACK. The results of the Cox regressions are shown in Table 3. The coefficient for SLACK is positive and statistically significant, which indicates that higher levels of slack are positively related to the probability of earlier product introduction in a generation.

**DISCUSSION AND IMPLICATIONS**

The results of the data analysis showed support for the hypothesized positive relationship between organizational slack and earlier time to market for new products. They were consistent with earlier research showing a positive relationship between slack and performance (e.g., Bourgeois, 1981; Nystrom et al., 2002) but differed to some extent from those of Nohria and Gulati (1996) and Geiger and Cashen (2002), which both found a curvilinear inverted-U shaped
relationship between slack and innovation. Our analysis considered a different dimension of performance – the new product development time to market rather than firm or product innovativeness (Nohria and Gulati, 1996; Geiger and Cashen, 2002). In addition, these earlier studies employed very different approaches to measuring organizational slack. One used a questionnaire-based measure related to a firm’s employee and budget resources (Nohria and Gulati, 1996), and the other used financial measures of quick ratio; selling, general, and administrative expenses divided by sales; and debt to equity ratio (Geiger and Cashen, 2002). In contrast, our study uses a different measure of slack as the ratio of the number of employees to sales (Azadegan et al., 2013).

TABLE 3

<table>
<thead>
<tr>
<th>Variable</th>
<th>TIME_MEAN</th>
<th></th>
<th>TIME_FIRST</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Model 1</td>
<td>Model 2</td>
<td>Model 3</td>
<td>Model 4</td>
</tr>
<tr>
<td>GEN1</td>
<td>-4.45 **</td>
<td>-5.35 ***</td>
<td>-2.26 **</td>
<td>-2.80 ***</td>
</tr>
<tr>
<td>(Std Error)</td>
<td>(1.35)</td>
<td>(1.45)</td>
<td>(0.80)</td>
<td>(0.85)</td>
</tr>
<tr>
<td>GEN2</td>
<td>-4.78 ***</td>
<td>-5.59 ***</td>
<td>-2.18 **</td>
<td>-2.57 ***</td>
</tr>
<tr>
<td>(Std Error)</td>
<td>(1.30)</td>
<td>(1.38)</td>
<td>(0.72)</td>
<td>(0.75)</td>
</tr>
<tr>
<td>GEN3</td>
<td>-5.93 ***</td>
<td>-6.75 ***</td>
<td>-3.31 ***</td>
<td>-3.71 ***</td>
</tr>
<tr>
<td>(Std Error)</td>
<td>(1.32)</td>
<td>(1.41)</td>
<td>(0.78)</td>
<td>(0.82)</td>
</tr>
<tr>
<td>GEN4</td>
<td>-6.13 ***</td>
<td>-6.87 ***</td>
<td>-3.33 ***</td>
<td>-3.69 ***</td>
</tr>
<tr>
<td>(Std Error)</td>
<td>(1.33)</td>
<td>(1.41)</td>
<td>(0.77)</td>
<td>(0.80)</td>
</tr>
<tr>
<td>GEN5</td>
<td>-4.66 ***</td>
<td>-5.21 ***</td>
<td>-2.34 ***</td>
<td>-2.59 ***</td>
</tr>
<tr>
<td>(Std Error)</td>
<td>(1.29)</td>
<td>(1.36)</td>
<td>(0.72)</td>
<td>(0.74)</td>
</tr>
<tr>
<td>GEN6</td>
<td>-0.82</td>
<td>-0.81</td>
<td>-0.33</td>
<td>-0.32</td>
</tr>
<tr>
<td>(Std Error)</td>
<td>(0.87)</td>
<td>(0.87)</td>
<td>(0.65)</td>
<td>(0.68)</td>
</tr>
<tr>
<td>N_PRODUCT</td>
<td>0.033</td>
<td>0.01</td>
<td>0.15 ***</td>
<td>0.14 **</td>
</tr>
<tr>
<td>(Std Error)</td>
<td>(0.04)</td>
<td>(0.04)</td>
<td>(0.04)</td>
<td>(0.04)</td>
</tr>
<tr>
<td>FIRM_SIZE</td>
<td>-1.46 *</td>
<td>-2.54 **</td>
<td>-1.14 *</td>
<td>-1.92 **</td>
</tr>
<tr>
<td>(Std Error)</td>
<td>(0.69)</td>
<td>(0.810)</td>
<td>(0.54)</td>
<td>(0.68)</td>
</tr>
<tr>
<td>SLACK</td>
<td>5.40 **</td>
<td>3.37 *</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Std Error)</td>
<td>(1.89)</td>
<td>(1.48)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

-2 Log Likelihood 202.37 *** 192.57 *** 263.47 *** 258.03 ***
-2 Log Likelihood Change 9.80 ** 5.44 *

* p < 0.05, ** p < 0.01, *** p < 0.001

From a managerial perspective, the primary implication is that greater levels of organizational slack (in this case, represented by extra employees) appear to lead to earlier introduction of new products. If earlier product introduction is important to a firm’s competitive success, then it is likely that a manager should be careful to ensure that an organization not become too lean.
From a research perspective, there are two principal implications. First, as we discussed above, our results support the notion found in prior research that organizational slack is not necessarily bad or wasteful. Rather, additional resources may be used to get new products to market sooner. The second research implication therefore is that additional research should be conducted at the organizational level to understand the potential causal mechanisms that explain why slack and innovation exhibit this relationship. We have provided several different arguments in support of our hypothesized relationship, but these arguments do not provide empirical evidence for the actual organizational or managerial effects that are responsible for the relationships we found in our analysis. Archival data sets, such as the one used in this study, trade off a broad scope in time for a lack of depth in the richness of the information provided. Alternative methodologies, such as case studies or longitudinal surveys, may yield greater insight into the ways in which organizational slack affects both the magnitude and timing of innovation. The findings of this paper provide a direction in which this future research may be pursued.

REFERENCES


