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Environmental influences upon firm entry into new sub-markets Evidence from the worldwide hard disk drive industry conditionally

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Abstract

Firms need to access skills, capital and customers to enter into an industry initially and the choices they make to access these resources are likely to exert path dependent influences over subsequent entry behavior into new sub-markets. This paper explores how firms configure themselves to access skills, capital and customers and reports data on their association with whether and when firms enter new sub-markets in the worldwide hard disk drive (HDD) industry. While, as with other studies, there appear to be geographic differences between US and Japanese firms in sub-market entry behavior, these are shown not to simply reflect differences in region: US startup firms with former IBM personnel and Japanese incumbent firms with keiretsu linkages to their customers, exhibit different entry behavior than other firms in the same region. The analysis suggests that entry decisions are influenced by firms' configuration choices to access needed resources and that the menu of configuration options available to firm managers varies across different institutional settings.

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1. Introduction

As technologies and markets evolve, new sub-markets often arise. These new sub-markets offer new possibilities to firms already active in the industry and they also offer opportunities for new firms to enter into the industry. Initially, the technologies enabling the new sub-market may not be fully understood and the potential market size of the sub-market also may be highly uncertain. Firms must decide whether to enter into these new sub-markets and if so, when to enter them.

Prior research on the factors that influence firms' sub-market entry decisions has emphasized economic and organizational aspects of these decisions. Some research indicates that firms are myopic to some degree in deciding this issue, favoring current markets and customers over potential new markets and customers. And while economic and organizational influences matter, there also appear to be geographic differences in whether and when firms enter new sub-markets. These geographic differences have been noted in the literature, but have not been explored.

This paper extends the earlier analyses of sub-market entry in three ways. One extension is the introduction of forward looking forecasts into firms' decisions about "whether and when" to enter into new sub-markets. If firms in fact make their entry decisions

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by means of these forecasts, there is little real myopia in their choices. If, however, firms still defer or delay entry even with the inclusion of these forecasts, that would strengthen the claims of myopic behavior in the literature. A second contribution is the examination of geographic differences in firm entry behavior in the disk drive industry. US firms and Japanese firms exhibit different tendencies towards entry and towards the timing of entry, into a new sub-market. The third contribution is to unpack the geographic differences into differences in firms' initial 'resource configurations': how firms gained access to technical skills, capital and customers when they first entered the industry. The menu of choices available to firms differs in different countries, though firms differ in the configuration choices they make within regions as well. These differing menus can be interpreted as different institutional environments within each country, which direct firms along particular paths of development, but constrain the choice of other paths.

The rest of the paper is organized as follows. The following section examines the emergence of sub-markets within an industry and reviews prior literature on the determinants of entry into emerging sub-markets. [Section 3](#) introduces the emerging sub-markets that developed in the worldwide disk drive industry and reports empirical analyses of entry, timing of entry and longevity of firms in the industry. [Section 4](#) discusses the results of the analysis and a final section concludes the paper.

2. Firm entry into emerging sub-markets

A new sub-market is created when a new technology offering causes one group of customers (some of whom may be new arrivals to that market) within an existing market to behave similarly to one another and differently from other customers in that market. This contrasts with new technologies that completely displace an earlier technology ([Reinganum, 1989](#)), because the new sub-market co-exists alongside the established market. Examples of new sub-markets in the literature include new medical diagnostic equipment addressing new applications, such as magnetic resonance imaging ([Mitchell, 1989](#)), or new types of hard disk drive (HDD) storage for emerging classes of computers ([Christensen, 1993](#)).

These sub-markets are regarded as market segments by economists ([Kamien and Schwartz, 1982](#)) and niches by organizational ecologists ([Carroll, 1985](#)). Firms competing in these markets must periodically confront the emergence of new sub-markets and decide whether or not to participate in them. Entering into a sub-market is a calculated risk, requiring the firm to incur costs in order to receive uncertain revenues in this new market area.

Whether or not to commit the resources to enter into a new market segment is potentially influenced by a number of factors. Mitchell's research program in the diagnostic imaging equipment industry ([Mitchell, 1989, 1991, 1994](#)) identifies and measures a number of economic and firm level influences. He considered the number of firms active in the industry, the size of firms, their age and the headquarters location of the firm. In addition, he examined whether the size and historic growth rate of the new markets influenced the decision to enter into a new diagnostic sub-field.

Another industry that has been characterized by the emergence of new sub-markets is the HDD industry. An extended analysis of the emergence of new sub-markets, which were served by different sized disk drives, industry was reported in a research program by [Christensen \(1992, 1993\)](#), [Christensen and Rosenbloom \(1995\)](#), [Christensen and Bower \(1996\)](#), [Christensen et al. \(1998\)](#). Christensen and his colleagues noted four transitions in the HDD industry between different diameter sizes of drives or "form factors", from the original 14 in. diameter drives, to 8, 5.25, 3.5 and 2.5 in. sizes.

These different sized disk drives each initially served a distinct market segment within the computer industry. The original 14 in. drives addressed the storage requirements of mainframe computers. The 8 in. drives arose to provide lower cost storage to a more modest class of computers, the minicomputer. The 5.25 in. drives initially provided storage to the microcomputer and the engineering workstation. The 3.5 in. drives were the storage medium of choice for what became known as personal computers. The 2.5 in. drives were used to provide storage to portable and laptop computers.

Other technology sub-markets that have been previously studied include computer software ([Steinmuller, 1996](#)), computer networking ([Von Burg, 1999](#)) and typesetting ([Tripsas, 1997](#)). As Christensen and his

colleagues have noted, the emergence of each of these sub-markets posed a choice for incumbent manufacturers: Where should the incumbent firms focus their resources? Should they enter the new sub-market, or reinforce their position in their current market? They report that, in the US disk drive industry, the pattern of choices made by incumbents caused them to under-invest in the new sub-market. As the sub-markets grew and as earlier sub-markets declined, these choices resulted in the displacement of the leading firms making each of the earlier drive sizes. Indeed, some industry observers have termed this displacement “disruptive innovation”.

2.1. *Forecasts and looking ahead*

With the benefit of hindsight, the under-investment by incumbent firms that led to their subsequent displacement seems to be rather myopic. Could not these firms look ahead and anticipate the consequences of their decisions? Could not they forecast the growth of the new sub-markets well enough to get into those markets in time to avoid being displaced?

One way in which firms could attempt to look ahead is to utilize forecasts of future market size in the new markets, supplied by outside market research companies. Of course, these forecasts contain a high degree of uncertainty and research firms forecasting the same sub-markets often differ in their perception of future size. But as noisy as these forecasts are, they attempt to incorporate forward looking information on trends in the new markets. These forecasts might enable firms to anticipate where their resources could be best utilized. Using these forecasts could reduce the myopic tendencies of incumbents to overserve their current markets and under-invest in new markets. If, on the other hand, a pattern of delayed or even deferred entry by incumbent manufacturers is found even after including forward looking forecasts, that would provide stronger confirmation of a disruptive innovation effect.

2.2. *Geographic differences in entry*

Prior research has also noted geographic differences in sub-market entry. Mitchell (1989, 1991) reported significant differences between US and non-US firms in their decisions of “whether and when” to enter into a new diagnostic imaging sub-market in the US.

He did not, however, pursue an explanation for these differences in his analysis. Christensen’s analysis of HDD sub-markets was restricted to US companies, but Chesbrough (1997, 1999b), reports that the pattern of incumbent displacement observed in the US did not occur in Japan. The Japanese incumbent firms that led the development of 14 in. disk drives (Fujitsu, Hitachi, NEC and Toshiba), went on to make 8, 5.25, 3.5 and 2.5 in. drives. While leading US incumbent firms such as Memorex, Control Data, HP and DEC lost their market leadership and were forced to exit the HDD business in the US, the four Japanese incumbent firms continue to lead the Japanese market 20 years later.

Another area where geographic differences appear to affect the sub-market entry has been the software industry. As reported in Mowery (1996), a variety of new software markets have arisen in the US (Steinmuller, 1996). Startup firms frequently pioneer these markets and often dominate them as they grow. By contrast, Cottrell (1996) shows that many of these same sub-markets have arisen in Japan as well, but the incumbent software firms (who tend to be large systems suppliers) in earlier Japanese sub-markets have led in most of these markets too.

2.3. *Configuring the firm to access skills, capital and customers*

Why do we see these geographic differences in entry behavior? The earlier mentioned studies are all from a single industry, undergoing the same technology changes, so industry and technology factors are implicitly held constant. One likely explanation is the environmental conditions confronting incumbent firms versus startup firms. If these vary between regions, then firms in the same industry undergoing the same changes might behave differently.

New sub-markets create new technical and market uncertainty for incumbent firms. This complicates the sub-market entry decision facing incumbent or startup firms. Indeed, the ability to enter new sub-markets at an appropriate time is itself a “dynamic capability” (Teece et al., 1997). The technology advances that have enabled a new sub-field to form may not initially be well understood. Firms need to access technical skills to work effectively with the new technology. In many high technology industries, these needed skills are embodied in skilled workers. Firms must

either retrain current workers in the new sub-field, or attract new workers into that new sub-field. Startup companies must attract workers, preferably ones who already have experience in the technical area, who require little or no additional training. Access to skilled technical workers is a capability; sometimes it can be bought, but oftentimes it has to be built.

Firms also need risk capital to finance the entry into the new sub-market. Some firms may utilize internal capital to pursue the opportunity, while venture capital (VC) might finance the formation of new companies to pursue the sub-market. The source of capital may influence entry behavior, since internal capital allocations may promote the current market over a potential new market (Bower, 1970; Christensen and Bower, 1996), while VC would seek out the highest return for its investment, unconstrained by any current business (Sahlman, 1990).

The market uncertainty inherent in the emergence of a new sub-market is intertwined with the problem of attracting customers. The technical uncertainty may obscure the current and potential capabilities of a technology and its most useful applications in the new sub-market may be unclear. Potential customers themselves may be unsure of how best to use the technology in their own business, making it harder for them to specify their requirements.

Firms need to create linkages with potential customers, in order to sort out these uncertainties. If they already have a relationship with a potential customer, they may be able to share more information more rapidly, to come to enough of a common understanding to create an acceptable initial offering in the new sub-market. In the automotive industry, the complexity of new product designs, combined with pressures to reduce time to market and product cost, have caused manufacturers to share much more information with their leading suppliers (Clark and Fujimoto, 1991). But, this information is not uniformly shared with all suppliers: the most trusted suppliers receive far more information than arms-length suppliers (Dyer, 1996; Wasti and Liker, 1997).

The initial configuration of the firm to access labor, capital and customers likely exerts a strong, path dependent effect over the firm's solution to subsequent entry decisions into new segments in that market. Skilled labor is specialized to particular tasks and may be less suited to more uncertain tasks required by

new sub-markets. Capital may be allocated according to priorities that accord higher value to current markets over potential new sub-markets (Bower, 1970). And currently-served customers may place a lower value on emergent markets than might potential new customers (Christensen and Bower, 1996). It seems plausible that environmental influences could affect the choices available to firms, as they work to assemble labor, capital and customers.

2.4. Whether and when to enter a sub-market

Taken together, these factors all might influence “whether and when” an incumbent firm chooses to enter a new sub-market. These expected influences are summarized in Table 1. The density of firms in the overall market and the firm's own size would be expected to increase the probability of entry by the firm into a new sub-market (Mitchell, 1989). Extending Mitchell's economic logic, firms would be more likely to enter sub-markets that are forecast to grow fast or become large. Firms would be discouraged to enter markets where a large number of participants were already established. Christensen (1993) argues that a firm's current sales in the overall market and prior experience in the market may cause firms to delay or eschew entry into a sub-market. Chesbrough (1997) argues that Japanese firms' entry behavior differed from that of US firms. The earlier discussion claims that these differences are due less to geographic differences per se and more to specific ways firms configured themselves to access customers, capital and technical skills in their respective geographic environments.

3. Estimating the determinants of sub-market entry in the worldwide hard disk drive industry

The HDD industry was chosen to examine these questions empirically for a number of reasons. One reason is that descriptive evidence indicates that US and Japanese firms appear to vary in their sub-market entry behavior in this industry, as noted earlier. A second reason is that a growing body of research is being conducted on the industry, though this has chiefly focused on the US case (Christensen, 1993; Christensen and Rosenbloom, 1995; Christensen and

Table 1

Expected signs for control and explanatory variables for likelihood of sub-market entry (1: did enter sub-market; 0: did not enter)

Control variables	Expected sign	Source/rationale
Density	Positive	Mitchell (1989)
Firm size	Positive	Mitchell (1989)
HDD business size	Negative	Christensen (1993)
Firm Experience	Negative	Christensen (1993)
New change rate (forecast)	Positive	Extension of Mitchell
New market size (forecast)	Positive	Extension of Mitchell
New density (in sub-market)	Negative	Extension of Mitchell
	Negative	Christensen (1993)
Geographic variables		
US	Base reference	
Japan	Positive	Chesbrough (1997)
Firm resource configuration factors		
Former IBM manager on founding team	Positive	Chesbrough (1999b)
Acquire	?	Alternative way to access technical skills and customers
License	?	Alternative way to access technical skills
Received VC	Positive	Chesbrough (1999b)
Keiretsu affiliation	Positive	Chesbrough (1999b)
Similar business	Positive	Dyer (1996)

Bower, 1996; Christensen et al., 1998; Lerner, 1995; Gourevich et al., 1997; McKendrick and Hicken, 1997; Barnett and McKendrick, 1998; Chesbrough, 1997, 1999b,c). A third reason is that information on the industry is available through public sources and private research services (e.g. Disk/Trend, International Data Corporation, Dataquest).

Fig. 1 depicts the entry and exit of firms into and out of the HDD industry from 1973 to 1995. Entry is measured by the date in which firms first began producing HDDs and exit is measured by the year in which a firm stopped manufacturing any HDD products. During this period, 172 firms participated in the industry, with a peak of 75 active firms in 1985.

During the period of this study, the original 14 in. diameter disk drives had just been introduced by IBM. Subsequent to that introduction, four additional form factors were shipped into the market: 8, 5.25, 3.5 and 2.5 in. diameter disk drives. Each of these new sizes of drive involved the combination of new technologies to produce them and each addressed a new market segment within the overall computer industry. Thus, for the purposes of this study, the choice of each firm of whether or not to enter into a different sized disk drive constituted a decision of whether or not to enter into a new sub-market.

3.1. Dependent variables

Following Mitchell (1989), one dependent variable was whether a firm entered into the sub-markets created by additional form factors once they were in production. A second dependent variable was the timing of that entry, conditional upon entry. A third dependent variable was the likelihood of exit for each firm who had entered the disk drive industry in each year starting in 1973.¹

3.2. Explanatory variables

In this analysis, explanatory variables influencing entry and exit were drawn from the organizational and economic literatures. Numerous studies of life chances in many industries over long spans of time have documented the role that firm density plays in the likelihood of firms exiting from an industry (Hannan and Freeman, 1977, 1989; Hannan and Carroll, 1992). The number of firms in an industry (i.e. the density) has been found to be positively associated

¹ The selection of 1973 for the start of the study was determined by the introduction of the original so-called “Winchester” disk drive by IBM. Earlier types of storage devices are discussed in Chesbrough (1997).

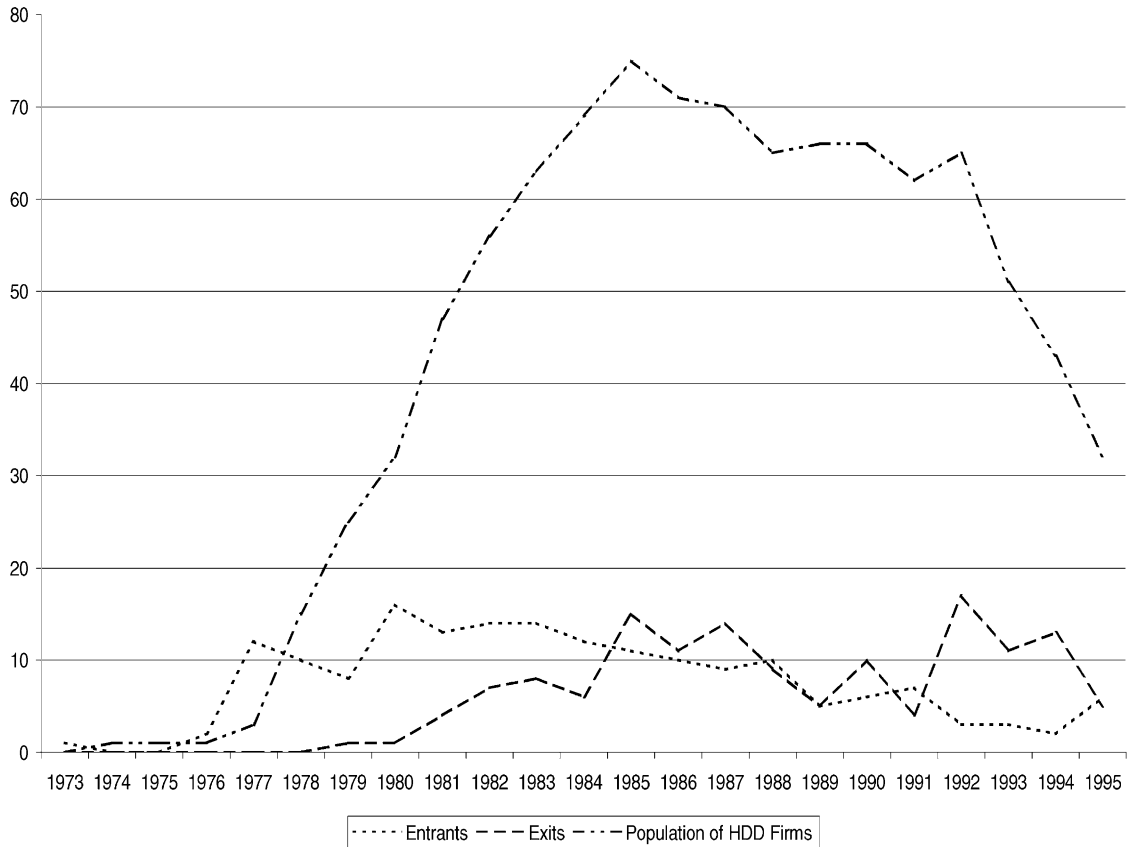


Fig. 1. Entry and exit from HDD industry: 1973–1995.

with firm longevity, due to the increased legitimacy of the industry resulting from the number of firms in it. At the same time, the square of firm density has strongly negative effects on the firm longevity, due to increased competition for resources when many firms are in the industry. Measures of firm density, the square of that density and the experience of the firm in the industry, were therefore included in this model.

From the economic perspective, the number of competitors in a market can spur firms to seek new and more profitable market niches. In addition to the overall density in a market, the number of firms active within one segment of the market is also relevant to whether and when firms elect to explore new market opportunities created by technological shifts (Mitchell, 1989). Another economic control variable is

the size of the firm. A larger firm might be expected to enjoy economies of scope (Teece, 1982) and therefore be better able to exploit new architectural innovations in the disk drive market. Empirical studies have found that size has a positive effect on business survival (Mitchell, 1994). To avoid issues of simultaneity, I have used the previous year's sales. To make this variable more stationary (Kmenta, 1986) I have taken its log and also deflated it into US\$ 1982 using a GDP deflator.²

² These transformations are intended to improve the quality of this measure and must be kept in mind in interpreting the resulting coefficient estimate for this measure. For international firms, I first converted the firm's sales into US currency, using the average of the beginning and ending year's exchange rates, as reported by the IMF. This converted number was then deflated, lagged and then the log of this was taken.

Another important variable in this analysis is the revenues of the firm's HDD business. One of the empirical regularities that previous research has shown has been the struggle of incumbent firms to respond to disruptive innovation (Christensen, 1997). As the size of a firm's lagged HDD revenues grows, these inertial forces presumably grow as well. This would suggest a positive sign *ex ante* for this explanatory variable. To again avoid simultaneity issues, I have used the previous year's drive sales for this measure and similarly deflated it and taken the log of that lagged, deflated number. For certain firms, the right-hand variables for firm size and for HDD size were not observable in 22 cases. In order to retain the information that was available in these cases, I recorded a dummy variable (MISSING) when such data were missing. These issues are discussed in Chesbrough (1997), along with alternative methods for handling the missing data.

One such forecast was supplied by the HDD research service that provided much of the previous information, Disk/Trend. While this was not the only forecast available to disk drive participants, it was a widely respected forecast and was the only one that was made each year throughout the period of the study. In modeling the form factor entry decision, I accordingly included variables for both the projected size (NEWMARKET) and forecasted growth of the new form factor market (NEWGROWTH) in the following year. Following Mitchell (1989), I also included a measure for the number of firms already producing products in the new form factor (NEW-DENSITY). This last measure is intended to reflect the competitive intensity in the new form factor sub-market.

3.3. Headquarters location

I have coded dummy variables for the headquarters location in which firms operate as they decide whether to enter into the HDD industry. There were dummies for US headquartered firms, Japan headquartered firms and "other" headquartered firms. Because there were a small number of firms in other countries, ranging from the UK and Germany to Brazil and South Korea, their individual geographies are not measured here. A more qualitative evaluation of European disk drive firms can be found in Chesbrough (1999b).

3.4. Measures for accessing skills, capital and customers

One way to develop the skills necessary to become an effective producer in a new sub-market is to retrain engineers from other fields. An alternative way to access these skills is to hire in people from other companies in the same industry. In the disk drive industry during the period of this study, IBM was the dominant supplier in terms of revenues and an even more dominant contributor of fundamental research to the industry (Harker et al., 1981). I recorded a dummy variable that examines whether the top management team of an entering firm into the industry included people who previously worked at IBM.³

However, firms may have alternative ways of assembling important resources beyond building them from within. They may be able instead to "buy" them instead from the external market (Teece et al., 1997). Two alternative proxy measures were included to provide alternative ways to access needed skills. One was whether the firm entered the industry through licensing a disk drive design from another firm. This might be viewed as another way to access the know-how and experience required to build disk drives, without requiring the firm to access engineers through the labor market. Another alternative was a dummy variable for whether or not a firm entered into HDD production through acquiring another company, which is yet another way to access the knowledge of experienced engineers outside the labor market. Acquisition also could be a way to acquire new customers, in addition to buying technical skills.

The second configuration factor is the availability of private equity capital for new venture formation. Here, there is reasonably good information on the investment activities of professional VC firms in the HDD industry, from private research firms such as Venture Economics (see Lerner, 1995, for an introduction to

³ I utilized public press releases and industry trade press articles for each firm (when available) and also utilized informants from within the industry, including observers such as James Porter from Disk/Trend (now retired) and Philip Devin from Dataquest (now deceased). The hardest data to reconstruct were the team backgrounds for companies in the 1970s and early 1980s. IBM cast a much longer shadow in HDDs back then, relative to the other companies and showed up far more frequently in the published background of founders than did other companies.

these data, as well as their limitations).⁴ Indeed, previous research has identified that VC financed the creation of a large number of startup companies in the US HDD industry (Sahlman and Stevenson, 1985; Lerner, 1995).

I supplemented these data with online searches of entering startup disk drive firms, which resulted in the addition of two UK firms, Rodime and Calluna, to the Venture Economics data. I excluded the data on investments in firms that never entered into production of HDDs. Those firms that did enter production and receive VC were coded with a dummy variable.⁵

The final configuration factor of interest is the pre-existing linkages between buyers and suppliers in product markets that were previously established in other industries. These linkages might advantage entering supplier firms with customer firms with whom they have had previous relations in other industries. I developed two variables that attempted to measure these linkages. One dummy measure was whether or not an entering firm was a member of a keiretsu organization. This was coded based on whether the firm was listed in a catalog of keiretsu organizations, the *Keiretsu no kenkyu*. Some observers have argued that formal linkages such as cross-shareholdings, shared main banks and posted directors are necessary to safeguard the hazards of business relations (Kester, 1991; Gilson and Roe, 1993; Gerlach, 1992).

Others have argued that more informal ties nonetheless safeguard the relations between customers and suppliers effectively as well (Dyer and Ouchi, 1993; Dyer, 1996; Wasti and Liker, 1997). To address this latter possibility, a second dummy measure was constructed to measure more informal relationships. While I could not observe all the prior dealings

between HDD entrants and their customers in all possible sectors, I recorded a single dummy variable for whether or not the HDD firm had operated in related businesses. The inference from this measure is that such previous experience would have provided informal customer relationships that might have influenced firm entry and exit decisions in the HDD industry. These related businesses were narrowly defined as one of the following businesses: floppy disk drives, floppy and hard disk controllers, tape drives, cartridge drives and disk drive components.

Collectively, the mechanisms for building access to skills, capital and customers, combined with these ways of buying technical skills, comprise the way that a given firm configured itself to enter the HDD industry. These variables and their construction are listed in Table 2.

The incidence of these firm configuration mechanisms for entering the HDD industry are noted in Table 3. Because I was not able to observe them in each firm over time, their effects are treated empirically as fixed for the period of the analysis.

The incidence of the measures shows that the ways in which firms configure themselves differ significantly between the US and Japan, as well as the combined “other” regions. All of the firms with ex-IBM personnel in their top management teams were US-headquartered firms.⁶ All but two of the firms that received professional VC investment were based in the US. Japanese firms comprise all of the firms with keiretsu links with their customers. The non-US, non-Japanese firms lacked former IBM personnel, received little VC financing and lacked the formal linkages with customers found in some of the Japanese companies. These firms relied to a much greater extent upon licensing and acquisition to acquire skills and technology, relative to either US or Japanese firms.

Table 3 also shows that Japanese firms entered a higher number of sub-markets (1.72) than did US (1.28) or other firms (1.41). US firms appear to be more focused in their choice of sub-markets to enter, in comparison with the Japanese firms.

⁴ I am indebted to Josh Lerner for sharing the data on professional US venture capital investment in US HDD firms.

⁵ These data did not report any observations of Japanese firms receiving either US or Japanese venture capital. I supplemented these data with field work to try to detect the presence of venture capital in financing any of the firms in the Japanese HDD industry. Through interviews of multiple participants of the surviving US and Japanese HDD manufacturers, no respondent could recall a single instance of venture capital financing of Japanese disk drive firms. Online literature searches (which did identify missing data on omitted venture investments for two European firms) did not identify any instances of venture financing either. I therefore coded each of the Japanese firms as not having received venture capital financing to enter the HDD market.

⁶ This need not have been so. IBM maintained important research operations during the time of this study in Japan and in Zurich, Switzerland. However, its data storage research program was concentrated in San Jose, CA.

Table 2
List of variables and their descriptions

Control variables (name)	Description
DENSITY	Number of firms in production that year in HDD industry
DENSITY2	Square of DENSITY
Firm size	The log of firm revenues (lagged) that year
HDD business size	The log of firm HD revenues (lagged) that year
Firm experience	Years of firm operation in the disk drive industry
Missing	Dummy variable for whether data on firm revenues and HD revenues were missing (=1) or not (=0)
New change	A 1 year forecast of unit growth rate of new HDD sub-market
New market	A 1 year forecast of unit market size of new HDD sub-market
NEWDENSITY	Number of firms in production in new HDD sub-market that year in HDD industry
Geographic variables	
US	Dummy variable for whether firm headquarters are located in US (=1) or not (=0)
Japan	Dummy variable for whether firm headquarters are located in Japan (=1) or not (=0)
Firm configuration variables	
Ex-IBM employee on founding team	Dummy variable for whether firm founding team included a former IBM executive (=1) or not (=0)
Acquire	Dummy variable for whether firm entered HD industry by acquisition (=1) or not (=0)
License	Dummy variable for whether firm acquired initial HD technology through a license (=1) or not (=0)
Received VC	Dummy variable for whether firm received VC (=1) or not (=0)
Formal customer linkages	Dummy variable for whether firm was a member of a keiretsu (=1) or not (=0)
Informal customer linkages	Dummy variable for whether firm previously participated in a related business (=1) or not (=0)

But the data in Table 3 allow us to go beyond the aggregate findings at the national level of how firms access critical resources. Within the US and also within Japan, there is substantial intra-regional heterogeneity in how firms configured their access to people, capital and customers. These differences within regions help explain why incumbent firms in the US might exhibit different entry behavior from incumbents in the same industry in Japan. They also

help us probe beyond facile explanations that “Japan (or the US) is different” and move us towards an understanding of how incumbents and entrants compete within each region. Finally, they provide a more nuanced interpretation of the institutional environment within each region and how it influences firm behavior. For example, while the Japanese environment may facilitate vertical keiretsu linkages, not all firms in Japan participate in these linkages—fully 15 of the 32 companies in this dataset did not do so. Nor did the majority of US HDD firms obtain VC financing, or utilize IBM personnel in their top management team.

Table 3
The incidence of firm configuration measures for disk drive firms at time of entry into HDD production

Location headquarters	US	Japan	Other	Total
Ex-IBM employee	21	0	0	21
Entered by licensing HDD design	13	10	24	47
Entered by acquisition VC	8	1	8	17
Keiretsu affiliation	28	0	2	30
Supplied customers in related business	0	17	0	17
Total firms	31	17	15	63
Total firms	99	32	41	172
Sub-market entries per firm (average)	1.28	1.72	1.41	1.40

3.5. Modeling firm entry into individual hard disk drive form factor sub-markets

The decision by firms to enter into a new sub-market was estimated with a logistic regression model. The dependent variable was coded as the probability of entry into the new form factor, given that the firm was already in the market. This is estimated using the log odds ratio of entry:

$$\ln \left(\frac{P_i}{1 - P_i} \right) = a + BX_i$$

The estimated coefficients for the right-hand side variables can be interpreted as influencing the log odds of entering into the new form factor. Not all of the firms in the sample were at risk for entering into new form factors. Some firms had entered the market and then exited before a new form factor emerged. Of the 172 firms in the sample, 149 survived long enough to face an entry decision. Sixty-two of these 149 firms chose to enter into an additional form factor, while 87 chose not to enter. A smaller number of firms survived long enough to face additional entry choices, for a total of 240 entry decision points.

In these instances, some of the right-hand side measures (such as firm and hard disk sales and new market size and growth) were updated and these cases are pooled in the estimation. To control for possible firm effects from repeated form factor entry, a generalized estimation equation was invoked in SAS. This technique allows information from these cases to be used, while capturing the fact that these repeated cases emerged from a single firm (see Liang and Zeger (1986) for a discussion). The results from this regression are depicted in Table 4.

The first model includes the variables that reflect the influence of the control variables for entering a new form factor. Variables that reflected the growth rate and unit size in the new form factor market, respectively, NEWCHANGE and NEWMARKET, were each significant and negative in sign. The sign and significance of both persist in further model specifications. These forward looking estimates appear to be strongly and negatively associated with the decision to enter into a new form factor: the larger the size of the new market and the higher its growth rate, the *less* likely the firm is to enter the new form factor market. Firms appear to have raced to enter into new sub-markets, to get in before they became large markets (Lerner, 1995). This racing may be due to the fact that, although a large and growing market increases the volumes a new entrant can expect from entering the sub-market, the costs of entering into that market may increase as well—indeed, the negatively signed coefficient might imply that the costs increase even more than the benefits. The measure for the number of firms in the new sub-market (NEWDENSITY) is negative (though not significant), suggesting that an increasing number of firms already in a sub-market discourages the entry. Firms appeared to be more likely to enter when the

market was still small and the positions of existing companies in that market were not so entrenched. The measure for the number of firms in the overall market (DENSITY) is positive (though not significant).

The significantly positive measure for lagged HDD revenues in model 1 in Table 4 (which also persists across further model specifications), by contrast, is quite intuitive: the greater the firm's HDD revenues, the more likely the firm is to enter into a new form factor. This finding for firms in the worldwide population of HDD firms is inconsistent with the earlier research on the leading incumbent firms in the US. That research, which did not utilize forecasts of future sub-market size, found that many incumbent firms were unable or unwilling to channel internal resources towards these new form factor markets (Christensen and Bower, 1996).⁷

The second model adds regional dummies and finds a modestly positive coefficient for the Japanese dummy variable, in comparison with the omitted reference variable of US-headquartered firms. This indicates that Japanese firms were more likely to enter into new form factor markets, *ceteris paribus*, relative to US firms. This is not surprising, given the average number of form factor entries shown in Table 3. It is also consistent with Mitchell's findings (Mitchell, 1989, 1991) in medical imaging equipment and Chesbrough's (1999a,b) qualitative evidence regarding the differing behavior of Japanese versus US incumbent firms.

The third models (3a and 3b) in Table 4 add the measures for how each firm configured itself to access labor, capital and customers at their time of initial entry into the HDD industry. Here, the sample is split, with US firms only in model 3a and only Japanese firms in model 3b. US firms are not found to have formal, institutional keiretsu linkages to their customers in these data and Japanese firms in the HDD industry do not utilize IBM founders or VC financing. The regional dummy variables and the institutional factors

⁷ Of course, this finding is silent on the financial performance of incumbents who enter into new form factors. Much of the analysis supporting Christensen's hypothesis is derived from analyzing the profitability of those firms in the US for whom profit data was available, which in turn meant that data from Japanese and other non-US companies had to be excluded. These firms are included in the present analysis, albeit by resorting to a less informative dependent variable.

Table 4
Logistic regression of likelihood of entry into new form factor

Variable	Model 1	Model 2	Model 3a (US only)	Model 3b (Japan only)
INTERCEPT	6.451** 1.444	6.26** 1.475	6.568** 2.080	12.104** 5.228
Lagged log firm sales	0.016 0.060	−0.022 0.064	−0.071 0.118	−0.171 0.260
Lagged log HD sales	0.403** 0.135	0.444** 0.138	0.522** 0.198	0.336 0.470
MISSING	0.464 0.629	0.549 0.639	0.461 0.933	−0.440 2.203
NEWMARKET	−0.727** 0.176	−0.715** 0.180	−0.800** 0.270	−1.930+ 0.823
NEWCHANGE	−0.976** 0.291	−0.906** 0.290	−0.705+ 0.379	−3.560+ 1.420
Firm experience	−0.031 0.052	−0.040 0.053	−0.109 0.082	0.1836 0.1849
DENSITY	0.033 0.021	0.029 0.021	0.030 0.035	0.136+ 0.075
NEWDENSITY	−0.008 0.017	−0.002 0.017	0.017 0.025	−0.025 0.057
Japan		0.781+ 0.411	–	–
Other		−0.113 0.529	–	–
IBM found			1.302** 0.607	– –
License			0.822 0.876	0.971 1.700
Acquire			0.160 0.805	−1.328 1.962
VC funded			0.592 0.609	– –
Keiretsu			–	1.510+ 0.839
Similar business			−0.080 0.534	0.191 0.885
−2log likelihood	259.92	255.80	121.62	42.45
No. of entry events	240	240	127	55

** $P < 0.05$.

+ $P < 0.1$.

not observed in each region (keiretsu linkages for the US-only model, IBM founders and VC in Japan) are omitted. While most coefficient estimates behave similarly to the overall sample, there are a few differences.

The US-only model shows a significantly positive association between the size of the firm's HDD revenues and their chances of entering a new sub-market, as well as another significantly positive association

between firms with ex-IBM founders. The Japan-only model finds no significant association with the size of the firm's hard disk revenues and sub-market entry, but finds significant associations with density and entry and keiretsu linkages and entry. The US and Japanese samples thus behave differently from one another.

3.6. Modeling the timing of entry into new form factor sub-markets

A second set of models analyzes the association between firms' individual configuration choices with a related decision, the timing of entry into a new form factor, conditional upon entry into that sub-market.

Table 5
Proportional hazards model of time to enter new HDD form factor

Variable	Model 1	Model 2	Model 3a (US only)	Model 3b (Japan only)
LOGSALM1	-0.048 0.046	-0.080 0.050	-0.071 0.090	-0.214 0.185
LOGHDSM1	0.119** 0.056	0.155** 0.060	0.198** 0.090	-0.071 0.156
MISSING	-1.030** 0.442	-0.952** 0.454	-1.374+ 0.757	0.615 1.720
NEWMARKET	0.161** 0.080	0.165** 0.081	0.101+ 0.105	0.558** 0.212
NEWCHANGE	-0.131 0.186	-0.104 0.187	-0.419+ 0.246	0.326 0.449
Firm experience	0.000** 0.000	0.000+ 0.000	0.001 0.000	0.004+ 0.002
DENSITY	-0.020** 0.010	-0.020** 0.010	-0.018 0.013	-0.028 0.023
NEWDENSITY	0.013 0.010	0.018 + 0.010	-0.003 0.014	0.069** 0.028
Japan		0.639 ** 0.241	-	-
Other		-0.362 0.401	-	-
IBM found			0.686** 0.321	-
License			0.743 0.568	-0.225 0.735
Acquire			0.576 0.535	-0.114 0.137
VC funded			0.149 0.373	-
Keiretsu			-	1.409+ 0.806
Similar business			0.046 0.305	0.550 0.466
-2log likelihood	1119.62	1110.97	512.49	214.95

** $P < 0.05$.

+ $P < 0.10$.

Table 5 shows three models that estimate the timing of entry into the various disk drive sub-markets, using a proportional hazards model of factors which were associated with the timing of entry. This model can be written as follows:

$$\frac{h_i(t)}{h_j(t)} = \exp\{\beta_1(x_{i1} - x_{j1}) + \dots + \beta_k(x_{ik} - x_{jk})\}$$

A proportional hazards model was used in part because it provided a way to treat right censored observations, specifically those instances where the firm had not (yet) entered into a form factor. Unless right censoring is managed in the estimation, the estimated coefficients would be biased, by truncating the observation period. The particular use of the proportional hazards model is also appropriate for exploratory research in this area, because it does not require particular distributional assumptions of the process being examined. Since theory provides us little guidance in modeling the underlying process, a general approach was deemed appropriate for this analysis.

Earlier research has documented the internal battles that US incumbent firms had in making entry decisions (Christensen and Bower, 1996). These battles presumably consumed important time in the decision to enter the new sub-market. While it may not be necessary to be first into a new market, it is generally bad to be among the last (Mitchell, 1989, 1991). Positive coefficients in these models are associated with a longer time to enter a new form factor. In this analysis, the factors that are associated with earlier entry are viewed as beneficial in the fast-moving HDD industry. These results are shown in Table 5.

The first model in Table 5 models the timing of entry as a function of the control variables. The (lagged) HDD revenues of firms are significantly and positively associated with the timing of entry, meaning that firms with more hard drive revenues entered new form factors later. This result persists throughout the subsequent specifications and is consistent with the US evidence reported by Christensen and Bower (1996).

The forward looking forecast of sub-market size here is positive and becomes significant in the later two specifications. The forecast growth rate in the new market was insignificant. Firm experience and overall density are significant, though the significance of the former disappears in later specifications. The density coefficient estimate, though, is robust to further speci-

fications, indicating that a greater number of firms in the overall market is associated with earlier firm entry into a new form factor. This is quite consistent with the entry pattern noted earlier in Table 4, with the racing behavior, Lerner (1995) found in this industry and with Mitchell's (1989) results in diagnostic imaging.

The second model adds the regional dummies and Japan is significantly positive, indicating that Japanese firms entered the new sub-markets later than the (omitted) US firms. The racing in the overall market appears to be somewhat attenuated for Japanese firms.

The third models again split the sample and add the firm resource configuration factors, The regional dummy variables and the institutional factors not observed in each region (keiretsu for US, IBM founders and VC in Japan) are again omitted from these last models in Table 5. Again, most coefficient estimates behave as before, but a couple of differences do emerge. IBM founder is significantly and positively associated with later entry in the US only analysis. Firms' HDD revenues and NEWDENSITY are significantly associated with later entry in Japan, as are keiretsu linkages.

These two sets of models explore "whether and when" HDD firms entered into new disk drive sub-markets. To assess the impact of a firm's economic, geographic and resource configuration variables upon its subsequent longevity, a last set of models was estimated.

3.7. Modeling the likelihood of exit from the hard disk drive industry

Fig. 1 shows the pattern of entry and exit from the HDD industry, from 1973 to 1995. In the analysis, there are data on 172 firms, with a total of 1,069 firm years of experience in the HDD market.

The likelihood of exit of firms from the HDD industry was estimated using a discrete time survival rate analysis, with the observations grouped into 1 year intervals. The model assumed a binomial distribution,⁸ employing the GENMOD procedure in SAS. Firms enter the dataset when they commence the production

⁸ Alternate assumptions for the distribution of the hazard rate were tested and results were substantially similar to those reported here. See Hannan and Carroll (1992) for a discussion of alternative distributional assumptions in hazard rate modeling.

of HDDs and are then at risk for subsequent exit. As of 12/95, there were 136 such exits. This particular hazard rate model employs the complementary log–log specification as a link function (Allison, 1995). The specification can be written as follows:

$$\ln[-\ln(1 - P_{it})] = a + BX_{it}$$

Variables that reduce the likelihood of exit from the industry in each year effectively increase firm

longevity. The estimated coefficients can be interpreted as the log odds of exiting the industry in the particular period. The results of estimating three specifications of this model are shown in Table 6.

The first model in Table 6 employs the basic control variables used in the earlier models to assess their effect upon the likelihood of firms exiting the industry, except for the sub-market entry variables which have been dropped. For comparability with other studies

Table 6
Hazard rate model of likelihood of exit from HDD industry

Variable	Model 1	Model 2	Model 3a (US only)	Model 3b (Japan only)
INTERCEPT	–3.529** 0.559	–5.202** 0.711	–2.704** 0.511	–2.810** 1.009
DENSITY	0.039** 0.012	0.039** 0.013	–	–
DENSITY2	–0.001 0.001	–0.001 0.001	–	–
Firm experience	–0.027 0.023	0.069** 0.030	0.050 0.036	0.041 0.067
Japan	–0.334 0.236	–0.262 0.264	–	–
Other	0.098 0.237	–0.238 0.256	–	–
Lagged log firm sales		–0.041 0.043	–0.030 0.060	–0.209+ 0.120
Lagged log HD Sales		–0.181** 0.058	–0.116 0.081	–0.068 0.144
Missing HD sales		0.185 0.269	0.197 0.347	–0.526 0.975
IBM founder			–0.771** 0.350	–
Acquire			–0.352 0.477	0.845 1.246
License			–0.169 0.381	–0.257 0.569
VC funded			–0.126 0.305	–
Keiretsu			–	–0.809+ 0.463
Similar business			0.070 0.268	–0.072 0.486
log likelihood	–393.404	–381.246	–221.030	–70.482
No. of firm years	1053	1053	591	245

** $P < 0.05$.

+ $P < 0.10$.

in organizational ecology, a second-order term for density was added as well. The measure for density is positive, suggesting that the entry of more firms reduces firm longevity and its sign and significance persist throughout the other specifications. This is consistent with what [Christensen et al. \(1998\)](#) report in their analysis of the US firms in the HDD industry, but it is contrary to the findings of many other industry studies in organizational ecology. The second-order density term is insignificant throughout these models, another surprising finding in light of earlier ecological studies.⁹ Firm experience, is negative, though insignificant. Its sign changes and becomes significantly positive once other factors are added in later models. The dummy measures for the headquarters location of Japanese and other firms are negative but insignificant.

The second model adds measures for the log of each firm's lagged sales and each firm's lagged HDD sales. It appreciably enhances the predictive ability of the model and offers some interesting results relative to prior research. Firms with greater HDD revenues are less likely to exit the industry. While prior research has shown that leading US incumbent disk drive firms were often displaced by the emergence of new form factors ([Christensen, 1992, 1993, 1997](#)), the effect of greater HDD revenues for firms in the entire worldwide industry appears to be opposite. Note also the reversal in the estimated sign of the coefficient for firm experience, which is now positive and significant. Firms operating in the HDD industry, but which fail to gain significant revenues over time, experience a higher rate of exit from the industry.

The third models incorporate firms' resource configuration choices to access experienced personnel, capital and customers. They once more analyze separately the US firms and the Japanese firms. The Japanese firms had only 245 firm years of experience

in the data, so I had to drop certain additional variables to allow the estimation to converge on a solution. I chose to omit the density measures, in addition to dropping the regional coefficients and absent firm configuration measures in these final models. The loss of degrees of freedom from splitting the sample render the estimates for firm experience and hard disk revenues insignificant.¹⁰ The US firm sample showed a significantly negative association between firms with ex-IBM founders and exit. The Japanese sample showed significantly negative associations with overall firm size and exit, as well as keiretsu linkages and exit.

4. Discussion of results

The inclusion of forecast sub-market information does appear to influence incumbents' decisions about "whether and when" to enter. The forecast size of the sub-market and the forecast growth of the sub-market are both significant influences in the sub-market entry decision and the forecast size also influences the timing of that entry. The signs of these estimated coefficients, though, suggest that firms did not wait until the market had already grown large before entering. Instead, they raced to enter the sub-market before that market became very large. This is consistent with [Lerner's \(1995\)](#) racing results in the disk drive industry.

With the addition of these forecasts, the results find only partial evidence consistent with disruptive innovation across the worldwide disk drive industry. We do find evidence of incumbent firms delaying the sub-market entry, which is quite consistent with a story of internal resource allocation conflicts between incumbents serving the existing markets versus pursuing new markets ([Christensen and Bower, 1996](#)). Indeed, the finding adds weight to their conclusion, because this finding comes from estimates that include forecasts of future market size and growth. Even when armed with forecasts of future market size, larger HDD firms enter later. However, we find that incumbent firms are more likely to enter (eventually)

⁹ It may be that this sample, which begins with the shipment of the first 3340-style HDD, is left-censored, due to earlier forms of storage being omitted from the sample. Work underway at the University of California, San Diego adds these earlier forms of storage to their sample, providing more years of observation and reducing the problem of left censoring ([Barnett and McKendrick, 1998](#)). Alternatively, this finding may reflect the rapid pace of entry into this industry during the observation period. This rapid rate of entry may have compressed the legitimacy effects and exacerbated the competitive effects found in other industries that evolved over a longer period of time.

¹⁰ In a model that pooled US and Japanese firms with other firms (not shown) and included these configuration measures, firm experience and hard drive revenues remain significantly associated with greater longevity.

into new sub-markets and incumbents are associated with greater overall longevity in the drive industry—findings which are not consistent with the disruptive technology story.

In this industry, firms within the US and Japan do differ in the sub-market entry behavior. Japanese disk drive firms are more likely to enter sub-markets and to enter those sub-markets later, than US and other firms. The racing behavior noted above among US firms seems to be attenuated for Japanese firms, while Japanese incumbent firms appeared to pursue a greater number of sub-markets than did US incumbent firms. The former appear to face less selection pressure, both on sub-market entry and on overall survival, than the latter. Put another way, the US startup entrants appear to crowd out US incumbents in emerging sub-markets, while Japanese incumbents seem not to be similarly affected.

These geographic differences at the national level mask important differences within each region in firms' choices of resource configuration factors. US firms with ex-IBM personnel in their founding teams appear to be more likely to enter additional form factors, to enter them later and tend to have a lower risk of exit, *ceteris paribus*. Other US firms that did not have an ex-IBM individual on their management team were at a greater risk of exit and less likely to enter into new form factors.¹¹ Rival methods of accessing knowledge and technical skills outside the labor market, either through licensing or through acquisition of other disk drive companies, do not show the same influence on US firms in these models.

VC funding's influence on the longevity and likelihood of entry of US firms into new form factors is not statistically significant. The lack of significance here may have multiple explanations. One explanation is that other important sources of private equity capital are missing in this measure. A second reason may be that VC may have over-invested in the US disk drive industry (Sahlman and Stevenson, 1985; Lerner, 1995), so that VC investments had positive survival effects up to a point, but then created

negative effects on the survival chances after that point.

We tested this latter hypothesis by coding the VC variable into two variables: US firms entering production before 1983 that received VC financing and US firms entering production in 1983 or after. We did find a significant and negative coefficient for VC financing in the first cohort and not for the second, which would be consistent with the "capital market myopia" reported by Sahlman and Stevenson (1985). This result, however, was not robust to alternate years for dividing the receipt of venture financing. When we coded the venture finance dummy year to before 1984 and after, or before 1985 and after, the effects of pre-versus post-financings were no longer significant and so we do not report these results.¹²

Japanese firms also differ from one another. Japanese firms that are linked to a keiretsu exhibit a lower risk of exit, are more likely to enter additional form factors and to enter them later, relative to the 15 "independent" Japanese firms that did not have such linkages. The reported results suggest that these independent firms behaved much like other non-Japanese firms who lacked a keiretsu affiliation.

The finding that keiretsu affiliation enhances the longevity in the disk drive industry is consistent with the notion of these structures as governance mechanisms (Kester, 1991; Gerlach, 1992; Gilson and Roe, 1993) that help to smooth the adjustment to technological shocks in the HDD industry. Chesbrough (1999b, p. 302) presents evidence that certain Japanese keiretsu member firms utilized affiliate firms to explore new disk drive form factors, which might explain why vertically-linked keiretsu firms themselves were able to enter into new sub-markets later and yet experience greater longevity in the industry.

These results are also consistent with the sociological literature that notes the reciprocal obligations of keiretsu members towards one another, resulting in lower profitability, but also lower variation in profitability, relative to non-affiliated firms (Lincoln et al., 1996). Non-affiliated Japanese HDD firms may enjoy

¹¹ I attempted to collect the data on the firms with managers from other companies such as DEC or HP, but could not reliably observe them. More and better discrimination on this measure would allow inferences between an "IBM effect", versus a "prior management experience" effect.

¹² A third explanation may be that some venture capital firms are better than others at financing successful HDD firms and that the estimated coefficient for all companies that received venture capital financing averages this unobserved heterogeneity, causing the aggregate influence to fall below a statistically significant level.

greater autonomy, but are at higher risk of exit and are less likely to enter new form factors in the HDD industry. And the structural, formal aspect of these linkages appears to matter: the alternate proxy variable for more informal business relations did not show any significant effects on entry, timing of entry, or exit behavior of Japanese firms.

5. Conclusion and directions for further research

This study has examined the determinants of firm entry into new sub-markets in the disk drive industry. It offers three contributions to the empirical literature on sub-market entry. First, it incorporates third party forecasts of the new sub-markets into its models and finds that these forecasts are associated with significant effects on whether and when firms choose to enter new sub-markets. Second, it reports significant geographic differences between US and Japanese firms in their sub-market entry behavior—both in the likelihood of entering a new sub-market and the timing of that entry. But, this paper does not simply note these geographic differences. It explores the need for firms to configure themselves to access skills, capital and customers and provides evidence that these initial resource configuration factors depend on the geographic region in part—the “menu” of configuration options available to the firm—and in part depend upon individual firms’ initial configurations—each firm’s choice off of its geographic menu. These initial configuration differences themselves are associated with sub-market entry behavior. This is the paper’s third contribution.

These firm configuration choices off of a geographic menu of options might usefully be regarded as managerial action, constrained by the institutional environment in which firms operate (North, 1990; Nelson, 1993; Aoki, 1994). Studies of managers’ responses to innovation typically omit the institutional constraints under which they operate; and the reverse is often true as well. Much of the evidence in the empirical organizational studies of innovation is developed from data on firms in the US (Abernathy and Utterback, 1978; Tushman and Anderson, 1986; Henderson and Clark, 1990; Mitchell, 1989; Christensen, 1993, 1997; for recent review see Chesbrough (2001)). The effects of labor market differences, capital market differences and linkages to customers may affect the context for man-

agerial action in many countries. Given that the US has unique institutional features in relation to many other leading industrial countries, it is quite possible that factors associated with effective managerial responses to innovation in the US may not apply in other contexts. It may be that the theories we have developed from these empirical studies on how to manage technological change in the US are in reality a special case of a more general phenomenon.

Christensen’s earlier research on incumbent displacement in the HDD industry can be explained as a special case (US incumbents are frequently displaced in new sub-markets) in a more generally contingent setting (conditions for startup formation and firms’ abilities to access labor, capital and customers influence whether incumbents are displaced). As Anderson and Tushman (1990) indicated, entrant firms often act as carriers of new combinations of technology that displace earlier combinations. When de novo firms can access experienced technical talent, attract sufficient risk capital to execute their business plans and recruit new customers, they bring new combinations of technology to an emerging sub-market. Here, one might well expect to see disruptive innovation, along with substantial racing behavior, that can overthrow the established firms and entrench a new entrant.

These conditions for startup formation may also influence the intensity of selection pressures upon firms once they enter into the industry. They can condition the extent to which firms may race against each other (and against new startup entrants) to serve a new sub-market versus relying upon formal, vertical linkages with suppliers or customers to leverage their entry into the sub-market. Where strong vertical linkages are prevalent, they can diminish the ability of new entrants to displace established firms and therefore reduce the selection pressures upon incumbents in those environments. Here, one would be less likely to see the disruptive effect and one would likely observe greater incumbent longevity as a result.

This suggests a view of firm sub-market entry behavior that is partly determined by the institutional environment and partly amenable to managerial action. The institutional environment determines a menu of choices for how firms configure themselves to access technical skills, capital and customers, and US firms do not face the same menu as Japanese firms. However, firms in each region retain substantial discretion in the

choices they make from their given menu, as evidenced by the substantial variation observed in how firms in each region accessed labor, capital and customers.

This suggests that future research in the organizational impact of innovation needs to admit consideration of the institutional environment into the analysis. Other recent comparative empirical research supports the need for a contingent perspective towards the impact of innovation. A recent detailed analysis of both US and Japanese firms in the semiconductor industry, noted many differences between each region's firms in how they organized the development teams, approached new process development and conducted experiments (West, 1997). A recent study by Darby and Zucker (1996) in the biotechnology industry, found that the number of firms created by "star" scientists in the US was 10 times greater than the number created by similarly matched star scientists in Japan. Moreover, the dominant mode of entry for new entrant firms in the US was de novo startup firms, while the dominant mode in Japan was new subsidiaries of existing firms.

Other single industry studies in technologically intensive settings can shed further light on these issues.¹³ A recent research volume provides further comparative studies of innovation in the same industry across countries (Burgelman and Chesbrough, 2001). By studying the impact of innovation upon firms in a single industry in different countries, we can implicitly control for the technical differences across industries and isolate the institutional and organizational influences upon firms' actions. This may help clarify why firms in the same industry in different countries may differ in their response to the emergence of sub-markets and help our theories of managerial response to innovation transcend their typically US origins.

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¹³ For a recent collection of seven comparative studies of industry evolution, see Mowery and Nelson (1999). While these studies are well done, they are descriptive in nature and do not focus on specific decisions such as sub-market entry by firms across regions in the same industry.

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