The Influence of Prior Industry Affiliation on Framing in Nascent Industries: The Evolution of Digital Cameras

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Abstract

New industries sparked by technological change are characterized by high technological, market, and competitive uncertainty. In this paper we explore how a firm's conceptualization of products in this context, reflected in its introduction of product features, is influenced by prior industry affiliation. We hypothesize first, that prior industry experience shapes a set of shared beliefs resulting in similar and concurrent firm behavior, second, that firms will notice and imitate the behaviors of firms from the same prior industry, and third, that as firms gain experience with particular features, the influence of prior industry will decrease. Our hypotheses are supported by findings from a quantitative, large sample study of digital cameras introduced from 1991 to 2006 by firms from three prior industries: photography, consumer electronics, and computers. By 2003, several features had emerged as a dominant design, however the timing and rate of adoption varied by prior industry. This study extends previous research on firm entry into new domains by examining heterogeneity in firms' feature-level entry choices. In addition, we contribute to work on dominant designs, going beyond characterizing a dominant design as a set of technological choices, to understanding cognitive convergence on a standard set of demand-side product features.

Keywords: Technological change; Innovation; Industry evolution; Dominant designs, Managerial beliefs; Digital photography

Introduction

The nascent stage of an industry's evolution is characterized by tremendous ambiguity and uncertainty, particularly when the new industry is sparked by radical technological change. Potential customers have little or no experience with products in the new industry, and their preferences are therefore unformed and unarticulated. Even basic assumptions about what the product is and how it should be used are subject to debate. Similarly, from a technological perspective, uncertainty exists about the rate of performance improvement of the new technology, how components of a technological system will interact, and whether the technology will work at all. Market and technological uncertainty are often compounded by competitive uncertainty as firms grapple with shifting industry boundaries and the convergence of firms from previously distinct domains into a new product market.

During this period of turbulence, a broad range of product variants are introduced as firms experiment with alternative configurations, functions, and technologies (Anderson and Tushman 1990; Klepper 1997; Utterback and Abernathy 1975). Firms or coalitions of firms sometimes promote particular technologies or product variants in an effort to establish an advantage (Cusumano, Mylonadis and Rosenbloom 1992; Garud and Rappa 1994; Rosenkopf and Tushman 1998). Eventually, as uncertainty about user preferences and technological progress is resolved, competing conceptions of both the desired functionality of the product and the underlying technologies often converge on what researchers have labeled a dominant design (Anderson and Tushman 1990; Utterback and Abernathy 1975). The dominant design comprises a standard set of technologies and interfaces as well as a shared understanding of what performance attributes are important (Kaplan and Tripsas 2008). The result of a negotiated political and social process, the dominant design is often not the technologically superior alternative (Tushman and Rosenkopf 1992; Utterback 1994)

While this basic pattern of evolution has been well-established by previous research, important gaps in our understanding remain. First, prior research on entry in the early stages of industries has treated entry as a dichotomous variable with the focus on predicting which firms enter, the timing of their entry, and how entry timing and prior experience affect performance. This research has shown, for example, that firms with related experience and capabilities are more likely to enter a new industry (Danneels 2002; Helfat and Lieberman 2002; King and Tucci 2002; Klepper and Simons 2000; Silverman 1999), and of the firms that enter, under certain conditions, those with related experience enter earlier and survive longer (Bayus and Agarwal 2007; Dowell and Swaminathan 2006; Klepper and Simons 2000). What we lack is a more granular understanding of the many individual choices that entry comprises. In particular we know little about the forces that influence variation in the type of products that entrants introduce, specifically at the level of product features. In other words, we are missing a detailed understanding of the sources of heterogeneity in entrants' interpretations of the new market as reflected in their product variants. Firms' decisions about product features are critical as they influence consumer adoption and diffusion, and ultimately whether the new market emerges (Rindova and Petkova 2007).

Second, although a dominant design represents convergence of both demand-side (market) and supply-side (technology) characteristics as articulated by Clark's (1985) distinction between market concepts and a technical design hierarchy, in studies of the emergence of dominant designs, researchers have focused mainly on the technological dimension. For example, the twenty-three papers reviewed in Murmann and Franken's (2006) recent synthesis of the literature all assessed the emergence of a dominant design in terms of technologies, broadly defined, while the features embodied in the dominant design were rarely examined. We therefore have little understanding of the market dimension of dominant designs, including both initial variance in product features and eventual convergence on a standard set of features. Insight into this aspect is important for improving our understanding of how dominant designs emerge, and more broadly, how industry evolution unfolds.

In this paper we address these gaps by exploring what factors influencing a firm's initial introduction of product features during the nascent stage of an industry, and how the process of convergence on a standard set of features unfolds. In particular, we assess how a firm's background, represented by its prior industry affiliation, influences its conceptualization of the product, as reflected by the features it incorporates. A firm's prior industry affiliation is likely to matter due to a combination of capabilities, beliefs, and a peer group, that result from prior industry experience and interactions. Existing capabilities might influence product-level choices in that a firm is likely to introduce products that leverage its core strengths (Helfat and Peteraf 2003; Helfat and Raubitschek 2000; Montgomery and Hariharan 1991). Given the ambiguity associated with a nascent industry, socio-cognitive processes also play an influential role as firms attempt to make sense of the confusing and often conflicting signals they receive about the market (Weick 1990, 1995). So a firm's perceptions of the emerging market, based on beliefs derived through both its own history (Tripsas and Gavetti 2000) and industry-level shared beliefs (Huff 1982; Porac, Thomas and Baden-Fuller 1989; Spender 1989), could also influence firm choices. Finally, during periods of high uncertainty, decision makers often imitate the behaviors of other salient firms (Haveman 1993; Rao, Greve and Davis 2001), and the most salient firms are likely to be those competing in the same industry. So, how a firm interprets the emerging opportunity and its conceptualizations of products in the nascent domain are likely to be influenced by its prior industry background.

We utilize a unique longitudinal dataset that includes the entry date and features of almost every camera in the history of the US consumer digital camera industry from its inception in 1991 through 2006 to disentangle and test for the influence of beliefs and imitation stemming from prior industry affiliation. The emergence of consumer digital cameras provides an ideal setting in that it brought together entrants from three prior industries, photography, computing, and consumer electronics, enabling a comparison of firm background and its influence on decisions about which features a digital camera should include. In contrast to many industries, start-ups did not play a major role in the digital camera market. The digital camera market is also unique in that this is a setting where technical capabilities are not a primary driver. As we discuss in detail later, incorporation of specific features in a camera was likely not dependent upon a firm's capabilities, since innovation occurred to a great extent in a well-developed supply chain, giving all firms access to the same core features.

We find that prior industry affiliation had a significant influence on a firm's initial conceptualization of the market as reflected in its initial introduction of product features. First, firms from the same prior industry shared similar beliefs about what features would be valued as reflected in their concurrent introduction of features. Firms were significantly more likely to introduce a feature (such as optical zoom) to the extent that other firms from the same prior entered with the feature in the same year, whereas concurrent entry by firms from different prior industries did not influence a firm's likelihood of entry. Second, firms were likely to imitate the behavior of firms from the same prior industry, as opposed to that of firms from different prior industries in introducing some, but not all features. We are thus able to untangle the influences of shared beliefs arising from the affiliation in the previous industry (that give rise to similar concurrent activities by firms from the same prior industry) and mimetic behavior. Finally, we found that as a firm's experience with a particular feature increased, the influence of prior industry decreased.

The paper proceeds as follows: First, we review prior research on technological change and industry emergence. We then develop hypotheses about the influence of both shared beliefs and imitation on a firm's initial introduction of features as well as its ongoing commitment to a feature after the firm has gained experience with it. Following that, we describe our data and empirical context. We first explore our hypotheses by providing a descriptive analysis of industry patterns. We then outline our quantitative measures and statistical methods, followed by the results of our quantitative hypothesis tests. We conclude with a discussion of the robustness of our findings to alternative specifications, and the implications and contributions of our findings and directions for future research.

Technological change, market uncertainty, and patterns of industry emergence

Studies of industry evolution following major changes in technology have documented consistent patterns of progress, falling into three prototypical stages: an era of ferment following the technological discontinuity, convergence on a dominant design or standard, and an era of incremental change, characterized by incremental improvements in products and processes (Anderson and Tushman 1990; Klepper and Graddy 1990; Utterback and Abernathy 1975).[1] The type of technological change that

[1] These stages are essentially the same as what Utterback & Abernathy (1975) label Fluid, Transitional and Specific stages, and what Klepper & Graddy (1990) label Growth, Shakeout, and Stabilization stages.

sparks an era of ferment is a discontinuous, radical innovation that shifts the underlying product technology to an entirely new knowledge base and offers the promise of significantly improved price and performance (e. g. Gatignon, Tushman, Smith et al. 2002). Examples of such changes include the shift from electromechanical accounting equipment to electronic computing for firms such as IBM, (Taylor and Helfat 2009), the shift from copper wire to fiber-optics in the communications industry, (Kaplan 2008) or the development of biotechnology and the pharmaceutical industry (Kaplan, Murray and Henderson 2003; Pisano 1990; Rothaermel 2001).

High levels of experimentation by both firms and customers dominate the era of ferment following a technological discontinuity. Firms introduce different technological variants as they experiment with alternative ways to improve performance. For instance, early automobiles utilized a variety of mechanisms for steering ranging from a joy-stick-like tiller to steering wheels; the internal combustion engine competed with electric and steam engines before becoming prevalent, and some vehicles had three wheels, not four (Abernathy 1978; Basalla 1988). In the early days of mechanical typesetter machines, over 175 technical variants emerged before "hot metal" linecasters became dominant in the early 1900s (Tripsas 1997). In addition to technical variation, fundamental beliefs about what the product is and what functions it should perform are subject to multiple interpretations. As Clark (1985 p. 244) noted, a customer's choice in the era of ferment "involves both the formation of concepts with which to understand the product, and the development of criteria to be used in evaluation." For instance, Americans and French held contrasting conceptions of what an automobile was early in the industry's history. Americans conceived of an automobile as a "horseless carriage" whereas "the French thought in terms of a road locomotive" (Langlois and Robertson 1989 p.366). These different perspectives were reflected in the product design, features, and technologies employed. Similarly, early in the evolution of cochlear implants, alternative visions of what the product should be resulted in completely different performance metrics being valued (Garud and Rappa 1994). Even within one user organization, the best application for a novel software product, Lotus Notes, varied depending upon what analogies users made (Orlikowski and Gash 1994).

As market and technological uncertainty are resolved, in some cases the industry converges on a dominant design. The dominant design represents not just consensus about the technological performance and configuration of a product – a set of standard technologies, modules and interfaces (Anderson and Tushman 1990; Utterback and Abernathy 1975; Utterback and Suarez 1993), but also cognitive convergence: a shared understanding of what the product is, how it will be used, and which attributes will have value (Kaplan and Tripsas 2008). The process by which a dominant design emerges is a complex combination of economic, social, political, and cognitive dynamics, and the technologically superior alternative does not necessarily win (Suarez 2004; Tushman and Rosenkopf 1992; Utterback 1994).

While this pattern of variation and eventual convergence on a dominant design has been documented in a range of industries from synthetic dyes (Murmann 2003) to microprocessors (Khazam and Mowery 1994), the focus has been on the technological, not market dimension of a dominant design. For example, in Christensen, Suarez, and Utterback's (1998) study of the rigid disk drive industry, they identify and track four technologies that make up the eventual dominant design: the Winchester architecture, the under-spindle pancake motor, rotary voice-coil actuator motors, and embedded intelligence interface electronics, and date the start of the emergence of the dominant design as the year when a firm first introduces a product incorporating all four technological variants. These product attributes are technological (supply side) in nature, reflecting the technological choices made by the disk drive firms. The demand-side product features that might be associated with customer adoption and use are not considered in the study. Similarly, in Baum, Korn and Kotha's (1995) study of the effect of dominant designs on population dynamics in the facsimile transmission equipment industry, the Consultative Committee on International Telephone and Telegraph (CCITT) technical standards for facsimile transmission were used to define the dominant design.

In addition, while research has clearly documented that variation in the era of ferment is high, we have no clear understanding of the sources of that heterogeneity, other than the general argument that *de novo* firms are an important source of entry and innovative technology in many industries (Christensen and Bower 1996; Cooper and Schendel 1976; Tushman and Anderson 1986). There is evidence that firm founders with different backgrounds will identify different market applications for the same core technology (Shane 2000), but the overall innovativeness of de novo firms in new industries is usually attributed to their small size, flexibility, and lack of inertia. We don't have a good sense of why different start-ups introduce different product variants in the same market.

Diversifying entrants also play an important role in many new industries, but the focus of most research has been on whether firms enter, when they enter, and whether they survive (e.g. Carroll, Bigelow, Seidel et al. 1996; Dowell and Swaminathan 2006; Mitchell 1989; Mitchell 1991). Diversifying entrants that possess relevant resources, capabilities and experience are more likely to enter a new industry and perform well. For instance, radio producers, with capabilities that were close to those eventually important in televisions, were more likely to enter the TV receiver industry, to enter early, and to survive (Klepper and Simons 2000). Similarly, of diversifying entrants in the automobile industry, bicycle and carriage manufacturers were more likely to survive than engine manufacturers (Carroll et al. 1996). But this research has focused little attention on how firms enter, i.e. the features firms from different prior industry backgrounds bring to products in the new domain. In addition, these studies have assumed that the impact of prior industry association is due to the capabilities of diversifying entrants which provide an advantage in the new domain. Much less consideration has been given to the possibility that prior industry affiliation also reflects shared beliefs and a common set of peers that are noticed and potentially imitated. In this paper we address both of these issues by examining how a shared set of beliefs about the emerging industry and imitation of peers from the same prior industry can influence the product-level choices firms make when entering a nascent industry.

The influence of prior industry affiliation on the introduction of product features

We next develop a set of hypotheses about how a firm's prior industry affiliation influences its introduction of particular product features. In doing so, we explicitly distinguish between the influence of shared beliefs and the influence of imitative behavior, both constructs that result from common industry affiliation. Existing research suggests that at one level, similar prior experiences give rise to a shared set of beliefs for firms in the same industry. At a second level, these shared beliefs are reinforced due to ongoing interaction among firms within an industry, through trade shows, industry conferences, employee mobility, and other specific mechanisms whereby firms exchange information. The combination of shared experiences and interactions of industry members results in a common set of overarching assumptions that guide interpretation and firm action. For example, Huff (1982 p.125) put forward the theoretical argument that organizations in the same industry have “shared or interlocking metaphors or worldviews” such as common beliefs about customer preferences, the role of regulation, and future levels of industry demand. In subsequent research, scholars have provided strong empirical support for the notion of industry-level frames. Spender (1989 p.188) identified sets of “industry recipes,” noting that “executives adopt a way of looking at situations that are widely shared within their industry.” These recipes are particularly salient when making decisions under uncertainty. Similarly, Porac, Thomas, and Baden-Fuller (1989 p.400) identified a set of shared causal beliefs held by Scottish knitwear manufacturers concerning customers, suppliers, retail, and competition, noting that “over time the mental models of competing strategists become similar thereby creating ‘group level’ beliefs about the marketplace.” Extending this work through additional analysis of the knitwear industry, Porac, et al (1995) developed the concept of an “industry model” which represents collective recognition on the part of producers about what fundamental attributes should be used to categorize competitors and which firms belong in which categories.

Industry-level beliefs are important because they influence decision-making and action (Levitt and March 1988). In the photolithography industry, firms developed shared, but mistaken, assumptions about the direction of change in the underlying technology, and these resulted in erroneous projections about performance limits by firms in the industry (Henderson 1995). Bogner and Barr (2000 p.221) proposed that in hypercompetitive industries, constant, rapid change becomes the norm, and this “common cognitive framework” of industry members in turn perpetuates the hypercompetitive environment. Even for seemingly straightforward analyses, such as firm evaluations of acquisition targets, different industry backgrounds can have a significant effect on outcomes (Hitt and Tyler 1991).

The commonly held perceptions, expectations, and assumptions that firms develop from their industry affiliation become particularly salient when those firms enter a highly uncertain emerging industry that incorporates novel technologies with novel uses. In this context, firms must decide which product features to offer, but have no concrete data about what consumers value. Firms must therefore make assumptions in order to project which customer segments the product will appeal to, how customers will use the product, and how customers will evaluate it. Given this set of assumptions, the firm then decides which specific features to incorporate in a product. A firm's prior industry affiliation creates common assumptions through both shared prior experiences and through ongoing interaction among firms from a prior industry, even after those firms have entered the new domain. First, past experience with similar customers creates common expectations about what customers in the new domain might value. Managers may "reason by analogy," transferring beliefs about prior situations to novel situations that they perceive to be similar (Gavetti, Levinthal, and Rivkin, 2005). Similar prior industry-specific experiences therefore likely lead to similarities in how these novel, uncertain markets are assessed by firms from the same industry. Second, ongoing interaction among firms from the same prior industry creates a forum for direct sharing of information about the emerging industry. A variety of venues such as industry consortia, standards committees, trade associations, and industry conferences have been shown to facilitate relationships and sharing of information (Lampel 2001; Rosenkopf, Metiu and George 2001). Firms that still compete in their prior industries will continue these interactions. In addition, even in the context of institutions associated with the emerging industry, firms are more likely to pay attention to and interact with familiar peers (Ocasio 1997). In aggregate, these mechanisms reinforce common expectations among firms from the same prior industry.

Thus, in the face of the uncertainty associated with new industries, managers rely upon existing beliefs as they make choices, and since these beliefs are similar among firms from the same prior industry, these firms are likely to make similar assessments of the product features that customers will value. The timing of a firm's initial introduction of product features is therefore likely to be more similar for firms entering the new domain from the same prior industry than for firms entering from different industry backgrounds. Put differently, concurrent entry is an indication of shared beliefs about the value of a particular feature.

> H1: In the nascent stage of an industry, the greater the number of other firms from the same prior industry that introduce a produce feature during a period (as opposed to firms from a different prior industry) the greater the likelihood a firm will introduce the product feature in that period.

Firms in the same industry, subject to similar institutional forces, are also likely to imitate each other (DiMaggio and Powell 1983). Researchers in institutional theory have documented the isomorphic tendencies for firms that face similar institutional environments to adopt similar structures and practices, including for example, civil service reforms (Tolbert and Zucker 1983), multidivisional structures (Fligstein 1985) or matrix management practices (Burns and Wholey 1993). Moreover, firms are more likely to imitate the practices and behaviors of similar, comparable firms than to imitate firms they categorize as distant (Baum, Li and Usher 2000; Haveman 1993). The tendency for mimetic isomorphism or imitation is heightened under conditions of high uncertainty such as entry into new markets (Greve 1996; Haveman 1993; Korn and Baum 1999). Imitation is a factor not only in decisions about whether to enter new, emerging domains, but is also likely to influence how firms enter, i.e. how they conceptualize the new product and which features they include in products. In the highly uncertain setting of an era of ferment, therefore, firms are likely to imitate the features that have already been introduced by other firms from the same industry background.

> H2: In the nascent stage of an industry, the greater the previous introductions of a given product feature by other firms from the same prior industry, the greater the likelihood a firm will imitate them and enter with that feature (as opposed to imitate firms from a different prior industry).

Thus H1 suggests that shared beliefs are indicated by firms from the same background behaving in similar ways concurrently, while H2 suggests that imitation is indicated by firms first observing the product attributes introduced by other firms from the same prior industry, and engaging in the same behavior in a subsequent period.

Our discussion so far concerns the choices that firms make in their initial introductions of products incorporating particular attributes or technologies. In this highly uncertain initial stage, a firm must rely on prior beliefs or observations of the actions of other salient firms to make decisions about the appropriate elements to incorporate in a new product. But these influences, which are particularly prevalent under conditions of uncertainty, dissipate over time as firms gain knowledge based on their own experience. For instance, in a study of South Korean firms in China, Guillen (2002) found that while firms imitated other firms from the same home-country industry in the rate of their foreign expansion, this effect decreased once a firm had made its first foreign entry. Prior research has also shown that although decision makers may initially imitate other firms in situations of high uncertainty, updated information based on experience can lead to abandoning a particular course of action (Fiske and Taylor 1991; Rao et al. 2001). Similarly, in our context, once a firm has introduced particular product features and sold products, it gains knowledge from experience and also has access to information from customers to better understand the usage and of different features. Thus, beyond the initial stage, the firm's own experience with features in the new industry is likely to play a heightened role in subsequent decisions about whether to continue to incorporate those features in its products, and the influence of prior industry beliefs and peers is likely to decrease.

> H3: In the nascent stage of an industry, the more experience a firm has with a particular product feature, the less the influence of other firms from the same prior industry on the firm's commitment to that product feature.

DATA AND RESEARCH SETTING

Overview of the digital camera industry

The emergence of digital cameras provides an ideal context in which to study these issues in that the majority of entrants came from three prior industries: photography, consumer electronics, and computers, thus facilitating an examination of the impact of prior industry affiliation on responses to the new industry. Digital camera technology utilizes semiconductor chips such as CCDs (charge-coupled devices) to capture and convert light images to binary data, replacing the role of silver halide film in analog cameras. Beyond image capture, digital technology offers the benefits of transfer, manipulation, and storage of digital images. The first consumer digital camera, a non-color grayscale, 90,240 pixel camera that could store 32 images in internal memory was available in 1991. Between 1991 and 2006, a total of 83 firms entered the US consumer digital camera industry including 25 photography firms (camera or film producers such as Kodak and Olympus), 19 consumer electronics firms (such as Sony and Panasonic), 25 computer and computer peripheral firms (such as Hewlett-Packard and Logitech), 9 de novo start-ups, and 5 diversifying entrants from unrelated industries (e.g. Mattel and Disney). Industry sales began to take off in 2002, and in 2003 sales of digital cameras exceeded those of analog cameras.

The digital camera industry is also ideal for studying the role of prior industry affiliation in shaping perceptions and interpretations in that we can largely separate decisions about product features from the required capabilities underlying those decisions. The expertise required to develop the components that were eventually standard in a digital camera were resident in the supply chains of pre-existing industries: photography, consumer electronics, and computing and were widely available to all firms participating in digital cameras. For instance, the electronic capture of images using semiconductors had previously been used in video camcorders, and zoom lenses were a standard feature in both camcorders and analog cameras. Similarly, the digital manipulation of images through software had been developing in the computing industry, where desktop publishing had taken off. As a result, when consumer digital cameras emerged, component innovation was primarily accomplished by suppliers. Camera manufacturers could therefore choose from suppliers of available features when deciding which components to include in a camera. For instance, the ability to introduce higher megapixels was driven by sensor chip suppliers. Sony, Matsushita, Sharp, and Toshiba all supplied CCD sensors, and a firm contemplating the use of CMOS, instead of CCD sensors in 1998 could source them from a range of players including Motorola, Rockwell, and Hewlett Packard. Even firms that participated in the digital camera industry generally supplied their components to others. Kodak, an early leader in high end CCD sensor technology created a separate Image Sensor Solutions division to serve as a merchant market supplier of both CCD and CMOS sensors, and Kodak's consumer digital cameras mostly incorporated sensors from other suppliers.

In addition, a vibrant OEM and ODM industry developed early on, enabling firms to choose from features and technologies available in reference designs when deciding upon a camera to introduce. Japanese firms such as Chinon were producing cameras for others as early as 1993. Taiwanese firms entered the OEM/ODM industry in 1997, and by 1999 it was estimated that 10% of digital cameras worldwide were produced by Taiwanese ODMs/OEMs (Taiwan Economic News. 1999) rising to 20% in 2000 (Taiwan Economic News. 2000). In this industry, although some firms might develop more extensive capabilities in particular components, capability was likely not a major distinguishing factor in a firm's ability to introduce particular features or technologies in their digital camera assembly. Our tests of the influence of prior industry therefore allow us to a large extent to untangle firms' framing and conceptualizations of the appropriate features and technologies for a digital camera from considerations of their capabilities.

Sources and Data

Our dataset includes comprehensive longitudinal data covering the history of consumer digital imaging in the US from 1991 through 2006. It covers every firm to introduce a branded digital camera in the US (private label cameras are excluded), and every digital camera introduced by these firms from 1991 through 2006. Firm and product-level data were supplemented by industry-level data on aggregate sales and growth. In our analysis, we excluded three types of cameras that we determined were distinct product markets that would experience their own separate processes of variation and convergence on a dominant design: studio cameras, webcams, and digital single lens reflex cameras (SLRs). The earliest digital cameras in the mid-1980's were studio and professional cameras that resembled scanners, captured up to 16 megapixels, were priced in the $16,000 to $20,000 range, and were produced and sold primarily by graphic arts firms that did not enter consumer digital photography. Webcams, sometimes called "eyeball' cameras, were tethered to a PC and provided video-conferencing capability over the Internet. Finally, consumer-oriented digital SLRs, while sharing some attributes with consumer-oriented digital cameras, did not really emerge as a category until 2002 at which point non-SLR cameras were already beginning to coalesce on a dominant design.

Quantitative data were collected from a broad range of primary and secondary industry sources including company and industry association archives. Detailed information on digital camera specifications from 1993-2000 come primarily from the Future Image Report, a print publication issued ten times per year. These data were supplemented by trade journals such as PC Photo and Popular Photography, International Data Corporation reports on digital photography, archived product specifications from company websites, archives from photography industry websites (primarily dpreview.com, imaging-resource.com, and dcviews.com), and press coverage of the industry throughout the time period. The entry date and specifications for each camera were cross-checked and confirmed by at least two of these sources. In all, our dataset includes 682 digital cameras introduced by 83 firms during this period.

Emergence of a Dominant Design in Consumer Digital Cameras

Like other radical technological changes, the advent of digital photography triggered rapid innovation, uncertainty, and competition among product designs, features, and technical variants. Consistent with the pattern found in prior research on technological change (e.g. Utterback, 1994; Anderson & Tushman, 1990), digital cameras followed a pattern of high variation with competition among product attributes and technical variants, and eventual convergence on a standard camera – a dominant design.

To measure the emergence of a dominant design for digital cameras, we identified and tracked adoption of a set of key camera features. This measure is unique in that it focuses on the market dimension in contrast to prior empirical measures, which have focused almost exclusively on the technological dimension (e.g. Anderson and Tushman 1990; Christensen, Suarez and Utterback 1998). Since in the digital camera industry, component suppliers develop most of the technology underlying a given product feature, the primary decision facing firms in the industry was which features to incorporate and when as opposed to which technologies to invest in. For instance, firms had to decide whether to incorporate a zoom lens in their camera, but they did not have to decide among technologies to invest in to develop and manufacture a zoom lens – the suppliers made those choices. As recommended by Suarez

(2004) we considered a dominant design to emerge only when over 50% of new models had all of the elements that were included in the design, and that percentage was continuing to increase.

The features we tracked were: LCD Display, optical zoom lens, digital zoom software, movie clips, resolution, removable storage, and dual webcam capability. Inclusion of most of these features in a camera was a binary choice for a firm – either the camera had the feature or didn't. Image resolution was different. Since all digital cameras have resolution, the choice firms make is the level of resolution. Thus, it is what Rosenkopf and Tushman (1994) call a dimension of merit. We therefore sorted cameras into resolution categories, enabling us to also analyze introduction of higher resolution cameras as a binary choice. The first critical break point was the VGA resolution of a computer screen. Early digital cameras had either VGA resolution (307,200 pixels) or lower, and images were displayed on computer screens or TVs. Once sensors with greater than VGA resolution were available, firms had to decide whether they believed consumers would value higher resolution. We therefore used higher than VGA resolution as our first break point. We included 1 megapixel cameras in this category since this resolution was among the first available resolutions above VGA. For higher resolutions we followed the norm in the industry and categorized models as 2 megapixel (2 million through 2.9 million pixels), 3 megapixel etc. With the exception of the dual webcam feature all other features became part of the dominant design. Table 1 describes each of these features in more detail and summarizes when they were first introduced and how quickly they were adopted. Figure 1 shows the percentage of new cameras introduced each year that incorporated each feature. Wide variance in features is evident in the early years. For instance, in 1997, LCD displays were offered in 63% of new cameras, optical zoom in 17%, digital zoom in 5%, movie clips in 12%, over VGA resolution in 28%, removable storage in 70%, and dual webcam capability in 10%, but by 2006 each feature except for dual webcam was present in almost all new cameras. While individual elements were introduced earlier, the first camera to incorporate all elements of the dominant design was introduced in 1999 and it wasn't until 2004 that over 50% of models had all elements of the dominant design. We therefore define the nascent stage of the industry as extending from 1991 through 2003 and exclude subsequent years in our empirical analysis.

The role of prior industry affiliation and the introduction of features: descriptive analysis

Before turning to a quantitative analysis of the introduction of features, we first examine descriptive data on the initial introduction and subsequent diffusion of features to identify preliminary patterns that distinguish the influence of prior industry. While in retrospect the elements of the dominant design may seem obvious, in the moment there was high uncertainty about how products would be used and what features would be valued (Munir 2005; Srinivasan, Haunschild and Grewal 2007). For example, in 1993, a VP from Leaf Systems noted, "the thing about scanning is that there already was a perception in the marketplace of what a scanner was…Electronic photography is quite different." Similarly, the diversity of perspectives was reflected in 1997 by an industry analyst who noted, "It never occurred to Sony that images from a digital camera would be displayed predominantly on a computer as opposed to a TV." (Future Image Report, 1997).

Table 2 compares the initial introduction and adoption rates of features by firms from each prior industry. At a descriptive level, it appears that adoption rates differed depending upon what industry a firm originated in.

The photography industry led the introduction of high resolution, optical zoom, and removable storage features, indicative of a mindset that conceived of a digital camera as a photographic device, not a PC peripheral. Although the resolution of digital cameras (measured in pixels) ultimately emerged as an important product feature, early on the perceived value of exceeding the VGA resolution of a computer screen depended upon whether members of a firm believed that consumers would primarily display images on a TV or computer, or whether they would also want to print pictures. The first camera to offer higher than VGA resolution was introduced by Kodak in 1995. That same year, Logitech, a computer peripheral firm re-branded Kodak's model and sold it. However it wasn't until 1997 that other computer industry firms joined the fray, with Umax, a scanner company, Soundvision, a chip maker, and Epson all announcing models with higher than VGA resolution. By that time, six other photography firms were already in the market with high resolution cameras. Sony led the consumer electronics firms with a model in 1996.

Fuji was the first to introduce an optical zoom model in 1992, and Chinon and Ritz followed in 1995. However, consumer electronics firms didn't enter with optical zoom until 1996, and computer firms lagged even further behind. The first computer firm entrant with optical zoom was Epson, entering in 1998, at which point half of the models offered by photography and consumer electronics firms included the feature.

Removable storage was also first introduced by Fuji in 1992. In 1995 two more photography firms, Ritz and Chinon introduced models followed by 3 more photography firms in 1996. In 1996, consumer electronics firm Sony also introduced cameras with removable storage, and finally in 1997, several computer industry firms including Apple, Epson, HP, UMAX Technologies, NEC, and Soundvision followed suit.

Consumer electronics firms led the introduction of LCD displays, which were already a standard feature of camcorders. The LCD display feature on digital cameras allowed the user to preview and selectively delete images taken with the camera. LCD displays were first introduced in 1995, in the QV10 camera introduced by Casio. An industry analyst noted, "Casio was well-positioned to be the first to introduce [LCD] displays on digital cameras…because it was not a camera or film company, Casio was unencumbered by traditional concepts of what a 'digital camera' ought to be." (Future Image Report, 1997). This feature diffused quickly, with both computer and photography firms incorporating LCD displays into cameras the following year, and over half of new digital cameras having LCD displays by 1997.

Computer industry firms led the adoption of webcam capability. The dual webcam feature enabled a camera to serve as a webcam and do real time streaming video through a personal computer over the Internet in addition to functioning as a stand-alone camera. Webcam capability was first available in a digital camera in 1997, when three computer firms, UMAX Technologies, Apple, and Soundvision all introduced models. That same year two photography firms, Vivitar and Ricoh also introduced dual webcam models, and in 1998, Samsung, a consumer electronics firm, introduced a model, based on Intel technology.

In contrast to the other features tracked, the dual webcam feature did not emerge as a widely adopted product attribute in digital cameras. Although almost half of the models from computer firms had the feature in 2001, for photography and consumer electronics firms the percentage of models with the feature peaked at about 20%. By 2006 the percentage of new dual webcam models in the overall industry had declined to 13%.

For the movie clip and digital zoom features, it is difficult to assess adoption patterns from the descriptive data. The movie clip feature, which allowed the user to capture and store short video clips, was first introduced in 1996 by Ricoh, followed by firms from all three industries. Similarly, digital zoom, which involves software manipulation of the image to create a 'close-up' which is a cropped version of the original image captured was first offered in 1997, in digital cameras introduced by firms from all the prior industries: computing (Epson), photography (Fuji) and consumer electronics (Hitachi).

The role of prior industry affiliation and the introduction of features: quantitative analysis

The descriptive data suggest that prior industry affiliation was an important influence on when a firm introduced cameras that incorporated different features. We next use quantitative data on the introduction of cameras with specific features to test our hypotheses. We first define our dependent and independent variables, then our methods, and finally discuss the results.

Measures

Dependent Variables:

Initial introduction of features: For testing Hypotheses 1 and 2, the dependent variable is a firm's initial introduction of a digital camera that has a given product feature (e.g. LCD display). This variable has a value of 1 in the first year that a firm introduces a model with that product feature. The firm is at risk of entry starting the year after a digital camera with that product feature was first introduced into the industry and ending once the firm introduces a model, the firm exits the digital camera industry, or the time period under consideration (through 2003) ends. Since the choice of features for a firm's initial digital camera reflects the firm's framing of the opportunity in the context of high uncertainty, we include the first model introduced by a firm in the analysis.

Ongoing commitment to features: To test hypothesis 3, we use two different dependent variables. For all features other than resolution, we measure a firm's ongoing commitment to a feature as the *number of digital cameras introduced by firm i in year t* that have a particular feature. The data for these analyses begin in the year following the firm's initial year of entry into the feature. For the analyses of the digital camera resolution feature, we examined the timing of a firm's entry into each subsequent megapixel generation from 2 megapixels to 6 megapixels, since an ongoing commitment to high resolution is indicated by a firm continuing to introduce increasingly higher resolution cameras, (as opposed to more camera products with greater than VGA up to 1 megapixel resolution).

Independent Variables:

To test H1, that firms from the same prior industry share beliefs with each other more than with firms from different prior industries, we measure *Concurrent entry by other firms from* ***same*** *prior industry*, and *Concurrent entry by firms from a* ***different*** *prior industry*, counts of the number of other firms with the same and with different prior industry affiliations that enter with a particular feature in year t. If firms from the same prior industry have similar beliefs about what features to incorporate in a camera, then a firm should be more likely to enter in the same year that more firms from that same industry enter as opposed to more firms from a different industry.

To test H2, that firms are likely to notice and imitate firms from the same prior industry more than firms from a different prior industry, we use *Cumulative previous entry from* ***same*** *prior industry*, a count of the cumulative number of other firms with the same prior industry affiliation that have introduced a particular feature as of year t-1 and *Cumulative previous entry by firms from a* ***different*** *prior industry*, a count of the cumulative number of firms with a different prior industry affiliation that have introduced a particular feature as of year t-1. For example, for the photography firms such as Nikon, Olympus, or Kodak, we measure the cumulative number of other firms from photography that have introduced a camera with a feature (e.g. optical zoom) in prior years and the cumulative number of non-photography firms that have introduced the feature in prior years.

For testing hypothesis 3, that firm experience with a feature moderates the relationship between prior industry affiliation and a firm's ongoing commitment to a feature, we examine the interaction between the market presence of firms from the same prior industry in the feature and a firm's own experience with the feature. Both main effects are mean centered, with mean-centered values used to compute the interaction. We measure *Firms from same prior industry present in feature* as a count of the number of firms from the same prior industry that are currently in the market with a camera that has the feature. We measure *Firm experience in feature* using the cumulative number of models with the feature that the firm has introduced as of year t-1. If prior industry influence diminishes with experience, the interaction between these two measures should be negative. Finally, we also control for *Firms from* ***different*** *prior industry present in feature*, a count of the number of firms from a different prior industry that are currently in the market with a camera that has the feature.

Control Variables: We control for several other factors that might affect the introduction of digital camera features. A firm's commitment to and participation in the broader digital imaging industry may influence introduction of features, so we control for the *breadth of a firm's digital imaging offerings*, a time-varying measure calculated as the number of digital imaging product categories in which a firm participates in a given year, including photo printers, photo finishing/sharing websites, photo editing software, desktop scanners, and removable memory cards. Participation in closely related markets may also influence entry, so we include controls for whether a *firm is present in the webcam, camcorder, and digital SLR markets in year t*. Each of these variables is set to one if the firm is in that market in the current year. A webcam is defined as a device that is tethered to a PC and, with appropriate PC software enables live video/audio streaming – videoconferencing. Most webcams can also capture still images, which are stored on the PC. A camcorder is defined as either an analog or a digital device that's primary function is to capture video. A digital SLR camera is defined as a device that has exchangeable lenses and through the lens viewing.

Firms that have more digital camera models available in the consumer market may have a higher likelihood of introducing a feature simply because they offer more cameras. We therefore control for *firm models on the market in year t* using a count of the number of digital cameras that the firm has on the market in the year. Since larger firms may have the resources to experiment in a broader range, we control for *Firm size*, measured as sales at the corporate level. Since the firm size distribution is skewed, we take the log of sales. For public firms, data was obtained from Compustat. For private firms, data came from a combination of Wards, Dun & Bradstreet, OneSource, and trade press articles in which the firm disclosed sales figures. Missing years for private firms were interpolated based on the years for which data was available. Nine firms had no publicly available sales data, but based on press releases and information about number of employees, these firms were all classified as having sales of less than $10M. The *firm size* variable was constructed in $10M increments, so for firms with sales less than $10M, firm size=1, $10-$20M, firm size=2, $20-$30M, firm size=3 and so forth. Since institutional pressure may influence firm strategic choices, we control for whether a firm is *Public* with a dummy variable that equals one if it is publicly traded in the current year. Finally, *Non-US* is a dummy variable set to one if a firm has its headquarters outside of the U.S.

Models

To test hypotheses 1 and 2 concerning the influence of prior industry background on the initial introduction of product features, we used event history analysis, specifically a Cox Proportional Hazard model. Event history models analyze the length of time it takes for a specific event to occur. In our case the event is a firm's initial entry with a particular camera feature. The hazard function can be interpreted as the likelihood that a firm introduces a particular feature at time *t*. A Cox model is advantageous because it does not make assumptions about the particular shape of the underlying hazard function. This method is appropriate for our analysis, since there is no theory to suggest any specific underlying functional form for the hazard of a firm introducing a new product feature during the advent of a new industry. In a Cox model, the hazard rate is a function of the unspecified baseline rate and the exponential of a vector of covariates, as represented by the following equation:

$$r(t)=h(t)\exp(\beta X) \qquad (1)$$

Where h(t) is the baseline hazard rate and βX represents the influence of the vector of covariates. We split the data into annual spells to allow for time-varying covariates and used robust standard errors clustered by firm to account for interdependence between observations from the same firm. We ran separate models for each feature since we wanted to allow the coefficients of our independent variables to vary. While we hypothesize that the effect of the variables of interest will be in the same direction, we have no reason to believe that the magnitude of these variables will be the same for all features. We ran the models using *stcox* in STATA. We also analyzed the data using a piecewise exponential model, which allows the hazard rate to vary across different time periods, and the main results did not change.

To test hypothesis 3, assessing whether firm experience with a feature diminishes the influence of prior industry on the continued introduction of models with specific digital camera features, we used a negative binomial specification. Our dependent variable for this analysis is a count of camera models with a feature introduced by firm *i* in year *t*. Models with count measures as dependent variables may be misspecified if estimated with Ordinary Least Squares (OLS) regression (King 1988) and are more appropriately modeled with a Poisson specification. However, Poisson models rely on the strong assumption of a Poisson distribution, which requires that the mean and variance be equal. Overdispersion, when the variance is not equal to the mean, violates the Poisson assumption (Cameron and Trivedi 1990). Overdispersion can occur if the probability of later events exceeds that of earlier events, suggesting contagion or diffusion. This situation is particularly likely in our setting with the growth in adoption of specific digital camera product attributes and technologies over time. To correct for overdispersion, we employ a negative binomial model, which relaxes the assumption of equal mean and variance and includes an error term to capture overdispersion.

Since we have firm-year data, we use a panel data negative binomial specification with random effects (e.g. Guo 1996), (the *xtnbreg* command with the random effects option in STATA). A random effects specification considers both between-firm as well as within-firm variation, thus accounting for the non-independence of multiple observations for each firm and providing robust standard errors. The panel negative binomial models are represented by the following equation, modeled as the logarithm of the mean count λ_{it}:

$$\log \lambda_{it} = X_{it} \beta + \sigma\varepsilon_i + \mu_i \qquad (2)$$

alternatively, $\Pr(y_{it} = r) = (\lambda^r \varepsilon^{\lambda})/r!$; where y_{it} is the observed count and r is an integer; X is a vector of characteristics of firm *i* at time *t*, σ is a correction for overdispersion, and μ_i is a time-invariant firm i effect, which in our model is treated as a random effect.

For testing hypothesis 3 in the context of camera resolution, we used a multiple event hazard model in which we examined a firm's initial entry into subsequent megapixel generations (using the *stcox* procedure in STATA). Following Wei, Lin, and Weissfeld (1989) , we combined all megapixel generations (2MP-6MP) into one model, such that a firm is at risk of entering each MP generation and can have multiple entry events – one for each generation. We stratified the data on MP generation, thus allowing each generation to have its own baseline hazard function. We also clustered on firm and used robust standard errors to control for the lack of independence of observations.

RESULTS

Table 3 shows the pair-wise correlations and descriptive statistics.

--------------------------------------- Table 3 about here ---------------------------------------

Table 4 displays the results of the hazard rate analysis to test hypotheses 1 and 2, examining how a firm's introduction of digital camera product features in the market was influenced by the firm's industry background.[2] Consistent with H1, *Concurrent entry by other firms from the* ***same*** *prior industry* was significantly associated with the likelihood of entry for the LCD Display, optical zoom, digital zoom, movie clips removable storage and dual webcam features, and marginally significant for the higher

[2] We ran separate models to test H1 and H2 and the results were same as when we ran one model with both independent variables of interest, so we have included only the models with both independent variables in Table 4.

than VGA resolution feature. For each additional firm from the same prior industry that introduced a product with a particular feature during the year, the likelihood of a firm introducing that feature increased, ranging from a 23% increase for an LCD display (model 1) to an 85% increase for the dual webcam feature (model 7). In contrast, *Concurrent entry by firms from a **different** prior industry* did not have a significant effect on the introduction of any features. For the resolution feature (model 4), marginal significance may indicate that uncertainty surrounding the desirability of greater resolution was not actually high. If the notion that "more is better" was widely shared throughout the industry, then the introduction of higher resolution cameras would not be influenced more by prior industry peers.   Overall, a firm was more likely to introduce a feature at a given time if other firms from the same prior industry were also introducing it (as opposed to firms from a different prior industry), reflecting stronger shared beliefs among firms with similar backgrounds than among all firms entering the new market.

Hypothesis 2, that firms will imitate other firms from the same prior industry was supported for three features: LCD displays, digital zoom, and high resolution. As seen in models 1, 3, and 4 of Table 4, *Cumulative previous entry by firms from the same prior industry* had a positive and significant coefficient whereas the coefficient on *Cumulative previous entry by firms from a different industry* was not significant. The strongest impact was for the digital zoom feature; for each additional firm from the same prior industry that had previously introduced a digital zoom camera, a firm was 17% more likely to introduce a camera with the feature. For other features, however, imitation of firms from the same prior industry was not evident, and for the movie clips feature, it appears that firms imitated firms from other prior industries. While imitation has proven to be a powerful force in other settings, at the level of introducing product features, the results are mixed. It appears in this setting that concurrent entry, reflecting shared beliefs from prior industry affiliation has a stronger and more consistent influence than mimetic behavior.

Controls for experience with other imaging-related products had a significant effect in some cases. Not surprisingly, a firm's presence in dedicated webcams was a positive and significant factor that more than tripled the likelihood that a firm would introduce a camera with webcam capability. Presence in the webcam market significantly decreased the likelihood of introducing an LCD display, optical zoom, digital zoom, and removable storage. Since webcams had no LCDs, zoom lenses or removable storage, firms present in this market may have had a diminished belief in the value of these features. A firm's breadth of commitment to digital imaging, measured by the breadth of its presence in other parts of the digital imaging value chain had a positive and significant effect on a firm's entry into higher resolutions, indicating some increased level of experimentation with features the more experience a firm has in imaging.

Other firm controls had the expected effects for almost all seven product features. With the exception of the optical zoom feature, the more digital cameras a firm had on the market in a given year, the more likely it was to introduce a camera with a particular feature. *Firm* size had a significant effect on introduction of only one feature, and whether headquarters are *outside the US*, and whether a firm is *public* had no effect on entry into any features. Exclusion of these variables from the models does not change the primary results.

A likelihood ratio test comparing models with only controls with those that included the key variables of interest showed a significant improvement in fit for all features. In addition, coefficients on control variables were consistent with models that included our independent variables of interest. (Given space constraints, these models are not shown.)

-------------------------------------- Table 4 about here ----------------------------------

Table 5 shows the results of analyses using negative binomial count models to test hypothesis 3, assessing whether firm experience with a feature diminishes the influence of prior industry on the continued introduction of models with specific digital camera features. We ran negative binomial models with random effects, however the results were similar (size, direction, and significance of the coefficients) for models with and without random effects.

---------------------------------- Table 5 about here ---------------------------------

Models 1 - 5 in table 6 show strong support for hypothesis 3. For the optical zoom, digital zoom, movie clips, and removable storage features, the effect of other firms from the same prior industry being present in a feature diminished as a firm gained experience with the feature as indicated by the negative and significant coefficient on the interaction term (between *Firms from same prior industry present in feature* and *Firm feature experience*), and for LCD displays the interaction effect was marginally significant. For instance, for the optical zoom feature, the marginal effect of one more firm from the same prior industry present in the market is to increase a firm's count of optical zoom cameras by 13.8% if the firm has previously introduced only one product with optical zoom, but if the firm has introduced ten products with optical zoom, the marginal effect of one more peer firm decreases to 9.4%. Similarly, for movie clips, the marginal effect of an additional firm from the same prior industry goes from a 7.8% increase to a 3.7% increase in movie clip cameras when a firm's experience with movie clips increases from 1 to 10 products. Once a firm gains its own experience with a product feature, beliefs based on prior industry experience become less important, and the actions of firms from the same prior industry have less impact. For the dual webcam feature (model 6), a firm's prior experience with the feature has the strongest influence on ongoing commitment. The effect of prior experience is negative and significant as one would expect since the dual webcam feature does not become part of the dominant design and is present in only 13% of new cameras by 2006.

We next examine hypotheses 3 in the context of resolution. Once a firm has introduced a camera with higher than VGA resolution, and has increasing access to information about customers' requirements for resolution given their desired use of digital images, we would expect that the introduction of increasingly higher resolutions (2MP, 3MP, 4MP etc) would be less influenced by the adoption of other firms from the same prior industry. As seen in Table 5, Model 7, firm experience, measured as a firm having previously entered a megapixel generation, has a strong positive effect on the likelihood of entry into a higher megapixel generation. The interaction between *Firms from same prior industry present in feature* and *Firm experience* is also significant and negative (hazard ratio coefficient less than one) indicating that the effect of *Firms from the same prior industry present* in a megapixel generation decreases if a firm has previously entered with a megapixel camera, thus supporting hypothesis 3.

Other controls were in the expected direction, with overall number of models a positive and significant predictor of a firm's introductions of digital cameras with particular features. A likelihood ratio test comparing models using only the control variables with those in table 6 showed a significant improvement in the model fit with the addition of our independent variables of interest and the interaction variable (not shown here for space considerations),

To test the overall robustness of our results, we examined a number of alternative specifications and measures. To test hypotheses 1 and 2 regarding initial introduction of a feature, we used a piecewise exponential model instead of a Cox proportional hazard model, and the results did not change. For all models in tables 4 and 5, we tried defining the end of the period of ferment as 2002 instead of 2003, therefore excluding all years after 2002 (instead of 2003) and the results did not change. We also excluded Sony from the analysis, since, as a component supplier for CCD chips, Sony's expertise may have played a role in the timing of their introduction of features, and again, the results were unchanged.

In summary, our results provide general support for H1. We find first, that concurrent introduction of a digital camera feature by other firms from the same prior industry is a significant predictor of entry into digital camera features, including LCD display, optical zoom, digital zoom, movie clips, and dual webcam, and marginally significant for the high resolution feature. We found mixed support for H2. Depending upon the feature, firms sometimes imitated other firms from the same prior industry in their choices of digital camera features. Hypothesis 3 is also supported. We find that the influence of adoption by other firms from the same industry decreases the more experience a firm has with a feature.

DISCUSSION

Periods of technological change are characterized by high uncertainty, in particular about the characteristics of products that will ultimately diffuse and emerge as part of a successful dominant design. Managers must make sense of the change and make decisions during eras of technological ferment concerning the features that customers will value. While prior work has clearly documented high variety during the early period of turbulence, and has studied how dominant designs emerge from technological competition, it has not explored the factors that influence the specific product features firms introduce. In particular, the role of prior industry affiliation and the associated influences of industry-level beliefs and imitation on firms' choices of features have not been examined.

We explored these issues through an in-depth longitudinal study of the emergence of consumer digital cameras. We tracked the emergence of the dominant design characterized by the features incorporated in digital cameras. Our findings, both descriptive and quantitative, show the important influence of a firm's prior industry affiliation during the nascent stage of an industry. In particular, firms were more likely to introduce new product features concurrent with other firms from their prior industry, reflecting shared industry beliefs. The common understanding that firms develop when competing in an industry is thus an important source of firm heterogeneity when firms from multiple industries converge in a new industry. We also found that firms imitated other firms from the same prior industry in their introductions of some, but not all product features. Our results imply that firm choices in this instance arose both from common worldviews or mindsets that resulted in concurrent action as well as from social comparisons or mimetic behavior. In addition, we found that as firms develop experience with a product feature, the influence of industry background diminishes. Thus, beliefs based on prior industry may be less deeply embedded than other beliefs and not a significant source of long term cognitive inertia.

Our study makes several contributions to research. The difficulty with trying to understand the role of managerial cognition is that it is difficult to untangle managerial cognition from firms' capabilities. Behaviors that are assumed to result from managerial mindsets may in fact be driven by capabilities and vice versa. In our setting, the digital camera components we study are available through the industry supply chain, thus, firms rely less on their own capabilities to develop and introduce components and can generally select which ones to include from a range of existing suppliers. As a result, we are able to study the outcomes of organizational perceptions about which features to include in a camera, while essentially controlling for firm capabilities.

Our work also contributes to research on technological evolution, specifically illuminating the processes that underlie cognitive convergence on a dominant design. While prior work has focused almost exclusively on tracking how the selection of technologies unfolded in an emergent dominant design, we document variation and convergence in the demand-side product features associated with the new product category. Competing perceptions of what a digital camera would be used for and therefore what consumers would value converged on a standard set of features by 2003. Interestingly, these features reflect a combination of the features and usage occasions associated with analog cameras (optical zoom lenses), camcorders (LCD display and movie clips), and computers (digital zoom).

Industry convergence, which can occur when a new technology facilitates the blurring of boundaries between previously distinct industries, is a significant phenomenon, given the prevalence of digital technology in multiple industries (Greenstein and Khanna 1997; Yoffie 1997). But empirical research delving into the phenomenon is limited, with exceptions such as Gambardella and Torrisi (1998) who examine whether and how technological convergence is related to industry or market convergence, and Lee (2007) who explores the role of alliances and networks during periods of convergence. By tracking the dynamics of convergence in features that are initially introduced by firms from heterogeneous industries, we shed light on these processes.

These results also raise important questions for future research. In the digital camera industry start-up firms did not play a major role. In many other new industries, however, start-ups are the primary source of new technologies and features. What factors are responsible for the heterogeneity in approaches of start-ups? Founders who spin off from established firms inherit knowledge (Klepper and Sleeper 2005) and in the medical device and automobile industries have been found to outperform other entrants (Chatterji 2009; Klepper 2002). Founders' backgrounds have also been found to have a lasting influence on other firm characteristics such as employment models (Baron, Hannan and Burton 1999). It would be interesting to test whether founders also inherit industry mindsets and how that influences both how start-ups conceptualize a new industry and ultimately their performance.

This study has focused on a specific industry that is part of a broader network of industries characterized by inter-firm modularity. Digital cameras do not operate in isolation, but are part of a system that includes scanners, printers, software, imaging websites, and memory cards among others. The emergence of a broader digital imaging industry architecture – where modular boundaries are drawn and where in the system firms compete – is an important aspect of new industry emergence (Jacobides 2006; Jacobides, Knudsen and Augier 2006; Santos and Eisenhardt 2009). An interesting avenue for future research would be to examine how different firm backgrounds influence the preferred industry architecture and the manner in which firms attempt to influence boundaries. Finally, prior research has examined how adoption of the dominant design affects firm survival (Christensen et al. 1998; Suarez and Utterback 1995), but this work has focused on the adoption of the technologies that ultimately emerge as part of the dominant design. An interesting topic for future research is to explore how the adoption – and timing of adoption - of the features that emerge as part of the dominant design affects both firm performance and survival.

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FIGURE 1- Percentage of new cameras with feature, by year

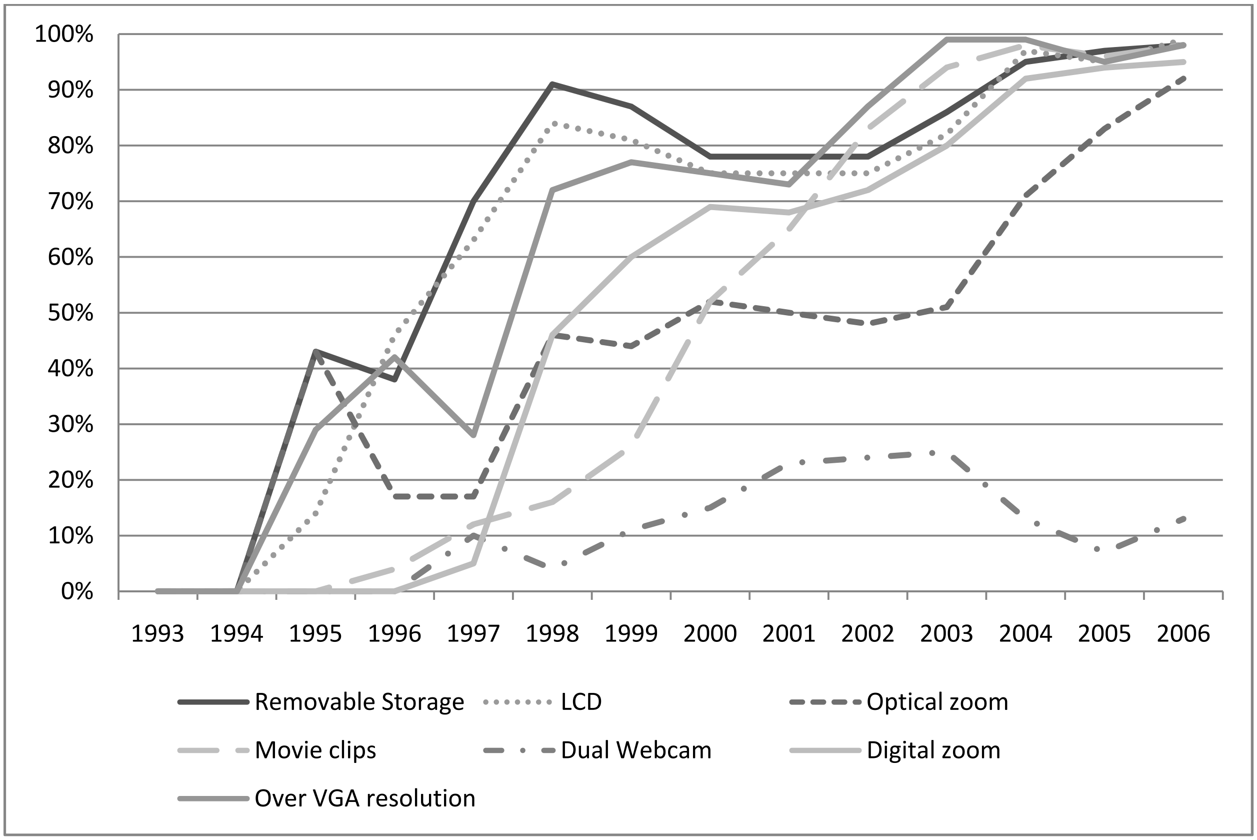

Table 1. Summary of Digital Camera Features

Feature	Description	First year feature was introduced / Firm(s) that introduced it	Year >50% of new models have feature	Percent of models with feature in 2006
Dominant Design	Model contains all elements of the dominant design: LCD display, optical zoom, digital zoom, movie clips, overVGA resolution, and removable storage	1999 Sony, Casio, Toshiba	2004	88%
LCD Display	Inclusion of an LCD display that allows the user to see an image before taking a picture and preview / selectively delete pictures after image capture	1995 Casio	1997	99%
Optical zoom	Instead of a lens with a fixed focal length, the camera incorporates a zoom lens with a range of focal lengths	1992 Fuji	2000	92%
Digital zoom	Software manipulation of the image within the camera to create a "close-up," which is a cropped version of the original image	1997 Fuji, Epson, Hitachi	1999	95%
Movie clips	Ability to capture and store short video clips	1996 Ricoh	2000	98%
Greater than VGA resolution	Camera sensor captures more pixels than the VGA (640x480) resolution of a computer display	1995 Kodak, Logitech (made by Kodak)	1998	98%
Removable storage	Incorporates a slot for memory (typically a flash memory card) that can be removed to transfer images to a PC or printer.	1992 Fuji	1997	97%
Dual webcam	Ability of a digital camera to switch to a webcam mode in which it enables real time streaming video through a PC	1997 Apple, Soundvision, UMAX, Ricoh, Vivitar	Never (peak 24% in 2002)	13%

Table 2. Adoption of features, by prior industry

Feature	Photography Industry Firms	Computer Industry Firms	Consumer Electronics Firms
LCD Display			
First year introduced	1996	1996	1995
Year >50% new models have attribute	1997	1998	1996
Optical zoom			
First year introduced	1992	1998	1996
Year >50% new models have attribute	1998	2004	1999
Digital zoom			
First year introduced	1997	1997	1997
Year >50% new models have attribute	1999	1998	1998
Movie Clips			
First year introduced	1996	1997	1997
Year >50% new models have attribute	2001	2001	1999
Greater than VGA resolution			
First year introduced	1995	1995	1996
Year >50% new models have attribute	1996	1998	1998
Removable Storage			
First year introduced	1992	1997	1996
Year >50% new models have attribute	1995	1997	1997
Dual Webcam			
First year introduced	1997	1997	1998
Peak adoption	17% in 2001	48% in 2001	20% in 2002

Table 3. Pair-wise correlations and descriptive statistics

	Variables	*Mean*	*SD*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
	Controls										
1	Firm Size (log)	5.054	2.858								
2	Non-US HQ	0.686	0.465	0.270							
3	Firm models on market	5.347	5.803	0.231	-0.045						
4	Public	0.720	0.449	0.706	0.284	0.171					
5	In webcams	0.153	0.360	-0.017	-0.086	0.132	0.089				
6	In camcorders	0.246	0.431	0.582	0.358	0.118	0.356	-0.041			
7	In SLRs	0.161	0.368	0.219	0.015	0.352	0.170	-0.079	0.036		
8	Breadth of digital imaging offerings	1.158	1.227	0.513	-0.007	0.364	0.353	-0.074	0.071	0.332	
	LCD display										
9	Firm entry into LCD	0.141	0.349	-0.011	0.012	-0.082	-0.036	0.031	-0.005	-0.045	-0.052
10	Firm experience in LCD	3.912	7.751	0.266	0.110	0.687	0.216	-0.090	0.157	0.188	0.312
11	Concurrent entry, same prior industry	2.110	2.647	-0.056	0.028	-0.013	-0.043	0.089	-0.061	-0.010	-0.012
12	Concurrent entry, diff. prior industry	4.621	4.102	-0.029	0.021	0.203	-0.024	0.016	-0.027	-0.016	-0.018
13	Cumulative prev. entry, same prior ind.	9.249	6.424	-0.170	0.014	0.414	-0.087	-0.117	-0.107	0.133	0.030
14	Cumulative prev. entry, diff. prior ind.	17.345	10.486	-0.139	-0.005	0.209	-0.058	0.177	-0.006	-0.243	-0.134
15	Firms from same prior industry w/ feat	9.384	5.570	-0.181	0.029	0.395	-0.103	-0.104	-0.154	0.191	0.065
16	Firms from different prior ind. w/ feat	17.695	9.191	-0.106	0.025	0.218	-0.030	0.200	0.009	-0.269	-0.132
	Optical zoom										
17	Firm entry into optical zoom	0.107	0.310	0.031	0.038	-0.065	-0.008	-0.071	0.078	-0.028	0.007
18	Firm experience in optical zoom	2.223	5.564	0.291	0.132	0.653	0.222	-0.072	0.194	0.237	0.324
19	Concurrent entry, same prior industry	1.672	1.164	-0.124	0.040	0.094	-0.067	-0.002	-0.116	0.143	0.031
20	Concurrent entry, diff. prior industry	3.398	2.082	-0.034	0.009	0.147	-0.005	0.074	0.011	-0.143	-0.046
21	Cumulative prev. entry, same prior ind.	7.339	5.980	-0.140	0.030	0.412	-0.070	-0.175	-0.081	0.199	0.025
22	Cumulative prev. entry, diff. prior ind.	14.028	9.182	-0.150	-0.025	0.175	-0.075	0.202	-0.024	-0.262	-0.136
23	Firms from same prior industry w/ feat	7.121	4.681	-0.164	0.037	0.402	-0.084	-0.164	-0.122	0.245	0.042
24	Firms from different prior ind. w/ feat	12.876	6.909	-0.121	-0.001	0.168	-0.044	0.224	0.000	-0.303	-0.130
	Digital zoom										
25	Firm entry into digital zoom	0.127	0.334	-0.021	0.020	0.017	-0.065	-0.020	0.019	-0.006	-0.029
26	Firm experience in digital zoom	2.542	6.030	0.256	0.114	0.628	0.194	-0.094	0.185	0.189	0.307
27	Concurrent entry, same prior industry	2.141	2.169	-0.083	0.010	0.153	-0.052	0.049	-0.068	-0.004	0.030

28	Concurrent entry, diff. prior industry	4.768	3.906	-0.086	0.007	0.253	-0.037	0.078	-0.008	-0.090	-0.068
29	Cumulative prev. entry, same prior ind.	6.444	6.424	-0.159	-0.009	0.374	-0.083	-0.125	-0.079	0.099	-0.021
30	Cumulative prev. entry, diff. prior ind.	12.009	10.370	-0.163	-0.022	0.237	-0.091	0.147	-0.027	-0.175	-0.124
31	Firms from same prior industry w/ feat	7.322	5.797	-0.193	-0.020	0.399	-0.108	-0.097	-0.132	0.114	0.010
32	Firms from different prior ind. w/ feat	14.130	10.213	-0.144	0.004	0.276	-0.066	0.160	-0.002	-0.193	-0.127
	Greater than VGA resolution										
33	Firm entry into greater-than-VGA	0.138	0.346	-0.039	-0.029	-0.052	-0.060	0.080	-0.020	-0.042	-0.085
34	Firm experience in greater-than-VGA	1.850	3.270	0.246	0.016	0.712	0.193	-0.060	0.137	0.201	0.409
35	Concurrent entry, same prior industry	2.031	1.240	-0.133	0.002	0.055	-0.086	0.059	-0.184	0.088	0.064
36	Concurrent entry, diff. prior industry	4.605	1.873	-0.012	0.092	0.100	0.040	0.052	0.047	-0.191	-0.066
37	Cumulative prev. entry, same prior ind.	9.124	6.363	-0.278	-0.065	0.399	-0.171	-0.057	-0.227	0.109	0.017
38	Cumulative prev. entry, diff. prior ind.	17.917	11.776	-0.109	0.025	0.265	-0.037	0.123	0.045	-0.199	-0.138
39	Firms from same prior industry w/ feat	7.681	4.101	-0.221	0.005	0.402	-0.127	-0.040	-0.202	0.166	0.084
40	Firms from different prior ind. w/ feat	15.325	7.467	-0.092	0.050	0.227	-0.008	0.164	0.034	-0.256	-0.133
	Movie clip										
41	Firm entry into movie clips	0.153	0.360	-0.062	-0.018	0.017	-0.051	0.039	-0.041	-0.058	-0.042
42	Firm experience in movie clips	1.884	4.466	0.111	0.070	0.625	0.091	0.022	0.131	0.055	0.101
43	Concurrent entry, same prior industry	2.497	1.922	-0.141	-0.038	0.107	-0.058	0.095	-0.134	-0.081	0.012
44	Concurrent entry, diff. prior industry	5.729	3.342	-0.086	0.040	0.208	0.014	0.042	0.037	-0.130	-0.063
45	Cumulative prev. entry, same prior ind.	7.308	6.680	-0.228	-0.054	0.319	-0.147	0.016	-0.121	-0.026	-0.089
46	Cumulative prev. entry, diff. prior ind.	15.581	14.044	-0.159	-0.010	0.325	-0.092	0.051	-0.026	-0.082	-0.104
47	Firms from same prior industry w/ feat	7.573	5.933	-0.203	-0.032	0.344	-0.118	-0.033	-0.113	0.021	-0.053
48	Firms from different prior ind. w/ feat	16.282	12.342	-0.168	-0.004	0.300	-0.081	0.091	-0.028	-0.132	-0.110
	Removable storage										
49	Firm entry into removable storage	0.164	0.371	-0.102	-0.046	-0.128	-0.098	0.003	-0.058	-0.090	-0.101
50	Firm experience in removable storage	4.079	7.803	0.268	0.084	0.704	0.201	-0.087	0.202	0.229	0.361
51	Concurrent entry, same prior industry	2.345	2.043	-0.076	0.001	-0.058	-0.071	0.117	-0.132	-0.014	0.010
52	Concurrent entry, diff. prior industry	5.517	3.626	0.005	0.066	0.098	0.014	-0.017	0.011	-0.050	-0.024
53	Cumulative prev. entry, same prior ind.	11.429	6.811	-0.259	-0.037	0.396	-0.149	-0.041	-0.190	0.088	0.006
54	Cumulative prev. entry, diff. prior ind.	23.205	13.463	-0.120	0.018	0.276	-0.042	0.125	0.022	-0.199	-0.122
55	Firms from same prior industry w/ feat	10.328	5.194	-0.230	-0.001	0.397	-0.138	-0.078	-0.211	0.183	0.058
56	Firms from different prior ind. w/ feat	20.655	9.592	-0.103	0.046	0.245	-0.024	0.175	0.025	-0.261	-0.131
	Webcam capability										
57	Firm entry into webcam capability	0.090	0.287	-0.123	-0.084	0.025	-0.111	0.140	-0.088	-0.111	-0.065

58	Firm experience in webcam capability	0.585	1.609	-0.225	-0.118	0.276	-0.118	0.188	-0.098	-0.116	-0.094
59	Concurrent entry, same prior industry	1.480	1.345	-0.199	-0.089	0.088	-0.101	0.030	-0.209	-0.042	0.031
60	Concurrent entry, diff. prior industry	3.712	2.572	-0.059	0.045	0.145	0.013	0.029	0.064	-0.136	-0.086
61	Cumulative prev. entry, same prior ind.	4.153	4.303	-0.292	-0.115	0.269	-0.209	0.084	-0.225	-0.033	-0.078
62	Cumulative prev. entry, diff. prior ind.	9.316	8.869	-0.113	0.025	0.344	-0.059	0.020	0.028	-0.067	-0.103
63	Firms from same prior industry w/ feat	4.085	3.331	-0.285	-0.100	0.261	-0.187	0.051	-0.226	-0.032	-0.042
64	Firms from different prior ind. w/ feat	9.845	7.836	-0.131	0.022	0.310	-0.057	0.037	0.016	-0.102	-0.115
	Variables										
	LCD display	***9***	***10***	***11***	***12***	***13***	***14***	***15***			
9	Firm entry into LCD										
10	Firm experience in LCD	-0.205									
11	Concurrent entry, same prior industry	0.425	-0.129								
12	Concurrent entry, diff. prior industry	0.148	0.244	0.281							
13	Cumulative prev. entry, same prior ind.	-0.192	0.430	-0.259	0.182						
14	Cumulative prev. entry, diff. prior ind.	-0.109	0.278	-0.130	0.094	0.442					
15	Firms from same prior industry w/ feat	0.016	0.305	0.217	0.258	0.854	0.194				
16	Firms from different prior ind. w/ feat	-0.010	0.286	0.032	0.478	0.346	0.901	0.179			
	Optical zoom	***17***	***18***	***19***	***20***	***21***	***22***	***23***			
17	Firm entry into optical zoom										
18	Firm experience in optical zoom	-0.139									
19	Concurrent entry, same prior industry	0.192	-0.026								
20	Concurrent entry, diff. prior industry	-0.062	0.175	-0.090							
21	Cumulative prev. entry, same prior ind.	-0.040	0.414	0.175	0.173						
22	Cumulative prev. entry, diff. prior ind.	-0.104	0.195	-0.098	0.340	0.196					
23	Firms from same prior industry w/ feat	0.018	0.353	0.417	0.083	0.957	0.096				
24	Firms from different prior ind. w/ feat	-0.106	0.183	-0.122	0.566	0.141	0.958	0.036			
	Digital zoom	***25***	***26***	***27***	***28***	***29***	***30***	***31***			
25	Firm entry into digital zoom										
26	Firm experience in digital zoom	-0.161									
27	Concurrent entry, same prior industry	0.331	-0.010								
28	Concurrent entry, diff. prior industry	0.079	0.326	0.215							
29	Cumulative prev. entry, same prior ind.	-0.011	0.477	0.077	0.400						
30	Cumulative prev. entry, diff. prior ind.	0.020	0.341	0.178	0.403	0.551					

31	Firms from same prior industry w/ feat	0.122	0.403	0.458	0.423	0.910	0.516	
32	Firms from different prior ind. w/ feat	0.052	0.378	0.231	0.701	0.553	0.931	0.538
	Greater than VGA resolution	***33***	***34***	***35***	***36***	***37***	***38***	***39***
33	Firm entry into greater-than-VGA							
34	Firm experience in greater-than-VGA	-0.227						
35	Concurrent entry, same prior industry	0.208	-0.103					
36	Concurrent entry, diff. prior industry	-0.025	0.147	-0.037				
37	Cumulative prev. entry, same prior ind.	-0.115	0.446	-0.057	0.324			
38	Cumulative prev. entry, diff. prior ind.	-0.087	0.302	-0.187	0.366	0.625		
39	Firms from same prior industry w/ feat	-0.009	0.331	0.379	0.169	0.763	0.328	
40	Firms from different prior ind. w/ feat	-0.079	0.243	-0.186	0.581	0.551	0.890	0.313
	Movie clip	***41***	***42***	***43***	***44***	***45***	***46***	***47***
41	Firm entry into movie clips							
42	Firm experience in movie clips	-0.179						
43	Concurrent entry, same prior industry	0.283	-0.014					
44	Concurrent entry, diff. prior industry	0.152	0.244	0.476				
45	Cumulative prev. entry, same prior ind.	0.018	0.467	0.326	0.539			
46	Cumulative prev. entry, diff. prior ind.	0.023	0.523	0.306	0.556	0.941		
47	Firms from same prior industry w/ feat	0.090	0.414	0.531	0.609	0.934	0.858	
48	Firms from different prior ind. w/ feat	0.064	0.482	0.396	0.700	0.908	0.974	0.832
	Removable storage	***49***	***50***	***51***	***52***	***53***	***54***	***55***
49	Firm entry into removable storage							
50	Firm experience in removable storage	-0.232						
51	Concurrent entry, same prior industry	0.374	-0.193					
52	Concurrent entry, diff. prior industry	0.232	0.127	0.547				
53	Cumulative prev. entry, same prior ind.	-0.213	0.419	-0.227	0.022			
54	Cumulative prev. entry, diff. prior ind.	-0.180	0.366	-0.282	0.008	0.710		
55	Firms from same prior industry w/ feat	-0.060	0.333	0.140	0.259	0.867	0.392	
56	Firms from different prior ind. w/ feat	-0.034	0.312	0.039	0.385	0.544	0.902	0.351
	Webcam capability	***57***	***58***	***59***	***60***	***61***	***62***	***63***
57	Firm entry into webcam capability							
58	Firm experience in webcam capability	-0.115						
59	Concurrent entry, same prior industry	0.291	0.096					
60	Concurrent entry, diff. prior industry	0.112	0.157	0.476				

61	Cumulative prev. entry, same prior ind.	0.046	0.416	0.324	0.416			
62	Cumulative prev. entry, diff. prior ind.	0.028	0.377	0.241	0.516	0.756		
63	Firms from same prior industry w/ feat	0.131	0.362	0.607	0.576	0.902	0.720	
64	Firms from different prior ind. w/ feat	0.071	0.358	0.378	0.716	0.764	0.959	0.760

Table 4: The influence of prior industry shared beliefs and imitation on introduction of digital camera features, Cox Hazard Model

	COEFFICIENT	(1) LCD display	(2) Optical zoom	(3) Digital zoom	(4) Over VGA resolution	(5) Movie clips	(6) Removable storage	(7) Dual Webcam capability
H1	Shared beliefs: concurrent entry by other	1.227***	1.571***	1.343***	1.285*	1.435***	1.292***	1.849***
	firms from ***same*** prior industry	(0.0681)	(0.245)	(0.0971)	(0.180)	(0.150)	(0.0832)	(0.300)
	Concurrent entry by firms from a	0.985	0.956	1.038	0.920	1.010	1.002	1.073
	different prior industry	(0.0423)	(0.134)	(0.0524)	(0.103)	(0.0685)	(0.0416)	(0.167)
H2	Imitation: Cumulative previous entry by	1.104**	1.077	1.169***	1.116**	0.921	1.003	0.996
	firms from the ***same*** prior industry	(0.0436)	(0.0522)	(0.0429)	(0.0589)	(0.0588)	(0.0319)	(0.0809)
	Cumulative previous entry by firms	1.023	0.984	1.026	0.983	1.084***	1.023	1.037
	From a ***different*** prior industry	(0.0203)	(0.0325)	(0.0246)	(0.0202)	(0.0299)	(0.0167)	(0.0448)
	Controls: Presence in related markets							
	Firm present in webcam market in year t	0.438**	0.109***	0.263**	0.851	0.704	0.274***	3.330***
		(0.141)	(0.0924)	(0.160)	(0.241)	(0.264)	(0.0828)	(1.376)
	Firm present in camcorder market in year t	1.341	1.994	1.165	1.538	1.510	2.040*	1.613
		(0.678)	(1.169)	(0.663)	(0.568)	(0.565)	(0.844)	(1.309)
	Firm present in digital SLR market in year t	0.375*	0.330	0.328*	0.254***	0.222*	0.580	0.0697***
		(0.214)	(0.248)	(0.219)	(0.130)	(0.174)	(0.230)	(0.0718)
	Breadth in other digital imaging products	1.297	0.937	1.218	1.491**	0.969	1.222*	0.818
		(0.242)	(0.219)	(0.287)	(0.278)	(0.128)	(0.148)	(0.217)
	Other firm controls							
	Firm models on market in year t	1.166***	1.099	1.138***	1.365***	1.139***	1.285***	1.165***
		(0.0598)	(0.0818)	(0.0514)	(0.0616)	(0.0456)	(0.0493)	(0.0567)
	Firm size (ln)	1.160*	1.305	1.333**	1.015	0.980	0.987	0.866
		(0.104)	(0.212)	(0.186)	(0.0813)	(0.0787)	(0.0699)	(0.123)
	Public company	1.082	0.879	0.454	1.087	1.337	0.799	1.015
		(0.341)	(0.489)	(0.239)	(0.432)	(0.481)	(0.215)	(0.567)
	Non-US HQ	1.212	1.309	1.976*	1.185	1.163	0.974	0.979
		(0.393)	(0.559)	(0.688)	(0.417)	(0.370)	(0.267)	(0.368)
	Observations	146	208	143	153	171	141	187
	No._fail	48	36	41	46	52	56	27
	Log likelihood	-140.0	-100.1	-113.1	-130.4	-147.0	-161.7	-72.01
	No. firms	64	64	60	63	63	64	58

Dependent variable: firm initial introduction of a feature, Robust standard errors in parentheses, Coefficients are hazard ratios,
*** p<0.01, ** p<0.05, * p<0.1,

TABLE 5. Firm ongoing commitment to a feature: The effect of firm feature experience and prior industry affiliation

	Variable	(1) LCD	(2) Optical zoom	(3) Digital zoom	(4) Movie clips	(5) Removable storage	(6) Dual webcam capability	(7) Megapixel generations
		Negative binomial model with random effects: Annual count of firm new models with feature						Cox Hazard model+
	Firms from **same** prior industry present in feature	-0.002	0.110***	0.023	0.057***	0.048***	0.003	1.085
		(0.016)	(0.030)	(0.015)	(0.021)	(0.016)	(0.049)	(0.0896)
	Firm experience in feature (cumulative models t-1)	0.015***	-0.003	0.010	-0.008	0.013**	-0.125**	7.980***
		(0.005)	(0.010)	(0.007)	(0.012)	(0.005)	(0.055)	(5.294)
H3	Firms from same prior industry present in feature X Firm experience in feature	-0.002*	-0.004**	-0.002**	-0.004***	-0.002***	0.032*	0.810***
		(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.019)	(0.0640)
	Firms from **different** prior industry present in feature	0.001	0.039**	0.001	0.018*	0.010	0.020	0.819***
		(0.007)	(0.016)	(0.007)	(0.010)	(0.007)	(0.029)	(0.0416)
	Controls: Presence in related markets							
	Firm present in webcam market in year t	-1.062***	-1.091***	-1.097***	-0.864***	-1.028***	0.063	0.502
		(0.198)	(0.337)	(0.262)	(0.214)	(0.210)	(0.267)	(0.265)
	Firm present in camcorder market in year t	-0.024	-0.036	-0.025	0.313	0.180	0.018	0.400
		(0.140)	(0.262)	(0.152)	(0.194)	(0.149)	(0.492)	(0.230)
	Firm present in digital SLR market in year t	-0.110	-0.110	-0.059	-0.186	-0.151		1.045
		(0.128)	(0.190)	(0.143)	(0.175)	(0.135)		(0.424)
	Firm breadth in digital imaging	0.042	0.150	-0.012	0.005	0.061	-0.236	0.934
		(0.047)	(0.091)	(0.056)	(0.069)	(0.052)	(0.151)	(0.145)
	Other firm controls							
	Firm size (ln)	0.033	0.158*	0.080*	0.012	0.039	-0.314***	1.086***
		(0.041)	(0.081)	(0.046)	(0.049)	(0.041)	(0.084)	(0.0189)
	Firm models on market in year t	0.073***	0.059***	0.072***	0.084***	0.070***	0.136***	1.353*
		(0.008)	(0.013)	(0.008)	(0.011)	(0.008)	(0.027)	(0.216)
	Public company	0.178	0.264	0.259	0.223	0.195	0.471	2.569**
		(0.214)	(0.400)	(0.238)	(0.245)	(0.199)	(0.315)	(1.020)
	Non-US HQ	-0.073	0.243	-0.098	-0.027	-0.169	0.602*	0.663
		(0.129)	(0.253)	(0.145)	(0.179)	(0.127)	(0.325)	(0.349)
	Constant	1.862**	12.875	2.007*	13.979	1.018*	7.053	
		(0.775)	(471.915)	(1.123)	(821.318)	(0.529)	(68.259)	
	Observations	172	130	122	126	191	74	522
	Number of firms	37	31	35	44	46	27	59
	Log likelihood	-331.0	-225.3	-245.3	-233.1	-355.8	-89.75	-374.1

+ Marginal risk of entry into 2MP, 3MP 4MP & 5MP, stratified by MP generation and clustered by firm, coefficient is hazard ratio

*** p<0.01, ** p<0.05, * p<0.1, Robust standard errors in parentheses