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The Effect of New Product Radicality and Scope on the Extent and Speed of Innovation Diffusion

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Drawing from institutional and bandwagon theories, we develop and examine how characteristics of an innovation—radicality and scope—affect diffusion rates—the extent and speed of diffusion. The hypotheses are empirically tested with a sample of 82 new product innovations in three separate industries over a sixteen-year time span. We find that: (1) the greater the radicality of innovation, the higher the extent and faster the speed of diffusion and (2) the greater the scope of innovation, the faster the speed of diffusion. We advance the innovation diffusion literature by using the institutional and bandwagon literature to explain how micro-characteristics of each innovation influence diffusion rates.

Innovations often vary in terms of the rates of adoption or imitation among industry participants (D'Aveni, 1994; O'Neill, Pouder & Buchholtz, 1998; Rogers, 1995). Some innovations diffuse among many competitors at a rapid rate, while other innovations diffuse more slowly among just a few industry players. Importantly, variations in rates of diffusion have critical consequences for innovators and imitators (D'Aveni, 1994; O'Neill et al., 1998; Rogers, 1995). Indeed, rapid diffusion of an innovation may limit the performance advantages of the first moving innovator (Lee, Smith, Grimm & Schomburg, 2000; Lieberman & Montgomery, 1988; Nelson & Winter, 1982), accelerate the competition among all firms

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(D’Aveni, 1994; Porter, 1980; Smith, Grimm & Gannon, 1992), and require competitors to move faster to the next stage of innovation (D’Aveni, 1994). The fact that diffusion rates vary and have performance implications for innovators and imitators raises an important research question: How do characteristics of each innovation impact the extent and speed of diffusion within an industry?

In exploring this research question, we draw on institutional and bandwagon theories to explain how firms are influenced by the characteristics of the innovation. We argue that firms in an industry interpret each innovation based on its characteristics, which provide certain information, and in relation to institutional norms in the industry. Innovations then diffuse based on pressures to conform to norms of rationality (Meyer & Rowan, 1977) and popularity (Abrahamson & Rosenkopf, 1993, 1997; Pfeffer, 1994). The literature on institutional and bandwagon pressures is particularly relevant because it accommodates a focus on both the innovation and how it is diffused through an industry. Thus, it provides a rich foundation for hypothesizing relationships between the characteristics of innovation and the rate of industry diffusion.

Accordingly, the present paper makes two key contributions. First, we advance the literature on innovation diffusion by developing and empirically testing a set of hypotheses that connect characteristics of each innovation to rates of diffusion. Generally, past studies in the diffusion literature have studied organizational context and innovation (Drazin & Schoonhoven, 1996).[1] In contrast, we explore the extent to which rates of diffusion can be explained by more specific innovation attributes (independent of firm-level effects), a less examined research area within the diffusion literature. Second, we link these micro-innovation characteristics—radicality and scope—to dynamic measures of diffusion—extent and speed. In doing so, we seek to better understand the four key dimensions of the diffusion process—innovation, communication channels between competitors, time, and social system—identified in the innovation diffusion literature (Mahajan, Muller & Bass, 1990).

Importantly, our level of analysis is on the event of each new product innovation and diffusion within an industry. For instance, each event consists of the first introduction of a new product and corresponding adoptions by one or more industry competitors. We develop and test hypotheses linking characteristics of innovation with diffusion rates with a sample of 82 new product innovation events over a sixteen-year time span in three separate industries: brewing, long distance telecommunication, and personal computer industries.

Theory and Hypotheses

Innovations, Institutional Bandwagon Effects, and Diffusion

Schumpeter (1934) defined innovation as the first introduction of a new product, process, method, or system. Similarly, Damanpour (1991: 556) defined innovation as “adoption of an internally generated or purchased device, system, policy, program, process, product, or service that is new to the adopting organization.” Prior researchers have also distinguished types of innovation, the most common including technical versus administrative, radical versus incremental, and product versus process (Damanpour, 1991). We recognize that innovation and diffusion are multidimensional constructs. Since new product innovations are generally considered to be a key driver of firm performance (Capon, Farley & Hoenig, 1990; D'Aveni, 1994), in this study, we focus on the special case of new product introductions and how these innovations are diffused (or imitated) among rival firms in an industry. Consistent with prior researchers, we define a new product innovation as a product that is new to the firm and market (Li & Atuahene-Gima, 2001).

Given the importance of the innovation diffusion process, it is not surprising that there has been a significant amount of research on the topic. Much of the prior research focus has been on innovation diffusion rates (Abrahamson & Rosenkopf, 1993). Within this domain, several researchers have attempted to explain innovation diffusion rates due to bandwagon pressures. For example, Mansfield's (1961) model proposed that the probability of an innovation being imitated depended on the proportion of firms already adopting the imitation (the bandwagon effect), along with the profitability of using the innovation and the investment required to install the innovation. Other researchers also contended that bandwagon effects or herd behavior can explain the tendency that as a greater number of firms adopt an innovation, the more other potential adopters will adopt because initial adoption serves as evidence that these adopters must have superior information about the innovation (Banerjee, 1992; Bikhchandani, Hirshleifer & Welch, 1992; Davies, 1979).

Similarly, institutional theory, which suggests that firms in the same environment will adopt similar practices because they are driven by institutional pressures for conformity and legitimacy, has been used to explain adoption and diffusion of organizational practices and innovations. For example, DiMaggio and Powell (1983: 148) noted that as an innovation is diffused, a "threshold is reached beyond which adoption provides legitimacy rather than improves performance." Meyer and Rowan (1977) argued that as more firms adopt an innovation, the more it becomes taken for granted that the innovation is normal and legitimate.

More recently, a number of researchers have integrated institutional theory with bandwagon pressures to explain innovation diffusion rates (Abrahamson, 1991; Abrahamson & Rosenkopf, 1993, 1997; O'Neill et al., 1998, Rogers, 1995). For example, Abrahamson and Rosenkopf (1993) presented a model in which bandwagon effects occur at the institutional level (group of organizations). They identified two types of bandwagon pressures that compel imitation. Institutional bandwagon pressures arise from social legitimacy, while competitive bandwagon pressures arise from the threat of lost competitive advantage. In general, this research stream argues that the potential adopters tend to adopt an innovation because of the fear of lost legitimacy and loss of stakeholder support, and to keep up with the competitors, even when profitability is uncertain (Abrahamson & Rosenkopf, 1993; Pennings & Harianto, 1992; Tolbert & Zucker, 1983; Wade, 1995).

The literature on innovation diffusion has long recognized that the properties of an innovation can influence the rate of imitation and diffusion (Mansfield, 1985, 1993; O'Neill et al., 1998; Rogers, 1995). Not all innovations are alike, and an understanding of how these innovation-specific characteristics influence the diffusion process is a fundamental question in diffusion research (Rogers, 1995). Our research model in Figure 1 emphasizes that the characteristics of the new product innovation drive imitation and diffusion within an industry, while controlling for firm and industry effects. In the following discussion, we offer hypotheses related to two attributes of an innovation and predict the diffusion rates drawing on institutional and bandwagon pressures.

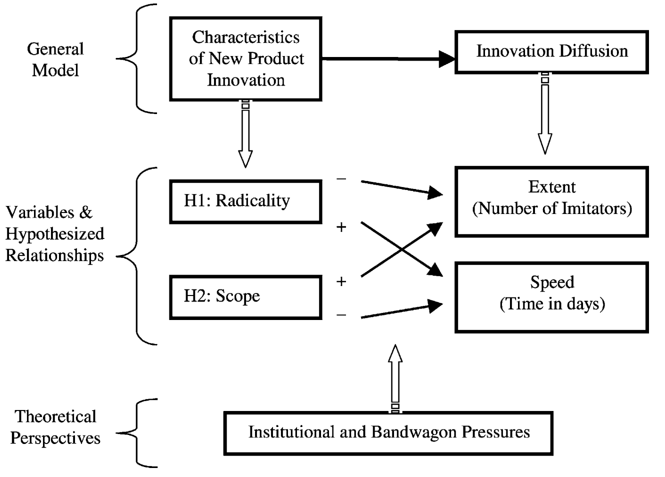

Figure 1. Research model of new product innovation diffusion.

Radicality of innovation. Following MacMillan, McCaffrey and Van Wijk (1985), radicality is defined as the extent to which the innovator's new product departs from prior new products in an industry (i.e., the industry's previous product offerings). Bandwagon and institutional theories make certain assumptions about information availability surrounding innovations; for example, they assume that information about the innovation leaks to constituencies and stakeholders at an uneven rate (Abrahamson & Rosenkopf, 1997). In general, information retrieval, acquisition, and retention affect the speed of adoption (Rogers, 1995; Mansfield, 1985).

Information surrounding actions that are radically different from past norms and operating assumptions in an industry will be more uncertain (Chen & MacMillan, 1992; MacMillan et al., 1985). Actions of greater radicality carry less familiar information from which potential imitators could evaluate the benefits of imitation (Smith et al., 1992). Greater radicality hinders the ability of rivals to learn about the innovation, thus causing slower information flow and adoption behavior and less bandwagon pressures. Innovations that match existing structures or acceptable behaviors are more quickly adopted because competitors can absorb and evaluate information more quickly and easily. On the other hand, innovations that do not match existing patterns are less likely to be adopted and will be adopted more slowly (O'Neill et al., 1998; Walsh & Ungson, 1991).

For example, when potential adopters have difficulty evaluating the new innovation, perhaps because of the lack of information and understanding of the innovation and innovator, they will be forced to delay adoption (Oliver, 1991) or a response (Smith et al., 1992). Because potential adopters will be unfamiliar with radical new products, their information will be more uncertain, leading to fewer imitators adopting at a slower speed (MacMillan et al., 1985; Porter, 1980; Smith et al., 1992). Thus, we predict that the radicality of a new product innovation will decrease the extent of industry diffusion (measured by the number of firms that imitate) and delay the speed of diffusion (measured by time in days of imitation). (More detailed descriptions of diffusion rate measures are provided in the Method's section.)

Hypothesis 1: The greater the radicality of the new product innovation, (a) the lower the extent of diffusion and (b) the slower the speed of diffusion.

Scope of innovation. Following prior researchers (Chen, Smith & Grimm, 1992; MacMillan et al., 1985; Smith et al., 1992), scope of the innovation refers to the number of customers, markets, and competitors a new product innovation is targeting. Some new products have a very narrow scope, aimed at a single set of customers or a few product segments (e.g., a new beer targeted at a rugby football sports market), while other new products are targeted at multiple segments and competitors (e.g., light beer). Thus, scope can influence the awareness of new product innovations (Chen et al., 1992). In theory, as the number of customers, markets, and competitors impacted by an innovation increases so will the awareness of the innovation (Smith et al., 1992). As awareness increases, it generates more information about the innovation, thereby creating stronger institutional and bandwagon pressures to adopt the innovation (Abrahamson & Rosenkopf, 1997). This information will enable potential imitators to effectively evaluate the likely outcomes of the introduction than will innovations of more narrow scope, which may have less information.

For diffusion to occur, potential adopters must see the benefits to imitation, including the belief that imitation will increase profits or enhance legitimacy for the imitating firm (Abrahamson, 1991; Abrahamson & Rosenkopf, 1993, 1997). New products targeted towards a broad customer base will likely be perceived as having more potential either to increase future profits for the innovator and all potential adopters. Adopting products that can dramatically impact sales and profits will enhance legitimacy just as a loss of customers to such an innovation may adversely affect a firm's legitimacy. This notion is theoretically consistent with previous research (e.g., DiMaggio & Powell, 1983; O'Neill et al., 1998); for example, MacMillan et al. (1985) found that competitors responded faster to new product innovations that had a broad impact, and Smith et al. (1992) hypothesized that competitors affected directly by an action (innovation) are most likely to be the potential responders. Therefore, as the number of customers, markets, and competitors impacted by the innovation increases so will the extent and speed of diffusion. Thus, we hypothesize that the scope of a new product innovation will impact the process of diffusion.

Hypothesis 2: The greater the scope of the new product innovation, (a) the higher the extent of diffusion and (b) the faster the speed of diffusion.

Method

Sample

To examine the relationship between innovation attributes and industry diffusion, we focus our level of analysis on the event of each new product innovation within an industry. Each event consists of the first moving firm and all subsequent imitators or adopters of the corresponding innovation within an industry. Our level of analysis allows us to relate the institutional and bandwagon pressures to the innovation attributes of each new product innovation and to investigate how they impact industry diffusion rates.

The new product innovations and their diffusion were identified from a structured content analysis of *Predicasts F&S Index United States*. A number of alternative industries were first examined in terms of the frequency of new product introductions and imitations. The brewing, long distance telecommunications, and personal computer industries were selected for study because of their extensive new product offerings, the varying degree of new product introductions across the industries and imitation across the new product offerings,[2] and the fairly undiversified nature of the firms observed in these industries. The time period of study was 1975 to 1990. This period of study was selected because this was the time in which the long distance telecommunications and personal computer industries emerged and when the brewing industry changed from a commodity/price based industry to a more product driven industry. Thus, new product rivalry played a significant role in each industry.

A new product innovation is simply the ability to introduce a new product, and is defined as the introduction of a product or service category that did not exist prior to the introduction date. Accordingly, the new product innovations in our sample were new to the firm and market. For this study, the first article to report the introduction of a new product that previously did not exist in the industry was considered the introduction date, and the date of introduction was recorded. The next step was to identify all imitations or diffusion of the new product innovation. The first article that reported the introduction of a product that was the same or imitative of an already existing competitor's product was considered the initial imitation, and the date of imitation (speed/time) was recorded. Subsequent imitations or diffusions (extent) were identified in the same manner. Table 1 lists the new product innovations in chronological order by industry. Overall, there were 82 new product

Table 1
New product innovations in the brewing, long-distance, and personal computer industries from 1975 to 1990

Brewing	Long distance	Personal computer	Personal computer
Light beer	Data/digital	Kits	51/4/320 k drive
Foreign beer	Microwave	6502 processor	31/2/720 k drive
Aluminum cans	Residential	8080 processor	68010 processor
Irish ale	Satellite transmission	Z80 processor	100 MB HD
Holiday beer	Facsimile transmission	For games	EGA graphics
7 oz. bottle	Electronic mail	8″ disk drives	80386 processor
Beer ball	Video conferencing	32 k RAM	16 MB RAM
Dark beer	Long distance credit cards	Apple compatible	130 MB HD
Slim bottle	WATS–in	64 k RAM	31/2/1.2 MB
Bock beer	Fiber optic cable	8088 processor	Backlit liquid crystal
Celebrity name	Facsimile network	IBM compatible	68030 processor
Non-alcoholic	International	256 k RAM	150 MB hard drive
Long neck NR	Videotex	40 MB hard drive	Gas plasma
Malt liquor	WATS–out	68000 processor	31/2/1.44 MB drive
Flavored beer	Operator assistance	512 k RAM	VGA graphics
Lager	SDN	80816 processor	300 MB hard drive
Low alcohol	Nationwide paging	Mouse	32 MB RAM
Packaged draft	900 numbers	IMB RAM	320 MB hard drive
Beer coolers		Liquid crystal	80386 processor
Packaged wheat		Mac compatible	80486 processor
4-packs		80286 processor	64 k RAM
Dry beer			

innovations (22-brewing, 18-long distance, and 42-personal computer) and 632 imitative responses identified.

Measures

Diffusion. Extent of diffusion is essentially the number of imitators adopting the innovation. This measure is normalized and defined as the number of firms that imitated the innovator's new product divided by the total number of firms in the industry who could have potentially imitated.[3] Although normalization allows for the potentially different number of adopters for each innovation, it also limits the variance and normal distribution. Consequently, this measure was transformed using a log transformation, and the transformed data were used for the statistical analysis. Simply put, when one or two out of numerous competitors imitate the innovation, extent will be limited.

The speed of diffusion is essentially the time in calendar days. Since this measure is temporal and our data is censored, we employ Cox regression (1972) in our analysis. Specifically, for censored events or firms in the industry that imitated during the period of data collection, the speed of diffusion is the time in calendar days between the first new product innovation and when the subsequent imitations occurred. For uncensored events or firms in the industry that could have potentially imitated after the period of data collection, the speed of diffusion is the time in calendar days between the first new product innovation and end period of our data collection.

Attributes of innovation. This study examined two innovation attributes: radicality and scope. The three experts from each industry were interviewed and asked to rate the radicality and scope of each new product innovation on an ordinal number scale of one (low) to five (high). Following our earlier definitions, the experts were asked "to what extent does the new product depart from previous introductions in the industry (e.g., new and different from previous new product innovations)" to measure radicality. Likewise, the experts were asked "to what extent does the new product impact industry participants (e.g., the number of customers, markets, and competitors the new product innovation is targeting)" to measure scope.

These experts possessed industry experience for the majority of the sixteen-year study period and held responsible management or professional positions in their respective industries. They held positions such as vice president for research, director of public affairs, chief of analysis, assistant division director, division administrator, and regional sales manager with leading firms in the industry, trade associations, or the U.S. Government. The average ratings of the three industry experts on the radicality and scope of the innovation were used in the analysis.

The coefficients of reliability (alpha) were .70 for the radicality variable and .79 for the scope variable, which exceed the .65 minimum for combining the ratings (Glick, 1985). Furthermore, the intraclass correlation coefficients were .72 for the radicality variable and .79 for the scope variable, which are high enough to support interrater reliability (James, 1982; Shrout & Fleiss, 1979).

Controls. Since our sample includes new product innovations from three different industries, industry effects may confound the testing of the innovation characteristics. Thus, we control for these confounding effects with industry dummy variables. We also included firm dummies to control for the attributes of an innovation that may correlate with the innovating firm.

Results

Table 2 reports the descriptive statistics and correlations while Table 3 reports the descriptive statistics by industry. Although all the variables reported in these tables are not used in the regression models, we report them to provide the reader with more detailed description of our data. Specifically, we performed multiple regression on a sample of 82 new product innovations to test our Hypotheses (1a and 2a) related to the extent of diffusion. We performed Cox regression (Cox, 1972) on a sample of 632 censored events and 45,291 uncensored events to test our Hypotheses (1b and 2b) related to the speed of diffusion since it is a temporal measure. Censored events refer to adoption of an innovation by imitators in an industry, while uncensored events refer to non-adoption of an innovation by potential imitators in an industry. Table 4 reports the regression results.With regard to Hypothesis 1, the analysis reveals significant relationship between radicality of innovation and both the extent and speed of diffusion. Namely, the results show that radicality is positively related to extent of diffusion ($\beta = .24$ and $p < .05$ in the multiple regression model), and to speed of diffusion ($B = 1.04$ and $p < .001$ in the Cox regression model), contrary to our predictions in Hypothesis 1a and 1b.[4] That is, the greater the radicality of the new product innovation, the greater the number of adopters and faster the speed of diffusion. Regarding Hypothesis 2, the analysis shows a significant, positive relationship between scope of innovation and speed of diffusion ($B = 1.09$ and $P < .001$ in the Cox regression), consistent to our prediction in Hypothesis 2b. That is, the greater the scope of the new product innovation, the faster the speed of diffusion.[5]

To further illustrate how characteristics of an innovation influence the extent and speed of diffusion, we show graphically the diffusion rates of two sets of new product innovations with dissimilar innovation characteristics—high radicality and scope versus low radicality and scope—for the personal computer and brewing industries. In Figures 2–5, the horizontal

Table 2
Descriptive statistics and correlations for key variables[a]

Variables	Mean	*SD*	1	2	3	4	5	6
1. Extent of diffusion[a]	−1.61	.77	1.00					
2. Speed of last diffusion	1505.9	1403.6	.39**	1.00				
3. Average speed of diffusion	951.7	918.9	.32**	.92**	1.00			
4. Speed of first diffusion	422.7	531.6	.06	.54**	.76**	1.00		
5. Radicality of innovation	3.31	.85	.23*	.33**	.26*	.14	1.00	
6. Scope of innovation	3.36	.94	−.02	−.13	−.18	−.28*	−.06	1.00

[a] Extent of diffusion is the log transformation of the normalized variable—the number of firms that imitated the innovator's new product divided by the total number of firms in the industry that could have potentially imitated.

* $p < .05$.

** $p < .01$.

Table 3
Descriptive statistics for key variables by industry

Variables	Industry[a]	Mean	*SD*	Min.	Max.
Extent of diffusion	Brewing	.12	.09	.01	.34
	Long distance	.09	.07	.01	.20
	Personal computer	.05	.17	.01	.96
Extent of diffusion log transformed	Brewing	−1.05	.37	−1.86	−.47
	Long distance	−1.19	.37	−1.89	−.70
	Personal computer	−2.08	.77	−3.42	−.02
Speed of last diffusion	Brewing	2583.23	1650.60	84	4822
	Long distance	1729.56	1444.36	32	5157
	Personal computer	845.69	734.98	31	2927
Average speed of diffusion	Brewing	1631.97	1150.39	84	4037
	Long distance	994.50	874.32	32	3139
	Personal computer	577.64	497.50	31	1839
Speed of first diffusion	Brewing	662.9	798.84	1	2640
	Long distance	399.3	399.44	1	1245
	Personal computer	306.9	347.45	1	1709
Radicality of innovation	Brewing	3.55	.69	2.33	5.00
	Long distance	3.35	.94	1.67	5.00
	Personal computer	3.17	.88	1.33	5.00
Scope of innovation	Brewing	2.67	1.03	1.00	5.00
	Long distance	3.72	.79	2.33	5.00
	Personal computer	3.57	.77	1.33	4.67

[a] $N = 22$, 18, and 42 for the brewing, long distance, and personal computer industries, respectively.

Table 4
Regression analysis for diffusion rates of new product innovations[a]

Variables	Multiple model for extent of diffusion[b]	Cox model for speed of diffusion[c]
Radicality of innovation	.24* (2.19)	1.04*** (192.15)
Scope of innovation	.19 (1.22)	1.09*** (74.15)
Industry dummy 1 (brewing)	.85* (2.19)	1.94** (7.24)
Industry dummy 2 (long distance)	.61 (1.66)	1.04 (.80)
R^2	.82	
F	2.81***	
-2 Log likelihood		12664.65
χ^2		1049.89***
N	82	
Events		632
Uncensored events		45291

[a] Firm dummies are included as controls but are not shown.
[b] Standardized β coefficients and two-tailed t-statistics in parentheses reported.
[c] B coefficients and two-tailed Wald statistics in parentheses reported.
* $p < .05$.
** $p < .01$.
*** $p < .001$.

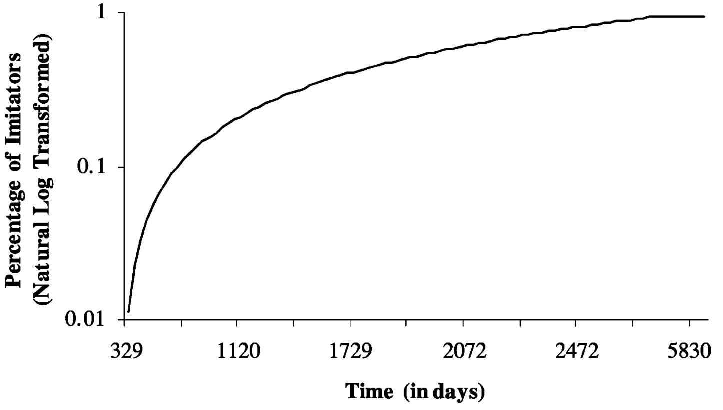

Figure 2. Diffusion rate of the IBM compatible new product innovation: high radicality and scope.

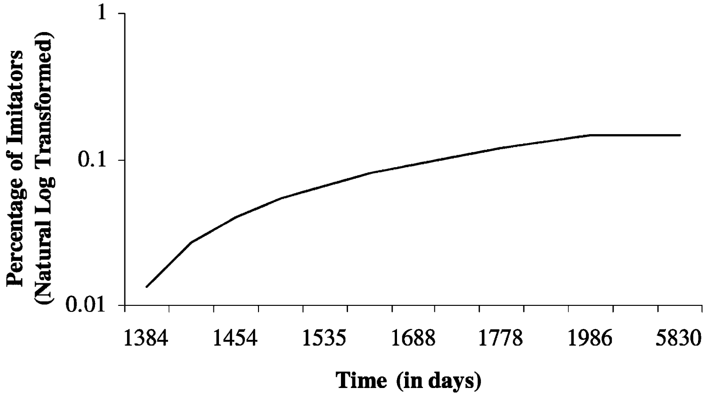

Figure 3. Diffusion rate of the Z80 processor new product innovation: low radicality and scope.

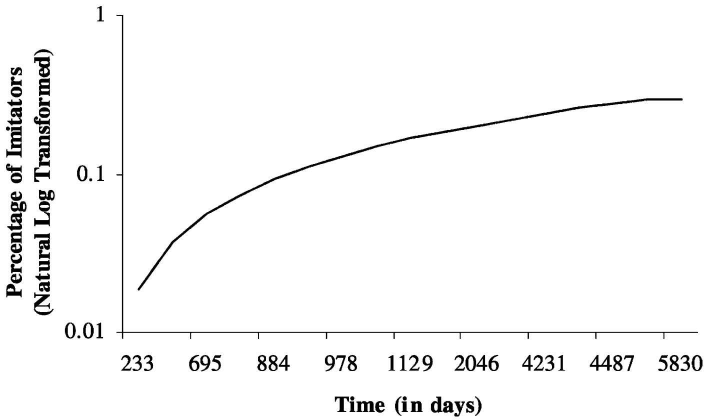

Figure 4. Diffusion rate of the light beer new product innovation: high radicality and scope.

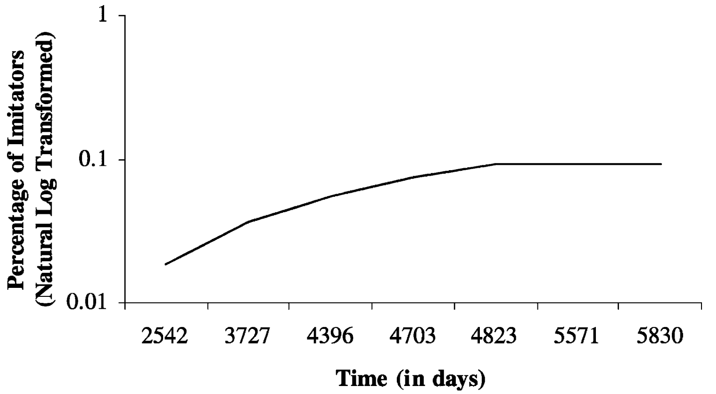

Figure 5. Diffusion rate of the holiday beer new product innovation: low radicality and scope.

scale measures the natural log transformation of the percentage of imitators, and the vertical scale measures time of imitation in days.

For the personal computer industry, Figure 2 illustrates the diffusion of the IBM compatible innovation with high radicality (4.6) and scope (4.6). In contrast, Figure 3 illustrates the diffusion of the Z80 processor innovation with lower radicality (3.0) and scope (2.3). The IBM compatible relative to Z80 processor innovation displays much higher extent and faster speed of diffusion. For the brewing industry, Figure 4 illustrates the diffusion of the light beer innovation with high radicality (4.6) and scope (5.0). In contrast, Figure 5 illustrates the diffusion of the holiday beer innovation with lower radicality (3.0) and scope (2.0). Again, light beer relative to holiday beer innovation displays much higher extent and faster speed of diffusion. Consistent with our regression results, the figures show that, on average, the greater the radicality and scope, the higher the extent and faster the speed of diffusion.

Discussion

The purpose of this study was to advance our understanding of the institutional bandwagon effects that may impact the extent and speed of innovation diffusion. Researchers have attempted to explain diffusion rates by institutional and bandwagon pressures to adopt innovations. These theories argue that information concerning the profitability and legitimacy of an innovation can influence the rate of diffusion. That is, innovations diffuse rapidly when firms adopting them benefit in terms of increased profits and legitimacy, leading to a bandwagon effect.

In our study, we specifically examined new product innovation characteristics and their impact on the rate of diffusion, independent of industry-level and firm-level effects. First, we found important and interesting results regarding the impact of radicality of innovation on the rate of new product diffusion. Although contrary to our predicted hypothesis, as radicality increases, it arguably influences the extent and speed of diffusion. The new and entirely different nature of the radical innovation presumably pressures diffusion, which is driven by the fear of lost revenues and being left behind.

To some, the decision to imitate a new product innovation will be driven by a rational estimate of the potential profits from adoption (Mansfield, 1993; Robinson, 1990), and more importantly, will occur when a firm's assessment of returns exceeds a certain threshold (Abrahamson & Rosenkopf, 1993). But firms may have different information on the innovation and differing assessments regarding the profitability of the innovation that affect the rate of diffusion (Reinganum, 1989). For example, when a new product introduction is significantly different from prior innovations, industry participants cannot adequately assess its impact because the information surrounding the innovation is more uncertain and difficult to understand. This is consistent with the earlier theoretical arguments of the information availability related to institutional and bandwagon theories (e.g., O'Neill et al., 1998). However, under this condition, our results indicate that firms are concurrently compelled to imitate to keep up with their competitors, which is also entirely consistent with the institutional and bandwagon pressures, leading to rapid diffusion of the innovation (e.g., Abrahamson & Rosenkopf, 1993, 1997). In this case, the adoption of the innovation may be viewed as an option (e.g., McGrath, 1999) or a defensive response (e.g., Chen et al., 1992) to protect the adopting firms from a novel innovation and fear of being left behind (Abrahamson & Rosenkopf, 1993).

On the other hand, when a new product introduction is consistent with prior innovations, industry participants have a better baseline to assess its impact because the information surrounding the innovation is more quickly and easily absorbed and evaluated. Thus, competitors are influenced less by the institutional and bandwagon pressures. With less radical actions, there is a history, which can be used to speculate on the innovation's profit potential. Radicality has been an essential concept in distinguishing types of innovations in prior research (Damanpour, 1991; Tushman, Newman & Romanelli, 1986; Van de Ven, Polley, Garud & Venkataraman, 1999) but indeed remains a complex characteristic of an innovation. Our results provide additional insights into the intricate nature of the radicality construct.

Second, we found support for the impact of scope of innovation on the speed of new product diffusion. As we predicted in our hypothesis, as scope increases, it arguably influences the speed of first diffusion by providing greater awareness and information about the new product innovation and thus allowing the adopting firms to more effectively evaluate and to quickly respond to the new product innovation. Within this information context, prior researchers have argued that a desire to improve performance and/or the threat of lost competitive advantage often drives early adopters of innovations (Abrahamson & Rosenkopf, 1993, 1997; Davies, 1979; DiMaggio & Powell, 1983). Initially, the threat of lost competitive advantage drives industry participants to quickly adopt or imitate a new product innovation (D'Aveni, 1994; Smith et al., 1992). Later on, once the competitive advantage from moving first or early can no longer be attained from adoption of the new product innovation, the institutional and bandwagon pressures weaken, limiting the extent of diffusion.

These results provide some interesting empirical evidence that characteristics of innovation affect the diffusion of new product innovations. It seems every innovation carries a message, consistent with the communications literature (Smith et al., 1992), and it influences diffusion rates. It is an important contribution, given the limited studies that distinguish between characteristics or types of innovations (Damanpour, 1991, 1992; Drazin & Schoonhoven, 1996; Klein & Sorra, 1996) and importance of understanding communication channels between competitors in the diffusion process (Mahajan et al., 1990).

Our level of analysis on the event of introducing a new product innovation and all associated imitations by industry rivals permits us to focus on the relationship between innovation attributes and diffusion rates in the industry. However, this focus limits the scope of our research and must be taken into account when evaluating the results. Certainly, there are many factors that may impact the rate of new product innovations and imitations that are not dealt with in our research. Untangling these complexities is an obvious direction for future research, but we would also point out, in general, the great difficulty in collecting the required data to address all of the research questions regarding industry diffusion of innovations. Nevertheless, we offer some suggestions for future studies.

First, we focus only on new product innovations and two innovation characteristics—radicality and scope—to predict diffusion rates. Future research can examine the rate of diffusion of other types of innovations (e.g., service, marketing and process innovations, or creations of new markets) and provide a more detailed examination of innovation attributes (e.g., specialized or unique strategic assets and other attribute measures like visibility and profitability), which can provide further insights to drivers of diffusion rates. For example, resources and capabilities can enable firms to introduce innovations that cannot be easily copied, perhaps because they may be tied to unique assets (Barney, 1988). As well, once resources and capabilities become rigid, they can hinder firms from introducing or imitating innovations (Leonard-Barton, 1992).

Second, we define radicality and scope in a very broad sense. Future research, for example, can separate and examine scope on different dimensions: customers, markets, and competitors, which can be based on different theoretical arguments leading to different predictions.

Third, although we show innovation characteristics impact diffusion rates, independent of firm-level effects, future research can examine in more detail firm-level characteristics (e.g., firm size, age, and slack resource) as well as adopters and non-adopters (e.g., costs, revenues, and profitability from the adoption, and winners versus losers from the adoption), which advance our understanding of the impact of innovation attributes on first mover advantages or imitation disadvantages.

Fourth, an extensive investigation into broader industry context (e.g., different industries, multi-market competition, network of competitors and suppliers), and industry innovation (e.g., relationship between frequency of industry innovation and diffusion rates) can provide further insights on the rate of innovation diffusion among industry players. Also, further investigation into diffusion rates and their impact on firm and industry profitability can be insightful.

In summary, these findings confirm that innovation characteristics affect the diffusion process, independent of firm and industry effects. We have argued that these characteristics reflect institutional and bandwagon pressures that enhance or retard the extent and speed of new product diffusions, depending on the specific characteristics. As such, these results advance our understanding of the rate of innovation diffusion.

Notes

1. For example, see Damanpour's (1991) study, which provides an extensive review of organizational factors and diffusion rates of innovation.
2. The sample varies in frequency of new product innovations across the three industries. Specifically, brewing, long distance, and personal computer industries have 22, 18, and 42 new product innovations, respectively, over the sixteen-year period of study. Furthermore, the sample consists of new product innovations with varying levels of imitations. That is, although all of the new product innovations have at least one imitation, some have lower levels of imitations while others have higher levels of imitations. For example, 5 out of 22, 4 out of 18, and 18 out of 42 in the brewing, long distance, and personal computer industries, respectively, have two or one imitations. As well, 6 out of 22, 6 out of 18, and 12 out of 42 in the brewing, long distance, and personal computer industries, respectively, have nine or more imitations.
3. The total number of firms represents the total number of firms competing in the industry at the end of the calendar year in which the first mover introduced the new product innovation. Annual data were collected from various sources such as *Standard & Poor's Industry Surveys* and trade association records and publications.
4. In the Cox regression, the positive parameter coefficient indicates a faster temporal measure.
5. The results were similar when analyzing the high technology industries (long distance and personal computer), which may be clearer in the metrics regarding profit potential relative to the brewing industry, which is a marketing driven industry.

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