Paper to be presented at the

DRUID Society Conference 2014, CBS, Copenhagen, June 16-18

# Pre-Entry Resources, Strategic Positioning Choices and Introduction of Dominant Designs: Evidence from the Hard Disk Drive Industry

**Anu Wadhwa**
Ecole Polytechnique Fédérale de Lausanne
Management of Technology and Entrepreneurship Institute (MTE
anu.wadhwa@epfl.ch

**Richard Tee**
École Polytechnique Fédérale de Lausanne - EPFL
CDM
richard.tee@epfl.ch

**Christopher Tucci**
EPFL
CDM
christopher.tucci@epfl.ch

Abstract

We investigate the role that strategic positioning choices and pre-entry endowments play in determining the post-entry innovative performance of firms that enter new markets. We hypothesize that entrepreneurial entrants possessing greater levels of pre-entry endowments and those that choose to operate in multiple niches and position themselves aggressively in new markets will introduce products with dominant design features earlier. We also hypothesize that pre-entry endowments positively moderate the relationship between post-entry technology strategy choices and early introduction of dominant design features. We test our hypotheses using longitudinal data on entrepreneurial startups in the computer hard disk drive industry from 1974 to 1995.

Jelcodes:M10,O32

**Pre-Entry Resources, Strategic Positioning Choices and Introduction of Dominant Designs: Evidence from the Hard Disk Drive Industry**


## Abstract

We investigate the role that strategic positioning choices and pre-entry endowments play in determining the post-entry innovative performance of firms that enter new markets. We hypothesize that entrepreneurial entrants possessing greater levels of pre-entry endowments and those that choose to operate in multiple niches and position themselves aggressively in new markets will introduce products with dominant design features earlier. We also hypothesize that pre-entry endowments positively moderate the relationship between post-entry technology strategy choices and early introduction of dominant design features. We test our hypotheses using longitudinal data on entrepreneurial startups in the computer hard disk drive industry from 1974 to 1995.

## Introduction

Entrant heterogeneity is an important determinant of future firm performance (Agarwal and Bayus, 2004). Research on industry evolution and entry into new markets (e.g., Klepper and Simons, 2000) has largely focused on whether prior industry experience, resources, and assets of diversifying entrants (firms entering from another industry) give them an advantage over de novo entrants (entrepreneurial startups). It has also examined how these differences influence their survival chances, growth, market share, and innovative performance (Agarwal and Bayus, 2004; Helfat and Lieberman, 2002; Khessina and Carroll, 2008). However, this stream of research has largely assumed that de novo firms are a homogenous group with similarly constrained resource endowments and has ignored sources of heterogeneity that might give some of these de novo firms an advantage over others (see Agarwal et al., 2004, for an exception). Predictably, this research has produced mixed empirical evidence for a de novo entrant advantage (Bayus and Agarwal, 2007; Khessina and Carroll, 2008) as well as a diversifying entrant advantage (Barnett and Freeman, 2001; Klepper and Simons, 2000).

A related stream of research on spinouts—startups founded by employees of an established firm—has examined formation, knowledge inheritance, and performance of such firms (Agarwal and Bayus, 2004; Chatterji, 2009; Klepper, 2009). This research explores a specific source of de novo firm heterogeneity in firms' pre-entry resource endowments: founders' pre-entry industry affiliations. Empirical work on this topic provides evidence that because of the knowledge they inherit from their established parents, spinouts enjoy greater levels of technological and marketing knowhow as well as greater survival chances as compared to other startups (Agarwal et al., 2004). Spinouts also perform better on dimensions such as obtaining funding more rapidly, achieving higher valuations, and obtaining faster regulatory approval for their products (Chatterji, 2009; Klepper, 2009). While this research helps highlights the fact that not all entrepreneurial entrants are resource-constrained at entry, we still have a limited understanding of whether and how entrepreneurial entrants, with and without pre-entry experience, differ in their post-entry product technology strategies. Understanding these product technology strategies (for instance whether it is focused on product breadth or technological pioneering) is especially important in industries where technologies converge toward a "dominant design" (Anderson and Tushman, 1990; Suarez, 2004; Utterback and Abernathy, 1975). In these environments, implementing technological features that fail to be part of such a dominant design can have detrimental outcomes for firms (Eggers, 2012). Consequently, there is an opportunity to explore how the combination of pre-entry resources and post-entry strategic choices result in superior product innovation outcomes for these firms.

In this paper, we attempt to fill this gap by investigating how pre-entry and post-entry differences among de novo entrants in an industry influence their post-entry innovative performance. More specifically, we examine the impact of (1) post-entry technology strategy choices and (2) the founding conditions of de novo entrants in a new industry on their adoption of elements of the eventual dominant design. This is an important research question for several reasons. First, it allows us to tease out whether de novo entrants, who start out with a "clean slate" and therefore are more flexible and nimble (Khessina and Carroll, 2008), are able to leverage their flexibility and make strategic positioning choices more compatible with superior product portfolios. Second, we can better understand the nature of the constraints imposed by de novo entrants' pre-entry resource endowments and the impact of heterogeneity in such resources on firms' innovative performance. Finally, we are able to identify the mechanisms through which de novo firms introduce products with features in line with the industry's eventual dominant design (Anderson and Tushman, 1990; Suarez, 2004; Utterback and Abernathy, 1975). Anticipating which features will comprise a dominant design is important, as this marks a turning point in the industry toward consolidation and process improvements (Murmann and Frenken, 2006). Therefore, firms that are able to define the dominant design through architectural innovations (Henderson and Clark, 1990), or adopt key features of the dominant design early, stand a better chance of survival (Klepper, 2006; Suarez and Utterback, 1995).

We test our hypotheses using longitudinal data on the computer hard disk drive industry from 1974 to 1995. We find that some post-entry technology strategy choices such as operating in multiple niches have a positive impact on product innovation, while other technology strategies, such as being a technology pioneer, have a mixed impact on product innovation. Pre-entry resources such as founder experience may represent superior resource endowments and may help firms leverage some of their technology strategy choices. By focusing on entrant heterogeneity and subsequent differences in product strategies in a technologically dynamic environment, our results contribute to the literature on market entry and industry evolution.

## Theory and Hypotheses

How do entrepreneurial entrants compete when entering fast-changing markets? Given their resource constraints, such firms face obvious disadvantages compared to more established firms. At the same time, because of their resource constraints entrepreneurial entrants can also be more flexible. In rapidly changing environments, this flexibility allows entrepreneurial entrants to be unencumbered by their own history, networks (Kaplan and Tripsas, 2008), or organizational routines (Nelson and Winter, 1982). Such flexibility mitigates inertia, prevents competency traps (Levitt and March, 1988; Siggelkow and Rivkin, 2005), and allows them to be more flexible in determining their competitive strategy, that is, where and how to compete in a new industry. This strategic flexibility can be particularly important in high-tech industries, where technological trajectories (cf. Dosi, 1982) can have important ramifications for firm performance and probability of survival. Furthermore, as the literature on technology and industry coevolution has shown (Anderson and Tushman, 1990; Utterback and Abernathy, 1975), the early stage of a technology's lifecycle is generally marked by great uncertainty. How technological trajectories eventually unfold is even more critical in industries that converge towards a dominant design, where a specific set of technological features prevails (Murmann and Frenken, 2006; Suarez, 2004). In such cases, selecting the "winning" technology is critical, because betting on the "losing" technology can have important negative implications in terms of subsequent learning and knowledge creation (Eggers, 2012).

At the same time, as highlighted in the population ecology literature, entrepreneurial entrants may suffer from a "liability of newness" (Stinchcombe, 1965). Empirical work in this area (Freeman et al., 1983) has shown that across a variety of industries, younger firms, given their low resource endowments, are more likely to exit (by dissolution or merger) than longer-running organizations. Given their lack of resources, heterogeneity in terms of pre-entry experience of de novo firms can play an important role in their subsequent performance. For instance, there may be important differences regarding resource endowments such as founder experience, as well as knowledge and financial resources (e.g., VC investment and the contacts and networks such funding might confer). Existing work has shown that pre-entry experience is a resource available to new entrants that generally confers a survival advantage, though results have not been entirely consistent (Ganco and Agarwal, 2009). Furthermore, diversifying entrants (de alio firms) may be at an advantage as they enter and grow in a new market compared to de novo entrants (Chen et al., 2012).

As the above research highlights, entrepreneurial ventures differ in their pre-entry resource endowments (e.g. pre-entry knowledge and experience) as well as in their flexibility. As a result, we expect variation in terms of their post entry strategic choices regarding their products. In particular, we expect the combination of pre-entry founding experience and post entry strategic choices to jointly determine the kinds of innovative products they develop. What types of product innovations these firms choose to focus on is vital in fast changing environments (such as many high-tech settings), as research shows that many firms are forced to exit as the industry matures (Klepper, 2006). The following section develops hypotheses on these product innovation choices, focusing on pre-entry resource endowments, the strategic positioning choices firms make, and their combined effects.

**Pre-Entry Resource Endowments.** We explore how firms' introduction of products with eventual dominant design elements is influenced by the constraints they have at entry: their pre-entry resource endowments such as pre-entry industry experience, pre-entry founder experience, and pre-entry financial resources.[1] However, even when a firm has not existed before, it is possible for it to possess pre-entry resources. Entrepreneurs who start firms in high technology industries typically have some experience working at other large firms, where they acquire both technical and non-technical knowledge as well as social capital (Chatterji, 2009). Prior research on such spinouts (also known as "spawns," see Chatterji, 2009) has found that not only are spinouts better able to accumulate financial and other resources, they also exhibit greater firm

[1] For this version of the paper, we will not explore pre-entry industry experience (diversifiers).

valuations, patent more, grow faster, have greater market share, and survive longer than other startups because of their knowledge advantage (Chatterji, 2009; Klepper, 2009). This knowledge advantage should improve the firm's ability to implement changes in existing linkages in product architecture that improve its performance (Fixson and Park, 2008; Ulrich and Eppinger, 2011) and recognize key characteristics of an emergent dominant design. Thus, we hypothesize that,

> **Hypothesis 1:** Entrants with pre-entry founder experience will introduce products with eventual dominant design features earlier than entrants with limited pre-entry founder experience.

**Technology Strategy Choices.** We examine how firms' introduction or adoption of eventual dominant designs elements in their products is affected by their pre- and post-entry technology strategy choices. We focus on two technology related strategies chosen by these firms after they enter a new industry: the number of product niches that they will operate in and whether they focus on technology or market pioneering.

A well-established line of work on technological innovation and industry evolution has shown how technologies often follow a cyclical pattern of variation, selection and retention (Anderson and Tushman, 1990; Clark, 1985; Utterback and Abernathy, 1975). A dominant design marks the point when a particular combination of technological features is adopted by the majority of industry participants. Such designs can change through an architectural innovation, that is, a change in the way existing components of the product architecture are connected (Henderson and Clark, 1990). Depending on the rate of technological change, dominant designs can be long lived (e.g., the internal combustion engine in the automotive industry), or evolve more quickly in technologically dynamic environments. In rapidly changing environments, firms must not only recognize the nature of potential architectural innovations, they must also apply their knowledge to execute a strategy to build as well as to offer products with such innovations

(Henderson and Clark, 1990). Broad architectural knowledge (Richard and Devinney, 2005; Sosa et al., 2004) of different niche markets may help young firms with the above challenges by exposing them to different demand conditions and allowing them to experiment (cf. Brusoni et al., 2001; Prencipe, 2000 for how this applies to large firms). Entrepreneurial entrants that follow a strategy of only operating in a single or small number of product niches may be unable to build the absorptive capacity (Cohen and Levinthal, 1990; Zahra and George, 2002) to recognize technology trends that give rise to dominant designs. Those entrepreneurial entrants that do make the conscious choice to operate in multiple product niches are able to draw from a stronger knowledge base than firms that focus on a smaller number of product niches. In turn, this knowledge base allows these firms to better anticipate architectural designs. Further, entrants with a richer knowledge base are more likely to possess larger repertoires of already developed component technologies that can be readily used in various combinations to integrate eventual dominant design components. Thus, we hypothesize that,

> **Hypothesis 2:** Entrants following a strategy of operating in multiple niches simultaneously will introduce products with eventual dominant design features earlier than entrants operating in relatively fewer simultaneous niches.

In technologically dynamic markets, firms need to balance efficiency and flexibility in their overall strategy (Eisenhardt et al., 2010). In such environments, early movers may reap benefits by introducing technologies before their competitors do so (Suarez and Lanzolla, 2007). However, moving early also entails greater risks, as the initial merits of new products or technologies are often initially unclear (Christensen, 1997). Furthermore, for new entrants, the payoff for introducing technologically superior products may actually be negative, in that their products have a shorter life span than technologically inferior products from diversifying entrants (Khessina and Carroll, 2008). Some firms may nevertheless follow a pioneering strategy because such products can, at least initially, command higher margins, thereby capturing profits before commoditization stabilizes price levels (Adner and Levinthal, 2001). Such pioneering may take multiple forms, including technologically complex improvements among anticipated dimensions of merit (e.g. storage capacity in our setting), as well as more complex transitions (e.g. to a smaller form factor). A further potential advantage of pioneering is that it forces the firm to keep up to date on the technological state of the art. Therefore, firms that follow a pioneering strategy may build up superior architectural knowledge of the potential benefits of changing linkages between existing or new components (Henderson and Clark, 1990), and better anticipate potential features that will eventually comprise the industry's dominant design. Thus, we hypothesize that,

> **Hypothesis 3:** Entrants following a pioneering strategy will introduce products with eventual dominant design features earlier than more "conservative" (*non*-pioneering) entrants.

**Moderating effect of pre-entry resource endowments.** As hypothesized earlier, we expect entrepreneurial entrants that operate in multiple niches to have greater stocks of relevant architectural knowledge, increasing their probability of introducing products with eventual dominant design features more quickly. When such entrants also possess prior experience via their founders, such firms will be able to execute and implement their chosen technology strategies even better. First, experienced founders may be able to draw upon additional resources, such as their personal networks (Higgins and Gulati, 2003), as well as their technological and market knowledge inherited from previous employers (Agarwal et al., 2004), all of which improve the firm's ability to recognize potential architectural innovations (Henderson and Clark, 1990) and anticipate key characteristics of an emergent dominant design. Second, experienced founders are also adept at establishing the appropriate organizational routines necessary for implementation of their technology strategies. Finally, entrants that can draw on pre-entry founder experience are expected to have higher absorptive capacity, increasing their ability to recognize and implement dominant design features. Therefore, we expect this effect to be intensified for firms operating in multiple niches that have pre-entry founder experience. Thus, we hypothesize that,

> **Hypothesis 4**: Pre-entry founder experience of entrants will positively moderate the relationship between a multiple niches strategy and time to adoption of eventual dominant design features.

A similar argument can be extended to entrepreneurial entrants that choose a pioneering strategy. We argued earlier that, ceteris paribus, entrants that follow a pioneering strategy will be more likely to adopt dominant design features early, given the advantages associated with operating at the technological frontier. Even though pursuing a pioneering strategy is attractive for entrants, entrants will likely differ in how effectively they can execute such a strategy. Pursuing a pioneering strategy can demand greater levels of attention and resources from the entrepreneurial entrants and its managers, those entrants with pre-entry founder experience and resources may be able to manage these cognitive constraints better than de novo entrants and be able to devote the necessary attention to the early recognition of emerging dominant designs. The access that these firms enjoy to knowledge networks and their ability to gather partner resources (Helfat and Lieberman, 2002) further allow them to simultaneously focus on competing in the technology they pioneer as well as to build their capabilities to offer dominant design elements. Furthermore, entrants with pre-entry founder experience are expected to be better able to identify and meet customer needs (Agarwal et al., 2004). Thus, we expect that the founder's ability to access relevant resources improves the ventures' chances of successfully executing the pioneering strategy. Therefore, we hypothesize that,

**Hypothesis 5:** Pre-entry founder experience of entrants will positively moderate the relationship between a pioneering strategy and time to adoption of eventual dominant design features.

## METHODS

### Research Context

The research setting for this study is the computer hard disk drive industry. We chose this setting because hard drives constitute a relatively mature industry that has witnessed several clear shifts in technology generations (typically reflected in changes in the "form factor" or physical size of the disk diameter, e.g. 14", 8", 5.25", 3.5", 2.5", 1.8") as well as multiple architectural and component innovations over the years. The rapid rate of change in this industry, which can be likened to the short lifespan of "fruit flies" (Christensen, 1997), allows researchers to gain insight into a large number of product generations over time. We collected entry data from the Disk/Trend Report (DTR), a highly credible source for all industrial activity in the disk drive sector (King and Tucci, 2002). The DTR contains all the companies in the industry as well as the technical characteristics of each drive produced by each firm, in addition to an estimate of the number of drives shipped and the experience of management prior to founding. We merged data on the technical characteristics of the drives with founder and financial data from Thomson Reuter's VentureXpert and online databases such as LexisNexis and Factiva.

In the rigid hard drive industry, there were two architectural design features that eventually comprised the dominant design (Christensen et al., 1998): the Winchester architecture and Intelligent Drive Electronics (IDE). Both technological features can be considered architectural innovations in the sense that they re-arranged components in new ways (Henderson and Clark, 1990). We consider a design feature to become dominant when it was adopted by more than 50% of industry participants (Anderson and Tushman, 1990). The Winchester architecture was introduced in 1973 by IBM. Instead of removable stacks of disks that could be replaced when full, the Winchester housing sealed the entire drive. This enabled read and write heads to be much closer to the surface of the disk, enabling dramatic improvements in drive capacity. The Winchester architecture was adopted by over 50% of firms in 1982 (Christensen et al., 1998).

IDE was introduced first in 1983 by Quantum Corporation, when it announced a SCSI control circuit integrated within the drive. Before this, hard disks connected to the host computer through a separate circuit card, typically supplied by a third party to the computer maker or disk drive manufacturer. By embedding the interface directly on the hard disk, IDE allowed a range of improvements including increased data transfer, defect location and error correction. IDE crossed the 50% threshold in 1987 (Christensen et al., 1998).

We started with a list of all firms that ever produced a rigid disk drive from 1974 to 1995. The year of entry into the disk drive industry for any firm was taken as the first year in which a firm produced and shipped a disk drive. We identified 35 diversifiers—firms that were present in other industries prior to introducing their first disk drive—and excluded them from the sample. The remaining 87 firms were treated as de novo entrants for the purpose of this study. Of these firms, there were 42 firms entering before the Winchester design became widely adopted in the year 1982, of which 13 adopted the design before 1982. For the IDE design, 66 startups entered before the IDE design became widely adopted in the year 1987, and of those, 11 firms adopted it before 1987. The reason relatively few of the startups adopted the technologies early is that the year of widespread adoption includes all the incumbents and diversifiers, and is on a disk-by-disk basis, i.e., 50% of all the drives produced contained the Winchester design in 1982, even if not 50% of the companies had adopted at that point.

## Dependent Variables

Dominant Design elements. This is a binary variable that equals 1 if the firm introduced the feature in question in year t+1, otherwise it equals 0. For the first part of the analysis, it equals 1 if the firm adopted the Winchester technology in their design (any disk drive) in year t and thereafter, 0 otherwise. We repeated the analysis with the IDE design element in the second part of the analysis. Thus the firm is considered to be "at risk" for adopting the dominant design element.

## Independent Variables

Pre-entry Founder Experience. We measure pre-entry resource endowments of a firm based on the prior experience, and related knowledge, of its founders. If the founders had been employed in a large corporation prior to founding the startup, the startup is considered a spinout (Berchicci et al., 2011). Spinouts were identified using data from the Disk/Trend Report, the Lexis Nexis database, and Franco and Filson(Franco and Filson, 2006: 844). Following prior research, we use a binary variable to indicate whether a firm in our sample is a spinout which equals 1 if the company founders had worked for an established firm until 1 year prior to founding the venture; 0 otherwise.

Multiple Niche Strategy. To measure whether a focal firm in our sample follows a strategy of operating in multiple technological niches, we computed the number of capacity categories (eight per form factor), summed across all form factors (or disk sizes), in which the firm operates in year t.

Pioneering strategy. We used two alternate operationalizations to measure whether a firm followed a pioneering strategy after entry. First, we considered a firm a pioneer if it produced in the most advanced market relative to its competitors (Berchicci et al., 2011). Between 1970 and 1995, the disk drive industry saw the introduction of multiple disk drive formats, each of which was smaller (in terms of the diameter of the spinning disk) than the previous one and served a different type of customer. To operationalize whether a focal firm in our sample follows a market pioneering strategy, we followed Berchicci et al. (2011) and used a binary variable that equals 1 if the firm produced in the most advanced market (that is, serves the market with the smallest disk drive, or, form factor) in year t, 0 otherwise. Second, we use a measure that captures the density (the amount of information that can be stored in bits per inch) of the disk drive being produced by a firm as compared to the industry mean. We follow prior research (Agarwal et al., 2004; King and Tucci, 2002) and compute the areal density of the firm's best drive measured in bits per inch, normalized relative to all firms' density in each year t. Thus for example a value of +1 indicates one standard deviation above the mean for all firms in the industry in that particular year. Note that the same density would most likely represent a value of less than +1 the following year, as the average BPI rose every year during the sample period due to technological advances.

**Control Variables**

We controlled for several factors that might also have an influence on our dependent variables. First, we control for firm size which is measured as the logarithm of the total unit sales of the firm in year t. Second, we control for firm location, which is operationalized using two dummy variables reflecting the headquarters of the focal firm: Japan, and Rest of the world (ROW). The default is North America. Third, we control for the financial support received annually by the focal firm after it entered the disk drive industry. This variable was measured as the number of VCs and corporate VCs investing in the firm in year t. Finally, we also added controls for the age of the industry in the year of entry for each firm and for whether the firm already introduced another dominant design element prior to the focal design element.

## Estimation

**Event history analysis.** We use event history analysis to test our hypotheses. We use a semi-parametric Cox proportional-hazards regression model that does not make any assumptions about the baseline hazard function and is particularly suitable for analyzing time-to-event data (Cox and Oakes, 1984; Cox, 1972). The Cox model is given by

$$h(t) = h_0(t)\exp\left(\beta' X(t)\right)$$

where $h_0(t)$ is the unspecified baseline hazards function, β is the vector of regression coefficients to be estimated, and **X** is the vector of covariates. Because some of our independent variables change with time, we divide the time period during which each firm was observed into yearly spells and update all time varying variables annually. We lagged all our independent and control variables by one year. Since we observe each firm in our data annually until the firm introduces (a) Winchester and (b) Inter Digital Electronics (IDE) in their disk drives, we compute robust standard errors adjusted for clustering at the firm level. This method also handles right censoring, as not all firms adopt within the window analyzed, and some never adopt. We used the stcox routine provided in Stata to estimate the models. Both the Breslow and the Efron options in stcox yielded identical results. We conducted additional diagnostics to test for the proportional hazard assumption made by the Cox model. The Schoenfeld residuals tests indicate that the overall model satisfies the proportional hazard assumption.

## RESULTS

We report the descriptive statistics and the pairwise correlation matrix in Table 1. Tables 2 and 3 present the results for the Cox proportional hazard regression used to examine the time taken by the firms to introduce Winchester and IDE dominant design elements, respectively. In each of these tables, Model 1 is the baseline controls-only model. Models 2–6 examine pioneering in terms of markets, whereas Models 7-10 show pioneering in terms of technical capabilities. Models 3-6 add the direct and interaction effects of multiple niche strategy and pioneering strategy (measured as the smallest form factor the firm is operating in) and models 7-10 present the direct and interaction effects of multiple niche strategy and pioneering strategy (measured as the highest density the firm is offering). Models 6 and 10 are the full models with controls and all independent variables including interactions.

The results show that de novo entrants that have founders with prior experience are more likely to introduce architectural dominant design elements earlier than firms without experienced founders. Coefficients of pre-entry founder experience in Tables 2 and 3 are positive and statistically significant in all models except those in which the variable is entered as an interactive term. Thus we find support for Hypothesis 1. The coefficients of the multiple niche strategy variable are positive and statistically significant in all models of Table 3 (Models 3-9) supporting the proposition that firms that adopt a multiple niche strategy are more likely to introduce products with the IDE dominant design features elements earlier than firms that do not follow this strategy. The non-significance of the direct effect of the multiple niche strategy in Model 10 of Table 3 may be due to the fact that the variable enters the regression as part of an interaction term. We do not find support for a direct effect of the multiple niche strategy on introduction of the Winchester design elements (Table 2, Models 4-10), however. Thus, Hypothesis 2 is supported for IDE but not for Winchester design.

Hypothesis 3 predicted that de novo entrants with a pioneering strategy will be positively associated with early introduction of dominant design elements. We do not find support for this hypothesis for either of the two design elements.

Hypothesis 4 predicts that the direct effect of following a multiple niche strategy will be stronger when the de novo entrant has an experienced founder, and we find support for this hypothesis for the introduction of both design elements (Tables 2 and 3, Models 4, 6, 8, 10). Contrary to our prediction in Hypothesis 5, however, pre-entry founder experience either has no statistically significant moderating effect, or has a negative and statistically significant moderating effect on the introduction of dominant design elements for both design elements. Thus we do not find support for Hypothesis 5.

*** Please insert Tables 2 and 3 about here ***

**Supplementary Analyses**

We conducted additional analyses to verify whether our results are robust to additional specifications. It is possible that other pre-entry resource endowments of entrepreneurial entrants such as financial resources could also have the same effect as pre-entry founder experience. In order to test for this possibility, we computed the number of VCs that invested in the entrant prior to its entry and entered it in the regression as a proxy for pre-entry financial endowments. The effect of pre-entry financial endowments was not statistically significant suggesting that having greater levels of pre-entry financial resources does not help entrants offer dominant design elements. We found only a weak effect of pre-entry financial endowments on the relationship between entrant technology strategy and introduction of dominant design. Our results hold if we use the dollar amount of investments received by the entrant prior to entry in the disk drive market.

## DISCUSSION

### Summary

The goal of this paper was to explore the effect of heterogeneity among entrants in a new industry on their long-term innovative performance. We found that de novo firms entering a new industry are most likely to introduce products with dominant design elements earlier when they have founders with prior industry experience and when they operate in multiple niches. Choosing pioneering strategies does not appear to have a direct effect. We also find that pre-entry founder experience has a positively moderating effect on the relationship between operating in multiple niches and early introduction of dominant design elements, but a negative moderating effect on the relationship between choosing a pioneering strategy and early introduction of dominant design elements.

### Contribution

This study makes several contributions to the literature on market entry and industry evolution, which largely focuses on differences between de novo and diversifying firms as they enter new industries and the implications for survival or performance. First, our focus on de novo firms' entry into an industry gives us insights into several sources of heterogeneity that may influence the outcomes for these firms. It is important to recognize that even de novo firms can differ in their starting conditions in terms of tangible and intangible resources and in the choices they make when entering and competing in a new industry. Our study offers some initial evidence on whether this heterogeneity gives rise to product portfolios that are likely to possess dominant design features.

Second, we examine the introduction and adoption of dominant design features instead of survival, growth, or other indicators of market performance. In industries where dominant designs are important, the survival and growth of firms depends not only on being able to anticipate which dominant design will prevail but also having the capability to introduce products with elements of the dominant design earlier rather than later (Suarez and Utterback, 1995). For entrepreneurial entrants competing with large and resource-rich firms, this may be a challenge; our results show that some entrants are able to overcome this resource constraint by leveraging their founders' prior experience working for other large companies. Surprisingly, pre-entry financial resources do not seem to help entrepreneurial entrants with their long term innovative performance—this non-result demonstrates that there may be a hierarchy of resources that can help entrepreneurial entrants at different times in their lifecycle.

Our analysis focuses on two architectural innovations, one occurring in the early stages of the industry, the other at a later point in time. Contrary to expectations (Henderson and Clark, 1990), not all startups entered with architectural innovations. In fact, as mentioned above, there are interesting differences among the startups. Spinouts appear to be more likely to adopt these elements early relative to other de novo startups. One explanation for this could be that experienced founders recognized the importance of these elements. Such recognition may have been developed in their prior positions which allowed them to experiment and pay attention to multiple technologies. This experience subsequently allowed them to combine these resources, either with or without the help of the parent company. Alternatively, along the lines of Henderson and Clark (1990), it may be that the spinouts' parent companies were hesitant to adopt these innovations, and the entrepreneurs left those companies predisposed about alternative configurations of design elements.

Following a strategy based on pioneering does not appear to be predictive of early adoption. It could be that pioneering requires more focus on the competition, and if firms adopt an architectural innovation, that would require rethinking interdependencies between components. This may slow down a company in the most competitive areas of the market, for example, to produce the most dense (high capacity) drive and to enter the most advanced market quickly. Thus it appears that adopting a more "conservative" (non-pioneering) strategy might be more amenable to early adoption of architectural innovations, whereas later on, competitive pressure might switch once the dominant design has been established. We can also speculate about "first-mover" advantages (Agarwal and Gort, 2001; Makadok and Walker, 1996; Suarez and Lanzolla, 2007) in adoption of eventual dominant design elements. Market pioneers, which might be considered to be early movers in terms of the markets they serve, are less likely to be early adopters of these elements. This early orientation toward market competition may (although we did not study this) eventually put them at a performance disadvantage in such a fast-moving industry.

Overall, our data suggest that a strategy based on breadth (i.e. operating in multiple niches), rather than focusing on pioneering, is more beneficial in terms of adopting architectural innovations that comprise the eventual dominant design. This finding may explain the results of existing work, which has highlighted the benefits for de novo firms of entering later in the industry lifecycle (Bayus and Agarwal, 2007; Ganco and Agarwal, 2009). Rather than operating at the frontier, which is risky given market and technological uncertainty, firms might want to operate at a distance from this frontier. Instead, operating in multiple niches prevents firms from "laying all their eggs in one basket", and allows them to adopt architectural innovations as the market converges towards a dominant design.

## Limitations and Future Research Directions

This study has some limitations that offer opportunities for future research. First, our results are based on a single industry and it is possible that our findings may not be generalizable to other industries, especially less dynamic ones. Given our setting, it may be the case that our findings are especially relevant for industries with short product cycles and fast product obsolescence. Understanding the effect of the type of industry on pre-entry and post-entry choices and the consequent performance implications is an interesting question. Second, we looked primarily at the product and resource related aspects of pre-entry and post-entry choices to examine introduction of eventual dominant design elements. It is possible that the range of product related choices and resource related endowments and needs is broader in industries other than the disk drive industry. Thus, further work is needed to understand how the entire spectrum of product and resource endowments influences the extent to which future product portfolios coalesce around the dominant design. Finally, because timing of entry into a market has been shown to be an important determinant of survival (Bayus and Agarwal, 2007; Mitchell, 1991), exploring the timing of implementing specific product strategies and obtaining resources might be critical for product development as well. Finally, in this study, we did not examine the type and level of experience the founders have. Future research could explore what kind of pre-entry founder experience matters for the firm's long-term innovation performance.

## References

Adner R., Levinthal D., 2001. Demand Heterogeneity and Technology Evolution: Implications for Product and Process Innovation. Management Science, 47, 611-628.

Agarwal R., Bayus B.L., 2004. Here today and gone tomorrow: the dissipating advantage of pre-entry experience in a technologically dynamic industry. Working Paper.

Agarwal R., Echambadi R., Franco A.M., Sarkar M.B., 2004. Knowledge transfer through inheritance: Spinout generation, development, and survival. Academy of Management Journal, 47, 501-522.

Agarwal R., Gort M., 2001. First-Mover Advantage and the Speed of Competitive Entry, 1887–1986. Journal of Law and Economics, 44, 161-177.

Anderson P., Tushman M.L., 1990. Technological Discontinuities and Dominant Designs: A Cyclical Model of Technological Change. Administrative Science Quarterly, 35, 604-633.

Barnett W.P., Freeman J., 2001. Too Much of a Good Thing? Product Proliferation and Organizational Failure. Organization Science, 12, 539-558.

Bayus B.L., Agarwal R., 2007. The Role of Pre-Entry Experience, Entry Timing, and Product Technology Strategies in Explaining Firm Survival. Management Science, 53, 1887-1902.

Berchicci L., King A., Tucci C.L., 2011. Does the apple always fall close to the tree? The geographical proximity choice of spin-outs. Strategic Entrepreneurship Journal, 5, 120-136.

Brusoni S., Prencipe A., Pavitt K., 2001. Knowledge Specialization, Organizational Coupling, and the Boundaries of the Firm: Why Do Firms Know More Than They Make? Administrative Science Quarterly, 46, 597-621.

Chatterji A.K., 2009. Spawned with a silver spoon? Entrepreneurial performance and innovation in the medical device industry. Strategic Management Journal, 30, 185-206.

Chen P.-L., Williams C., Agarwal R., 2012. Growing pains: Pre-entry experience and the challenge of transition to incumbency. Strategic Management Journal, 33, 252-276.

Christensen C.M., 1997. The innovator's dilemma: when new technologies cause great firms to fail. Harvard Business Press.

Christensen C.M., Suárez F.F., Utterback J.M., 1998. Strategies for Survival in Fast-Changing Industries. Management Science, 44, S207-S220.

Clark K.B., 1985. The interaction of design hierarchies and market concepts in technological evolution. Research Policy, 14, 235–251.

Cohen W.M., Levinthal D.A., 1990. Absorptive capacity: a new perspective on learning and innovation. Administrative Science Quarterly, 35, 128-152.

Cox D., Oakes D., 1984. Analysis of survival data. Chapman & Hall.

Cox D.R., 1972. Regression Models and Life-Tables. Journal of the Royal Statistical Society Series B (Methodological), 34, 187-220.

Dosi G., 1982. Technological Paradigms and Technological Trajectories. Research Policy, 11, 147-162.

Eggers J.P., 2012. Falling Flat: Failed Technologies and Investment under Uncertainty. Administrative Science Quarterly, 57, 47-80.

Eisenhardt K.M., Furr N.R., Bingham C.B., 2010. CROSSROADS—Microfoundations of Performance: Balancing Efficiency and Flexibility in Dynamic Environments. Organization Science, 21, 1263-1273.

Fixson S.K., Park J.-K., 2008. The power of integrality: Linkages between product architecture, innovation, and industry structure. Research Policy, 37, 1296-1316.

Franco A.M., Filson D., 2006. Spin-Outs: Knowledge Diffusion through Employee Mobility. The Rand Journal of Economics, 37, 841-860.

Freeman J., Carroll G.R., Hannan M.T., 1983. The liability of newness: Age dependence in organizational death rates. American Sociological Review, 48, 692-710.

Ganco M., Agarwal R., 2009. Performance Differentials Between Diversifying Entrants and Entrepreneurial start-ups: A Complexity Approach. Academy of Management Review, 34, 228-252.

Helfat C.E., Lieberman M.B., 2002. The birth of capabilities: market entry and the importance of pre-history. Industrial and Corporate Change, 11, 725-760.

Henderson R., Clark K., 1990. Architectural innovation : The reconfiguration of existing product technologies and failure of established firms. Administrative Science Quarterly, 35, 9-30.

Higgins M.C., Gulati R., 2003. Getting Off to a Good Start: The Effects of Upper Echelon Affiliations on Underwriter Prestige. Organization Science, 14, 244-263.

Kaplan S., Tripsas M., 2008. Thinking about Technology: Applying a Cognitive Lens to Technical Change. Research Policy, 37, 790-805.

Khessina O.M., Carroll G.R., 2008. Product Demography of De Novo and De Alio Firms in the Optical Disk Drive Industry, 1983–1999. Organization Science, 19, 25-38.

King A.A., Tucci C.L., 2002. Incumbent Entry into New Market Niches: The Role of Experience and Managerial Choice in the Creation of Dynamic Capabilities. Management Science, 48, 171-186.

Klepper S., 2006. Entry, exit, growth and innovation over the product life cycle. American Economic Review, 86, 562–583.

Klepper S., 2009. Spinoffs: A review and synthesis. European Management Review, 6, 159-171.

Klepper S., Simons K.L., 2000. Dominance by birthright: entry of prior radio producers and competitive ramifications in the U.S. television receiver industry. Strategic Management Journal, 21, 997-1016.

Levitt B., March J.G., 1988. Organizational learning. Annual Review of Sociology, 14, 319-340.

Makadok R., Walker G., 1996. Search and Selection on the money market fund industry. Strategic Management Journal, 17, 39 - 54.

Mitchell W., 1991. Dual Clocks: Entry Order Influences on Incumbent and Newcome. Strategic Management Journal, 12.

Murmann J.P., Frenken K., 2006. Toward a systematic framework for research on dominant designs, technological innovations, and industrial change. Research Policy, 35, 925-952.

Nelson R., Winter S., 1982. An evolutionary theory of economic change. Cambridge, MA, Belknap Press/Harvard University Press.

Prencipe A., 2000. Breadth and depth of technological capabilities in CoPS: the case of the aircraft engine control system. Research Policy, 29, 895-911.

Richard P., Devinney T., 2005. Modular strategies: B2B technology and architectural knowledge. California Management Review, 47, 86-113.

Siggelkow N., Rivkin J.W., 2005. Speed and Search: Designing Organizations for Turbulence and Complexity. Organization Science, 16, 101-122.

Sosa M.E., Eppinger S.D., Rowles C.M., 2004. The Misalignment of Product Architecture and Organizational Structure in Complex Product Development. Management Science, 50, 1674-1689.

Stinchcombe A.L., 1965. Social Structure and Organizations. In: March J.G. (Ed.). Handbook of Organizations. Chicago: Rand-McNally, pp. 142-193.

Suarez F., 2004. Battles for Technological Dominance: An Integrated Framework. Research Policy, 33, 271-286.

Suarez F.F., Lanzolla G., 2007. The Role of Environmental Dynamics in Building a First Mover Advantage Theory. The Academy of Management Review, 32, 377-392.

Suarez F.F., Utterback J.M., 1995. Dominant designs and the survival of firms. Strategic Management Journal, 16.

Ulrich K.T., Eppinger S.D., 2011. Product Design and Development. 5 ed., Irwin/ McGraw Hill.

Utterback J.M., Abernathy W.J., 1975. A dynamic model of process and product innovation. Omega, 3, 639–656.

Zahra S.A., George G., 2002. Absorptive capacity: A review, reconceptualization, and extension. Academy of Management Journal, 27.

## Table 1: Descriptive Statistics and Correlations

| | Variables | Mean | S.D. | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) | Introduced Winchester | 0.721 | 0.449 | 1.000 | | | | | | | | | | |
| (2) | Introduced IDE | 0.198 | 0.399 | 0.244 | 1.000 | | | | | | | | | |
| (3) | Pre-entry Founder Experience | 0.298 | 0.458 | 0.060 | 0.117 | 1.000 | | | | | | | | |
| (4) | Multiple Niche Strategy | 0.409 | 0.675 | 0.136 | 0.214 | 0.143 | 1.000 | | | | | | | |
| (5) | Pioneering Strategy (Smallest Form Factor) | 0.049 | 0.217 | -0.031 | 0.013 | 0.106 | 0.357 | 1.000 | | | | | | |
| (6) | Pioneering Strategy (Max. Density) | -0.139 | 0.940 | 0.148 | 0.219 | 0.191 | 0.612 | 0.001 | 1.000 | | | | | |
| (7) | Log Sales | 2.574 | 1.041 | 0.147 | 0.307 | 0.193 | 0.601 | 0.229 | 0.421 | 1.000 | | | | |
| (8) | Annual Number of VCs | 0.228 | 1.382 | -0.005 | 0.007 | 0.064 | 0.116 | 0.122 | 0.051 | 0.090 | 1.000 | | | |
| (9) | Japan | 0.109 | 0.312 | -0.100 | -0.040 | -0.180 | -0.022 | 0.020 | -0.126 | -0.080 | -0.063 | 1.000 | | |
| (10) | Non Japan | 0.240 | 0.427 | 0.179 | -0.125 | -0.165 | -0.091 | -0.058 | -0.158 | -0.114 | -0.092 | -0.197 | 1.000 | |
| (11) | Industry Age at Entry | 9.768 | 4.857 | 0.281 | 0.035 | 0.033 | -0.172 | -0.045 | -0.170 | -0.145 | -0.008 | -0.095 | 0.402 | 1.000 |

## Table 2. Event History Analysis: Time to introduction of Winchester design elements

| Variables | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 | Model 7 | Model 8 | Model 9 | Model 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Pre-entry Founder Experience | | 0.751*** | 0.828*** | -0.111 | 0.750** | -0.203 | 0.747*** | -0.253 | 0.867*** | 0.091 |
| | | [0.224] | [0.221] | [0.625] | [0.267] | [0.653] | [0.218] | [0.598] | [0.250] | [0.780] |
| Multiple Niche Strategy | | | 0.304 | -0.091 | 0.300 | -0.097 | 0.209 | -0.166 | 0.244 | -0.045 |
| | | | [0.293] | [0.422] | [0.294] | [0.423] | [0.348] | [0.463] | [0.352] | [0.520] |
| Pioneering Strategy (Smallest Form Factor) | | | -0.305+ | -0.288 | -0.509+ | -0.500+ | | | | |
| | | | [0.220] | [0.232] | [0.355] | [0.385] | | | | |
| Pioneering Strategy (Max. Density) | | | | | | | 0.030 | -0.002 | -0.210 | -0.093 |
| | | | | | | | [0.154] | [0.155] | [0.237] | [0.246] |
| Founder Experience X Multiple Niches | | | | 0.814* | | 0.822* | | 0.876* | | 0.617 |
| | | | | [0.485] | | [0.487] | | [0.486] | | [0.600] |
| Founder Experience X Pioneering Strategy (Smallest Form Factor) | | | | | 0.323 | 0.341 | | | | |
| | | | | | [0.476] | [0.503] | | | | |
| Founder Experience X Pioneering Strategy (Max. Density) | | | | | | | | | 0.439* | 0.185 |
| | | | | | | | | | [0.262] | [0.314] |
| Log Sales | -0.414** | -0.395* | -0.454** | -0.408* | -0.452** | -0.403* | -0.441** | -0.396* | -0.432** | -0.405* |
| | [0.159] | [0.154] | [0.166] | [0.164] | [0.167] | [0.163] | [0.162] | [0.161] | [0.160] | [0.163] |
| Annual Number of VCs | 0.100*** | 0.093*** | 0.098*** | 0.101*** | 0.096*** | 0.098*** | 0.093*** | 0.095*** | 0.095*** | 0.096*** |
| | [0.029] | [0.025] | [0.026] | [0.026] | [0.026] | [0.026] | [0.026] | [0.027] | [0.028] | [0.027] |
| Japan | 0.287 | 0.264 | 0.209 | 0.229 | 0.296 | 0.313 | 0.177 | 0.211 | 0.231 | 0.225 |
| | [0.192] | [0.207] | [0.315] | [0.399] | [0.360] | [0.436] | [0.223] | [0.303] | [0.256] | [0.292] |
| Non Japan | 0.071 | 0.185 | 0.151 | 0.217 | 0.135 | 0.199 | 0.122 | 0.194 | 0.170 | 0.192 |

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
|---|---|---|---|---|---|---|---|---|---|---|
| | [0.233] | [0.256] | [0.248] | [0.259] | [0.247] | [0.258] | [0.257] | [0.264] | [0.261] | [0.265] |
| Industry Age at Entry | -0.337*** | -0.370*** | -0.364*** | -0.374*** | -0.366*** | -0.375*** | -0.364*** | -0.372*** | -0.372*** | -0.373*** |
| | [0.040] | [0.039] | [0.040] | [0.038] | [0.039] | [0.038] | [0.039] | [0.038] | [0.037] | [0.037] |
| Observations | 109 | 109 | 109 | 109 | 109 | 109 | 108 | 108 | 108 | 108 |
| Num. of Firms | 75 | 75 | 75 | 75 | 75 | 75 | 75 | 75 | 75 | 75 |
| Num. Failed | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 66 |
| Degrees of Freedom | 5 | 6 | 8 | 9 | 9 | 10 | 8 | 9 | 9 | 10 |
| log Likelihood | -189.9 | -186.4 | -185.6 | -184.6 | -185.4 | -184.4 | -186.0 | -184.8 | -185.0 | -184.7 |
| Chi Squared | 108.4 | 142.6 | 139.1 | 158.8 | 144.9 | 159.0 | 140.3 | 160.6 | 156.9 | 158.4 |
| Pseudo R Squared | 0.157 | 0.173 | 0.177 | 0.181 | 0.177 | 0.182 | 0.174 | 0.179 | 0.178 | 0.179 |

Robust standard errors in brackets; *** p<0.001, ** p<0.01, * p<0.05, + p<0.1;
1-tailed t-tests for all independent variables; 2-tailed t-tests for all controls

## Table 3. Event History Analysis: Time to introduction of IDE design elements

| Variables | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 | Model 7 | Model 8 | Model 9 | Model 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Pre-entry Founder Experience | | 0.946* | 0.996* | -0.420 | 0.974 | -0.509 | 0.993* | -0.547 | 1.006* | -2.025* |
| | | [0.486] | [0.488] | [1.125] | [0.617] | [1.263] | [0.491] | [1.129] | [0.484] | [1.447] |
| Multiple Niche Strategy | | | 1.615** | 1.184* | 1.613** | 1.180* | 1.321* | 0.807 | 1.299* | 0.262 |
| | | | [0.622] | [0.694] | [0.625] | [0.692] | [0.750] | [0.870] | [0.752] | [0.918] |
| Pioneering Strategy (Smallest Form Factor) | | | 0.023 | 0.038 | -0.021 | -0.095 | | | | |
| | | | [0.359] | [0.348] | [0.769] | [0.758] | | | | |
| Pioneering Strategy (Max. Density) | | | | | | | 0.237 | 0.235 | 0.390 | 0.855* |
| | | | | | | | [0.285] | [0.289] | [0.450] | [0.403] |
| Founder Experience X Multiple Niches | | | | 0.928+ | | 0.942+ | | 1.014+ | | 2.039* |
| | | | | [0.654] | | [0.670] | | [0.676] | | [0.884] |
| Founder Experience X Pioneering Strategy (Smallest Form Factor) | | | | | 0.068 | 0.206 | | | | |
| | | | | | [0.914] | [0.915] | | | | |
| Founder Experience X Pioneering Strategy (Max. Density) | | | | | | | | | -0.240 | -1.053* |
| | | | | | | | | | [0.431] | [0.510] |
| Log Sales | 0.258* | 0.291** | -0.065 | -0.054 | -0.066 | -0.056 | -0.055 | -0.037 | -0.071 | -0.078 |
| | [0.119] | [0.109] | [0.166] | [0.161] | [0.166] | [0.162] | [0.173] | [0.172] | [0.177] | [0.176] |
| Annual Number of VCs | 0.028 | 0.013 | -0.006 | 0.009 | -0.007 | 0.006 | 0.001 | 0.019 | -0.004 | 0.011 |
| | [0.068] | [0.068] | [0.087] | [0.083] | [0.087] | [0.082] | [0.086] | [0.080] | [0.090] | [0.080] |
| Japan | 0.482 | 0.170 | -0.819+ | -0.874+ | -0.804 | -0.832+ | -0.707 | -0.750 | -0.753 | -1.076+ |
| | [0.420] | [0.294] | [0.476] | [0.477] | [0.518] | [0.497] | [0.493] | [0.518] | [0.511] | [0.617] |
| Non Japan | -0.460 | -0.316 | -0.695 | -0.724 | -0.703 | -0.750 | -0.617 | -0.648 | -0.611 | -0.686 |
| | [0.486] | [0.448] | [0.464] | [0.457] | [0.483] | [0.480] | [0.470] | [0.474] | [0.469] | [0.477] |
| Industry Age at Entry | -0.082* | -0.093* | -0.087+ | -0.092* | -0.088+ | -0.092* | -0.091* | -0.100* | -0.094* | -0.112* |
| | [0.041] | [0.042] | [0.047] | [0.045] | [0.047] | [0.045] | [0.045] | [0.044] | [0.045] | [0.044] |
| Whether firm adopts winchester drive (0/1) | -0.232 | -0.300 | -0.555 | -0.771 | -0.564 | -0.810 | -0.571 | -0.798 | -0.437 | -0.348 |
| | [1.246] | [1.281] | [1.183] | [1.172] | [1.136] | [1.132] | [1.216] | [1.214] | [1.268] | [1.338] |
| Observations | 237 | 237 | 237 | 237 | 237 | 237 | 233 | 233 | 233 | 233 |
| Num. of Firms | 75 | 75 | 75 | 75 | 75 | 75 | 75 | 75 | 75 | 75 |
| Num. Failed | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 |
| Degrees of Freedom | 6 | 7 | 9 | 10 | 10 | 11 | 9 | 10 | 10 | 11 |
| log Likelihood | -87.28 | -84.98 | -80.62 | -79.86 | -80.61 | -79.84 | -80.30 | -79.44 | -80.18 | -78.01 |
| Chi Squared | 35.19 | 49.12 | 54.85 | 77.52 | 57.13 | 81.73 | 60.48 | 103.9 | 58.60 | 78.69 |
| Pseudo R Squared | 0.100 | 0.124 | 0.169 | 0.177 | 0.169 | 0.177 | 0.169 | 0.178 | 0.171 | 0.193 |

Robust standard errors in brackets; *** p<0.001, ** p<0.01, * p<0.05, + p<0.1;
1-tailed t-tests for all independent variables; 2-tailed t-tests for all controls