Surviving the Gales of Creative Destruction:
The Patterns of Innovative Activity in the Desktop Laser Printer Industry

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Abstract

In this paper, we examine the product life cycle in the desktop laser printer industry, from its inception in 1984 through 1996. During this time, the industry experienced a significant degree of innovation, as well as an enormous amount of product introduction and subsequent exit. The relative roles of market structure, innovation, and firm effects are explored in more detail using a multidimensional product space. We introduce a very detailed product-level dataset on the desktop laser printer industry. We have a number of findings: (1) product portfolios of firms are growing larger on average, as fewer firms offer more products; (2) products on the technological frontier have better survival prospects than printers behind the frontier; (3) product characteristics, such as page description language, speed, and resolution, have the largest effect on product survival rates; (4) awards granted to models and firms by leading PC publications have no effect on hazard rates of the current product portfolios of firms, but lead to much higher entry rates by the firm; and (5) while there are many similarities between dominant and fringe firms, differences in innovative and product life cycle behavior persist which is often overlooked in current studies of economic activity.

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I. INTRODUCTION

In 1942, Joseph Schumpeter noted that the "perennial gale of creative destruction" leads to the demise of incumbent firms and current market structures from within, as new firms with better technology arise. This death and renewal leads to a constant cycle of innovation, generated primarily by new firms, which prosper until a newer, more innovative technology displaces the former (Schumpeter 1942). Schumpeter's ideas, combined with mainstream theories of competition, have generated a large number of insightful studies examining the entry and exit of firms from industries (for example, Jovanovic and MacDonald 1994a; Ghemawat and Nalebuff 1985; Hannan and Freeman 1984; Gort and Klepper 1982; Klepper 1997).

On the product level, the influence of market structure in determining product entry is just as important. Product exit, however, has been accorded less attention in the theoretical literature. A handful of studies argue that market structure factors influence product exit decisions (Judd 1985, Shaked and Sutton 1987). However, the empirical examination of product survival is more recent and has focused on high technology industries; for example, studies of the disk drive, personal computer, and mainframe computer industries have been conducted, investigating the determinants of product survival (Christensen 1997, 1998; Stavins 1995; and Greenstein and Wade 1998).

In this paper, we examine the product life cycle in the desktop laser printer industry, from its inception in 1984 through 1996. During this time, the industry experienced a significant degree of innovation, as well as an enormous amount of product introduction and subsequent exit. The relative role of market structure, innovation, and firm effects are explored in more detail using a multidimensional product space.

We contribute to and extend upon the current empirical literature in a number of ways. First, while all previous studies have examined unidimensional product competition, we examine how multidimensional product competition affects the product exit decisions of firms. In addition, we consider the separate roles of product characteristics, firm characteristics, product niche competition, and external market complements and substitutes in the entry and exit patterns of products. Second, we study product innovation that occurs on two frontiers. Studies to date, such as those in the hard drive industry and supercomputer industry, have focused on innovative efforts that occur to make the product faster or smaller. However, in our data set of the laser printer industry, we show that vendors are trying to manufacture a range of printers in terms of speed, in order to reach larger a market. Thus, we can explore the implications of a dual frontier in a given product characteristic and explore its implications for product survival. Third, because we can track the industry from its beginning (and are therefore able to track the product life cycle over the entire industry life cycle) in a comprehensive way, we can differentiate between patterns of dominant firms and fringe firms in the sample. To meet these goals, we introduce a very detailed product-level data set on the desktop laser printer industry.

This paper estimates both the determinants of product introduction and the instantaneous probability that a product model exits the marketplace. We perform the analysis at the product level, rather than on the firm level. Though our unit of analysis is the product, we also control for firm effects that might be important, as there is substantial turnover in both products and firms in the industry over this time period. We use a hazard rate model with time-varying covariates to predict the product exit decision. We then use a count model to estimate product entry.

In this paper, we have a number of findings. We demonstrate that firms are introducing fewer products into each product class over time. In addition, the product portfolios of firms are growing larger on average, as fewer firms offer more products overall. Products on the technological frontier have better survival prospects than printers behind the frontier. Product characteristics, such as page description language, speed, and resolution, have the largest effect on product survival rates. The data also show a consistent pattern of the effects of competition. We demonstrate that the number of models in unidimensional characteristics space is positively associated with survival rates and entry rates, while local class competition increases hazard rates. Awards granted to models and firms by leading PC publications have no effect on hazard rates of the current product portfolios of firms. However, awards lead to much higher entry rates by all types of firms, an increase of 68% to 294%, depending upon the type of firm. Finally, this study indicates that while there are many similarities between dominant and fringe firms, differences in innovative and product life cycle behavior persist, and create an interesting form of heterogeneity often overlooked in current studies of economic activity.

In the next section we briefly describe the key features of desktop laser printers and the laser printer industry. In section III, we describe our data and present the analysis for product exit using hazard rate models. In section IV, we estimate the determinants of product entry using count models. In section V, we interpret and discuss the joint results. We conclude in section VI.

II. THE DESKTOP LASER PRINTER INDUSTRY

A. THE TECHNOLOGY

As the personal computer market expanded in 1980s, so too did the market for the desktop printers. Four print technologies dominated the market: impact dot matrix, daisywheel, ink jet, and laser. Over time, impact dot matrix and daisywheel technologies have largely disappeared from the marketplace for desktop applications, and ink jet technology has recently improved in quality and reliability to the point where it can substitute for low-end laser printers. Described very simply, a laser printer is composed of a laser engine, a printed circuit board (printer controller), and some peripheral paper handling functions, inside of a molded plastic box. The printer takes in a piece of paper from its paper cassette and electrically charges the paper. The print controller then receives an image from the computer and imposes on the paper an opposite electrical charge representing the image. Electrically charged, fine grain toner is then placed on the paper so that it adheres to the image and not to the remainder of the paper. The paper with the toner is then directed to a fuser that melts the toner onto the paper, and the paper is discharged through to the output tray.

Although printers can be characterized on a number of dimensions, our research has found that two most common measures of printer performance are speed, measured by pages per minute (PPM), and resolution, measured by dots per inch (DPI). Another important characteristic of the printer is its chosen compatibility standards for image addressing. Two standards have come to dominate the industry: HP-PCL, an open standard that is based on industry compatibility with Hewlett-Packard printers; and Postscript, an addressing standard that was once dominated by Adobe, but has now been emulated by numerous firms in the industry.

These standards and other software code and capabilities designed into the print controller allow the printer to have increased functionality.

B. THE INDUSTRY

The first desktop laser printer (available on the retail market) was introduced by Hewlett Packard in 1984. The printer operated at 8 pages per minute, and was priced at just under $4,000. Two months later, Apple introduced the second desktop laser printer. By the end of 1985, 17 firms had introduced over 23 models of printers. Figure 1 illustrates the number of firms and models in the industry from the beginning of the industry in 1984 to 1996. At its peak in 1991, the industry had 143 firms. Since that time, the number of firms has fallen off to 97. The data sources are described below.

Three types of firms populate the industry. There is a large number of relatively big, diversified firms such as Ricoh, IBM, Hewlett Packard, Canon, and Xerox. There is also a small number of medium sized firms that specialize in multiple printer technologies, such as Lexmark, Kyocera, Genicom, and Kentek. Finally, there are over 100 very small “fringe” firms, which produce few printer models, ship very few units, or appear in the industry only briefly. Hewlett Packard is the dominant firm in the industry, and has maintained between 45% and 65% market share for most of the industry’s history. Table 1 documents the C1, C5, C10 concentration ratios and the market leaders in the industry.[1] If a firm has appeared in any year of the sample in the C10 ratio, then we code that firm as a dominant firm. All other firms are considered fringe firms.

[1] The quantity data we possess seems to be sufficiently good to make determinations about the largest firms in the industry. Unfortunately, its coverage of fringe firms and individual models is lacking.

In Figure 2, we illustrate the amount of product entry and exit by year. Figure 1 and Figure 2 together suggest that a smaller number of firms are offering more diversified product portfolios. The average number of products per firm is 12.5 in 1996, up from 2.8 in 1988.

C. DEFINITIONS AND FIRM BEHAVIOR

In defining the industry, we appealed to the data and to industry experts and trade journals. These sources consistently define the desktop laser printer industry as laser printers that print 0-12 PPM, can be attached to a personal computer, and are small enough to fit on a desk. This industry definition has remained constant over the time period. When we analyzed our data, we excluded printers that were particularly fast, exceeded certain weight and size measures, or were not designed to communicate with any type of personal computer. Our statistical analyses are robust to small definitional changes.

We define a product as a product model as defined by the vendors. On the surface, this definition may seem problematic. Vendors may have incentives to put many different product model numbers on the same printer in order to proliferate models in the product space (Judd 1985, Schmalensee 1978). Alternatively, they may make very small changes to a printer and market it as a different product. We have examined this possibility and found, with the exception of the addition of Postscript features (which in fact are substantial enhancements) printers with different model numbers generally do have different features. In addition, unlike some product markets, firms do not change printer attributes once the product has been introduced. Rather, they introduce new products.

Many factors may affect a firm's decision to introduce new products and to cease production of an existing one. We assume that a firm introduces a product if the expected profits from that introduction—including the effect on profits of the firm's other products—are positive and exceed those associated with the introduction of the best alternative product. In this paper, we consider the contribution of competition, innovation, and other firm effects to the product entry and exit decisions. In a vertically differentiated product market such as this, we would expect less entry into areas of the product space that have many similar products, or entry with some sort of innovation that is in fact a differentiated product. On the production side, a firm may introduce new products to take advantage of economies of scope in physical production, distribution channels, or reputation. Some firms may be prone to rapid turnover or may maintain their products on their market because they are innovators; others may concentrate on a product niche. Rapid technological innovation may also pressure firms to innovate in higher product niches, or at minimum, to innovate in the same product class by introducing printers with more or better features. A competing effect, however, arises if a firm is concerned about cannibalizing sales of its existing products.

With respect to product exit, we assume that a firm discontinues the manufacture of a model when the expected stream of profits from that model is less than that of an alternative or of not producing at all. We expect higher rates of exit from crowded areas of the product space. As products age and become obsolete, we predict that exit becomes more likely. As with entry, the exit decision for a firm may be intimately tied to entry decisions to avoid cannibalization of its existing products. A firm concerned with the performance of its entire product portfolio judges the decision to introduce a new product based not only on the competition from the products of other firms, but also on its effect on its own product portfolio's profitability, the impact of technological innovation and obsolescence, and the potential for economies within the entire firm in all of its businesses. We consider each of these in our econometric specifications.

III. THE DATA

The information on laser printer characteristics, entry, and exit come from a variety of sources. The primary source is Dataquest's SpecCheck analysis of page printers. Dataquest follows each manufacturer's product and records a variety of product characteristics, including ship date, speed, resolution, and other features. We found the data were incomplete for many models. Therefore, we supplemented our data with information from trade journals, private analysts' reports, and general industry data provided to us by a private consulting firm. We believe the dataset, which covers the industry from its inception in 1984 to 1996, is the most comprehensive available on the desktop laser printer industry. Over this 15-year period, we are able to record 833 printer introductions covering nearly 2835 printer-year observations. In the econometric analysis, we examine 1986-1996, because too few models were introduced in the early years of the industry to permit identification of the econometric models. Though we have attempted to be as thorough as possible, there remain some printers for which we cannot identify all of the independent variables. These have been dropped from the analysis. All data are recorded annually.

A. DEFINITION OF MODEL EXIT AND INDEPENDENT VARIABLES

We define a product failure as the first year that the product drops out of the dataset. This would mean that none of the sources reports the printer is being shipped, although it may still be available in some outlets from inventory. If any one of the sources reports the printer is still being shipped, we record it as still on the market.

One alternative measure of product failure is to examine the last year in which units are sold. Unfortunately, this is problematic if we are to include the fringe firms. We collected the best data available on the quantity of models shipped by manufacturers, and we found they are incomplete and biased in favor of popular models. Our analysis confirms that the data do not record units sold for low volume models or for models of smaller vendors. We know of no source of data that tracks the quantity over the entire time period for truly all models. Thus we prefer to use our definition of exit, which errs on the side of inclusion, should a bias exist. Greenstein and Wade find similar problems with the IDC data in mainframe computing (1991: p. 779, ftn 13-15).

We classify all models into five categories for speed (0-4 PPM, 5-6 PPM, 7-8 PPM, 9-10 PPM and 11-12 PPM) and four categories for resolution (0-300 DPI, 301-600 DPI, 601-1000 DPI, 1000+ DPI), for a total of twenty PPM-DPI product classes. These classifications are convenient due to the discrete nature of the speed and resolution variables, as Figure 3 demonstrates.

Using this framework to describe market structure, we define the following independent variables for our product exit analysis.

YEAR: Time trend variable to the beginning of the industry.

MODEL AGE: The age of the product measured as the number of years since introduction.

DPI: The resolution of the printer measured in dots per inch.

PPM: The speed of the printer measured in pages per minute.

PPM-squared: Speed of printer, measured in pages per minute, squared.

HP-PCL, POSTSCRIPT, DIABLO, and EPSON: Dummy variables for printing standards.

DOMINANT FIRM: A dummy variable equaling one if the vendor was one of the top ten of producers in terms of market share for at least two years in our sample, as defined in Table 1.

MODEL AWARD and FIRM AWARD: One measure of product quality is to examine whether the printer has won an award for price and performance. Every year, PC Magazine announces 4-10 printer awards for printers that they judge to be particularly good value across the spectrum of printers available, based on features and predicted reliability. MODEL AWARD equals one if the particular model won an award. FIRM AWARD equals one for all models manufactured by a firm if any of its models won an award in the prior two years.

TOTAL MODELS: The number of total models in the desktop laser printer market at the time.

OWN ALL MODELS: The number of total models the focal vendor currently has in the desktop printer market.

OWN LOCAL CLASS MODELS: The number of models the focal vendor currently has in the focal class.

SAME DPI and SAME PPM: The number of products that are at the same DPI (all classes covering the same DPI), and the number of products that are at the same PPM (all classes covering the same PPM).

SAME LOCAL CLASS: The number of products competing in the same local PPM-DPI class as the product under consideration.

INK JET PRICES: The average price of ink jet printers.

PC SALES: The number of personal computers sold in the United States in millions.

Two caveats must be made on the data with this study and previous studies. One important factor in a product's success in the marketplace is its price, and its omission from a model of product exit may be problematic. Unfortunately, for the subsample of models for which we have price information, we know only list prices. We experimented with specifications that included this measure of price; its coefficient was usually insignificant and its inclusion did not alter other parameter estimates. Price may also be endogenous (a firm might choose to lower the price of its product instead of discontinuing it), and we were unable to determine a satisfactory set of instruments.

A second potential issue in our estimation is the omission from our specification of demand growth, particularly in certain regions of the product space. As noted earlier, our quantity data are not refined enough to allow us to control for increases in sales at a disaggregated level. While the inclusion of a time trend or yearly dummies picks up growth in the entire market to some extent, the consequences of failing to incorporate changes in demand are discussed in Sections III through VI.

B. PATTERNS IN THE DATA

We begin by examining patterns in the data to describe the industry. We consider two dimensions of the product space: speed, measured as the number of pages per minute (PPM), and resolution, measured as the number of dots per inch (DPI). Printers are bunched tightly in groups in the performance space. For example, there are many printers that are 4PPM and 600 DPI. There are a few at 5PPM and 600 DPI, and then there are many at 6PPM and 600 DPI . Figure 3 presents our categorization of 20 discrete product classes in terms of these two characteristics, based on the clear grouping of printers. In doing this, we are able to measure the competitive effect of products that are proximate in DPI-PPM space. Moreover, it allows us to extend the unidimensional performance analysis of previous authors to two dimensions.

Dominant firms behave quite differently from fringe firms. First, they seem to be long term players in the industry, rather than "hit and run" players. Table 2 provides the descriptive statistics for the entire sample, for the dominant firms, and for the fringe firms. Fringe firms are in the industry for an average of 4.4 years, while dominant firms remain in the industry for nearly 9.9 years, on average. Thus product failures may, in some cases, correspond to firm failure. (This is discussed further later.) Second, dominant firm products have higher unconditional survival rates. Dominant firm products stay on the market for an average of 4.2 years, while fringe firm products stay on the market for an average of 3.7 years. Third, the dominant firms have much broader product portfolios. Dominant firms populate the product space with nearly three times as many products as fringe firms, and their product portfolios span a larger range of speed and resolution than those of their fringe counterparts. This is consistent with the work of Schmalensee and Judd on proliferating the product space to block entry. Fourth, fringe firms tend to make slightly higher end printers. On average, fringe firms introduce printers that have 25% higher resolution and are 5% faster than dominant firm products. While the page description language standards adopted by both sets of firms are similar, dominant firms and their products win awards more frequently than their fringe counterparts.

We now turn to the frontiers of product development and rollout. Figures 4a and 4b offer scatterplot graphs where each circle is a printer model for fringe firms and dominant firms, respectively. The x-axis is the year, and the y-axis is DPI. Note that over time in both graphs, new printers have higher resolution. This is what we will call a single-edged frontier, where firms are pushing the envelope on resolution. Examining Table 2, we find that small firms seem to be introducing more innovative printers on this dimension, as a statistically significant greater number of printers at higher resolutions is introduced by the smaller firms. Smaller firms introduce printers with resolutions of greater than 600 DPI with much greater frequency than their dominant counterparts.

Table 2 shows that fringe firms also introduce printers that are on average faster than those of the dominant firms. One interpretation is that smaller firms are more innovative in the PPM dimension (like DPI) than dominant firms. Figure 5a and 5b show the same types of graphs as earlier for printer speed (PPM). From 1986 to the early 1990s, both dominant firms and fringe firms were introducing printers that were faster as well as printers that were slower. Thus, we see a double-edged frontier. While most previous studies of product exit have focused on single-edged frontiers for a given characteristic, we can examine both edges. Why do we see this?

There are two possibilities. This could be technologically driven, if, for example, the cost of producing slower printers dropped faster than that of higher speed models. Alternatively, this double-edged frontier could be driven by consumers, some of whom value speed more than others. Offering a range of speeds enables firms to meet more consumers' demands and preferences.

This then leads us to inquire if product exit behavior is similar on both frontiers, or if one frontier has different properties than the other frontier. The descriptive statistics suggest that the fringe firms, which are introducing faster, higher resolution printers, make different product exit decisions than dominant firms. We examine each of these issues in the forthcoming statistical analysis.

A simple hedonic model is offered in Table 3. In this model we see that quality adjusted list prices have been dropping at about 18% per year, beginning in 1988, to the point today that quality adjusted prices are about 30% of their 1986 levels. The regression shows that dominant firms actually receive a list price discount relative to other firms. Moreover, IBM, DEC, and CANON, controlling for their grouping as dominant firms, obtain no additional discount or premium for their brands. Panasonic products are further discounted, while HP obtains a 21% price premium relative to its dominant firm counterparts. Kyle and de Figueiredo (2000) find that dominant firms on the whole had lower prices, but they also entered classes later. When this late entry is accounted for, it seems dominant latecomers charge higher prices than fringe firms that enter with a similar delay. Therefore one explanation for the finding that dominant firms' products are less expensive is that fringe products are the most advanced and first to market, while dominant firms follow and enter at lower prices than existing fringe products. The hedonic model also calculates the imputed value of each type of feature. While each PPM increases the value of the printer by 13%, each 100 DPI decreases the value by 4%. This is likely an artifact of the competitive dynamics in the industry, which we discuss later. Perhaps more interesting is that while Postscript increases the price of a printer by 12%, HP-PCL standards adoption tends to decrease the price of the printer by 21%. Again, we believe this is an artifact of the innovation and competitive dynamics.

C. HAZARD RATE SPECIFICATION

We use an exponential hazard rate specification to examine the determinants of product exit over the product life cycle. The flexibility of this method in accounting for censoring, as well as time variant and time invariant independent variables, makes it attractive to study product failure.

In this specification, the individual model is the unit of analysis. The likelihood function for any given observation, i, can be written as:

$$L_i = G_i(t_i)[\mu_i(t)]^{\phi}$$

where $G_i(t)$ is the survivor function, $\mu_i(t)$ is the hazard rate, ϕ is a variable that is one for uncensored cases and zero otherwise, and t_i is the number of periods that product *i* is in the market (Tuma and Hannan 1984). We begin by assuming a constant hazard rate of $\mu(t) = \gamma$ (the exponential distribution). The survivor function is then $G(t) = \exp[-\gamma t]$. The following specification is used:

$$\mu(t) = \exp[X(t)\alpha(t)]$$

where $\mu(t)$ is the instantaneous hazard rate for a system at time t and X(t) is a vector of time-varying independent variables. Each $\exp[X(t)\alpha]$ can be thought of as multipliers of the hazard rate, and α can be estimated using maximum likelihood techniques (Carroll 1983, Tuma and Hannan 1984). Because we have data from the beginning of the industry, left censoring is not a problem. We omit all observations for products that were introduced before 1986 (the first year of the econometrics). The estimation procedure accounts for right censoring.

Unfortunately, we do not have the sufficiently detailed price and quantity data to estimate consumer demand at this time. Indeed, our analysis here is not structural. At this early stage in our data collection and analysis we feel it appropriate to rely on reduced form for analysis. Patterns in the data have yet to be established statistically, and structural estimations that are sensitive to specification error and measurement error are likely to pose challenges for data and interpretation. However, we do believe that the development of structural models that are tailored to understanding the demand and cost structures might be a useful path to follow in the future (see, for example, Berry 1994, Pakes and McGuire 1994).

D. RESULTS

Specification. We present in Table 4 our preferred six models. The first variable in the box is the estimated coefficient from the hazard rate model. Below the coefficient estimate is its standard error. We have converted the coefficient to a hazard ratio (or multiplier of the hazard rate) in the third number in each box. A value of less than one indicates that an increase in the variable lowers the hazard rate; a value of more than one indicates that an increase in the variable increases the hazard rate. Significance is shown for two-tailed t-tests at the 95% significance level.

Models 2 and 3 use all the data, Models 4 and 5 use data for only dominant firms, and Models 6 and 7 use data for fringe firms. Models 2, 4, and 6 include variables related to age (MODEL AGE, YEAR), product characteristics (POSTSCRIPT, HP-PCL, MODEL AWARD, DPI, PPM, PPM-squared), and firm characteristics (FIRM AWARD, OWN ALL MODELS, OWN LOCAL CLASS MODELS,). In addition to these variables, Models 3, 5, and 7 include measures of direct and indirect competition (TOTAL MODELS, SAME PPM, SAME DPI, SAME LOCAL CLASS) and complements and substitutes (PC SALES, INKJET PRICES).

Coefficient Results and Interpretation of Full Sample. Let us consider Models 2 and 3 first, which include the entire sample. The signs of the coefficients are relatively stable in the specifications. Though some variables do vary in their statistical significance, the key variables of interest are fairly robust on this point. A log likelihood ratio test indicates that we cannot reject the hypothesis that Model 3 performs better than Model 2, suggesting that direct and indirect competition, and complements and substitutes do affect product exit rates along with product and firm characteristics.

As we expect in high technology industries, older products not only have higher hazard rates, but unconditional product life cycles in the industry are getting shorter by 16% (Model 2) each year. We are more interested, however, in the basic product characteristics. Consider the single-edged frontier of DPI. Products with better resolution tend to have increased probability of survival. An increase of 300 DPI increases the probability of survival by 36%.[2] Print speed (PPM), however, has two frontiers over time, an upper frontier that raises print speed for desktop printers, and a lower frontier that slows that speed and allows a mass market to access the desktop technology. The coefficients on PPM and PPM-squared allow us to pick up the non-linearity in print speed. The coefficient on PPM is positive, while the coefficient on PPM-squared is negative. Together, they suggest that printers on both frontiers have lower hazard rates than those in the middle. For example, a 4 page increase in printer speed (from the mean value of PPM) results in a 3% lower hazard rate, and 4 page decrease in printer speed (from the mean value of PPM) results in a 33% lower hazard rate.[3]

Some product standards, such as POSTSCRIPT (which was not widespread until after 1992), seem to have no statistical effect on the hazard rates of printers. However, HP-PCL has an enormous effect: it increases the survival rate by 34%. Interestingly, it is this standard that also lowers price in the hedonic model. We control for both FIRM AWARDS and MODEL AWARDS, but neither affected survival rates of printers.

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[2] In regressions with a DPI-squared variable, the coefficient is not statistically significant.
[3] We have also used dummy variables for each PPM Class, and the rank order of the coefficients support the specifications being suggested here.

Competition variables show small effects. First we consider the number of models (TOTAL MODELS) in the market as a whole, and show that each additional model currently sold in the desktop laser printer market decreases survival rates by about 1%. The number of printers in the same DPI class (SAME DPI) and same PPM class (SAME PPM) is positively correlated with survival rates as well. However, competition within the local class (SAME LOCAL CLASS) tends to decrease survival rates. Each additional printer in the same local class increases the probability of failure by 1.3%.

We suspect that the small estimates of the effect of competition are largely the result of the endogeneity of the number of competitors with growth in demand. If demand for products in a particular speed or resolution class grows faster than firms can introduce products, each product in that class has a better chance of survival despite a large number of competitors.

PCs are complements for printers, so perhaps it is not surprising that higher PC sales result in lower hazard rates for laser printers. Every additional million PC sales decreases the hazard rate by almost 4%, though this coefficient is not statistically different from zero. Increases in inkjet prices are related to higher exit rates for laser printers. While this is the opposite effect one might expect of a substitute product, it is likely that the price of inkjet printers reflects the advances in that technology that allows ink-jets to compete with low-end laser printers.

Finally, we include a variable for DOMINANT FIRM, which has the largest effect of any variable. Products from dominant firms have a much lower probability of dying—at nearly 61% the rate of non-dominant firms. To explore this last issue more, after a number of specification tests, we repeated the analysis on two subsamples of dominant and fringe firms.

Coefficient Results and Interpretation of Dominant and Fringe Firms. Models 4 and 5 repeat the specifications for dominant firms, and Models 6 and 7 do the same for fringe firms. Dominant firms account for 1261 of the 2062 spells in the data. The main results from the full sample seem to carry over to the dominant firm subsample. The DPI, PPM, and PPM-squared variables all have the same coefficient signs as the full sample, suggesting products on the frontiers have better survival properties than those behind the frontier. A printer that is HP compatible has a 25% better survival prospect than one without. Competitors in the same DPI and PPM class are associated with increases in a printer's survival rate, but local competition decreases survival rates. Each additional printer in the local class decreases survival rates by 1.6%. PC sales help printers survive, while increases in the price of ink jet printers are related toa higher probability of death.

Fringe firms have some, but not all, of the same results as the dominant firms. While the coefficients are signed as predicted for the DPI, PPM, and PPM-squared variables, only the coefficient on DPI is statistically significant at the 95% level of confidence. DPI's effect on the hazard rate of fringe firms is approximately equivalent to that of large firms. Fringe firm printers with HP-PCL have a nearly 43% higher survival rate than those without. This is the most important characteristic for the survival of printers made by fringe firms. The signs and magnitudes of the hazard ratios for the competition variables are the same for fringe firms as dominant firms, but not statistically significant. While PC SALES has no statistical effect on the survival rates of fringe firm printers, competition from ink jets can have a large negative effect on survival rates.

One source of the heterogeneity in survival rates between dominant firm products and fringe firm products may be heterogeneity in the firms themselves. As noted earlier, fringe firms tend to have much shorter lives than dominant firms. Figure 6 illustrates the profile for dominant/fringe firm and dominant/fringe firm product exit rates. We see that not only do dominant firms survive longer than fringe firms, but that their products survive longer as well. This intimate tie between firm survival rates and product survival rates may be driving some product exit rates of fringe firms.[4] Only a more complete theoretical model will allow us to understand the endogeneity that exists between these two processes.

IV. ENTRY

A. DATA: DEFINITION OF MODEL ENTRY AND INDEPENDENT VARIABLES

In this analysis, a model or product entry occurs when it first appears in our database. This is normally the first ship date reported by analysts. We count the number of product introductions for each firm for each class for each year, so each observation is a firm-class-year observation. Once a firm has entered the market, a firm becomes at risk for entry into any class, and it remains at risk for all time periods that it has a printer still on the market.[5] The dependent variable is the count of products entered by the firm in a given class-year.

Many of the independent variables to describe market structure are the same as in the previous section, such as the degree of competition in the focal class and the total number of printers in the same DPI class and PPM class. We also use many of the same firm variables, such as awards to the firm and dominant firm status. We include two additional variables:

[4] We have calculated hazard rate models on subsets of the sample where there are no firm exits at the same time as the product exit and compared these against the full sample hazard rate models. The effect of firm exit and product exit illustrated in Figure 6 is confirmed in these analyses.
[5] We have coded the data in this way because we believe that the decision to enter the market at all is fundamentally different than a decision to continue in the marketplace.

ENGINEERING WAGE: the average wage of a Level 4 engineer as defined by the Bureau of Labor Statistics. An entry decision may be affected by the product development cost. Engineers are required to design new products, but are less important when the printer is actually in manufacturing.

LAG OF ENTRY: the lag of the count of products of a firm's entry in the class.

B. METHOD

To estimate these equations, we begin with the assumption that the count variables are Poisson distributed. Unfortunately, specification tests (Cameron and Trivedi 1986) indicate there is overdispersion in the data. Overdispersion occurs when the Poisson model assumption that the conditional mean of the event counts equals the variance is violated. To allow for this, possibility, we assume a negative binomial distribution to estimate the model.[6] It sets the condition mean at $E(y_i \mid x_i) = u_i = \exp[x_i\beta]$, but allows the variance to take the form $V(y_i \mid x_i) = (1+\alpha)u_i$. Each of the parameters of $(\exp[x_i\beta])$ can be thought of as multipliers of the rate of product introduction.

C. RESULTS

Specification. Table 5 displays the entry regressions. Models 8, 9, and 10 present the entry model for the full sample, dominant firm subsample, and fringe firm subsample, respectively. The coefficient is the first number in each box, its standard error is beneath in parentheses, and the final number is the multiplier. If the multiplier is more than one, an increase in the variable by one unit is associated with an increase in the number of product introductions;

[6] We have estimated the models using a linear tobit formulation and results are roughly the same.

numbers less than one mean fewer product introductions. All coefficients are marked for statistical significance on two tailed asymptotic t-tests.

In specifications not reported here, we included variables for complements (PC sales) and substitutes (ink jet prices), but were unable to disentangle these effects from the wage effects. A log likelihood ratio test against a variety of restricted models gives the presented models the highest explanatory power at the 95% level of confidence.

Coefficient Results and Interpretations. Let us first consider Model 8. Competition in characteristics space, both on a single dimension and within the local product class, affects entry, but the effects are not very large. Competition along a single PPM or DPI dimension encourages more entry, but competition within a given class discourages entry. Each additional product competing in the local product class reduces the number of product introductions by 1.7%. Although for crowded classes this effect could be moderate, the impact of these competition variables on the number of product introductions is quite small when compared to the firm variables.

An award-winning firm is likely to increase its product introduction rate by a very large 93%. This finding is consistent with firms using their reputation capital to their advantage in the next set of product introductions. In addition, each product a firm introduced last year into the focal class increases the likelihood that it will introduce another product into that class this year by 37%. Finally, dominant firms again introduce more products than their smaller counterparts. Indeed, they tend to introduce products at a very high rate -- 360% greater than the fringe firms. Higher engineering wage rates do not deter firms from introducing new products.

In Model 9, we examine the entry patterns of dominant firms. We find the effects of the independent variables are in the same direction, though their magnitude is somewhat smaller, and some are not statistically different from zero. Each additional product competing in the characteristics space or the local product class has less than a 1% effect on the entry rates of dominant firms. Previous awards result in a 68% higher product introduction rate for dominant firms, while previous product introductions in the focal class result in a 45% higher rate in the focal class in the current year.

Fringe firm entry patterns are examined in Model 10. Again, in this specification, the coefficients are signed the same as in Model 8, though their magnitudes differ. Competition in characteristics and in the local class, on average, has approximately the same small effect on fringe firms as it does on the entire sample, causing between a 1% and 2% effect on the entry rates for each additional printer introduced. An additional product introduction in the focal class in the previous time period results in a 33% increase in focal class entry rates in the current period. There is, however, an overwhelming effect of awards for fringe firms on their entry rates. A fringe firm whose product has won an award in the previous two years has a 294% increase in their product entry rates. This effect is much larger for fringe firms than for dominant firms.

V. DISCUSSION AND JOINT INTERPRETATION

The results of the regressions together tell an interesting story of the desktop laser printer industry. Firms are introducing fewer products into each product class over time, i.e., their products span more of the product space, and cover it less densely. Moreover, the product portfolios of firms are growing larger on average, as fewer firms offer more products. The

YEAR coefficient from the exit regressions is positive (increases the probability of exit) in specifications that exclude competition and complements/substitutes variables, and negative otherwise. This result is likely the result of the endogeneity of market structure. Products that compete with many others in segments with high demand growth are likely to survive longer, although unconditionally, the product life cycle has shortened over our sample period. Products on the technological frontier, whether on the upper frontiers of PPM and DPI, or the lower frontier of PPM, have better survival prospects than printers behind the frontier. Our statistics suggest that the results hold on both frontiers.

Product characteristics, such as page description language, speed, and resolution, have the largest effect on product survival rates. However, many of the characteristics that increase longevity of the product life cycle in the hazard rate model also decrease price in the hedonic model. For example, HP-PCL standard adoption forces printer list prices down by 21%, but also increases model longevity by 34%. These kinds of relationships highlight the endogeneity of price and hazard rates, an issue that deserves future study. The data show a consistent pattern of the effects of competition. The number of models in unidimensional characteristics space is shown to be positively related to survival rates and entry rates. That is, the number of printers in the same DPI class and number of printers in the same PPM class are related to increases in both survival rates and entry rates. However, local competition in two-dimensional characteristics space causes survival rates and entry rates to decrease. This result is consistent with a class of empirical models of entry and competition in sociology (Hannan and Carroll 1993) and economics (Toivanen and Waterson 1999, 2000). The latter of these papers find that when McDonalds enters a market, Burger King has a very high probability of following. The reason, the authors argue, is that McDonalds' entry conveys information about the marketplace, including characteristics about demand and demand growth. This logic is consistent with the printer data. Previous entrants in the PPM and DPI categories convey information about market characteristics that might be attractive for entry or survival to other printer manufacturers. However, once in the market, competition is local. This explanation supports a negative hazard rate coefficient on the PPM and DPI category variables, but a positive coefficient on the local class variables, and the similar results for the negative binomial entry regressions. [7]

The way in which firms use exogenously created brand equity we found to be quite interesting. Awards granted to models and firms by leading PC publications have no effect on hazard rates of the current product portfolios of firms. However, awards lead to much higher entry rates by all types of firms, an increase of anywhere from 68% to 294%, depending upon the type of firm. Likewise, each additional product entry in a given class in the previous year results in a 33% to 45% increase in entry rates in that same class for that same firm in the current year.

Finally, the study indicates that while there are many similarities between dominant and fringe firms, a series of difference in innovative and product life cycle behavior persist. Dominant firms represent 9% of firms, 27% of firm-year observations, and 37% of the product introductions, while fringe firms represent 91% of firms, 73% of firm-year observations, and 63% of the product introductions, suggesting they are an important innovative force in this industry. Our data show that fringe firms tend to be first movers on the innovative frontiers in the industry, and that they have unconditionally faster and higher resolution products on average. Their products, however, have shorter lives than dominant firm products. This result is due in part to the fact that the firms themselves have less than half of the average life of a dominant firm.

[7] We do not control for demand growth in the different product classes. Entry is most likely where demand is strongest, i.e., the number of competitors in a product class is endogenous to new entry.

While the signs of the coefficients remain consistent across dominant and fringe firms, the magnitude of the coefficients differs. While competition does not seem to have a statistical impact on the product survival rates for fringe firms, it is quite important for dominant firms. However, HP-PCL standard adoption has nearly two times the impact on product survival for fringe firm products as it does for dominant firm products.

Dominant firms' entry decisions are not nearly as positively affected by the popular press awards as were fringe firms. Conversely, previous entry experience in a class increased entry rates for dominant firms more than fringe firms. Overall, the conditional entry rate for dominant firms is over 4 times that for fringe firms, while the conditional hazard rates for products are nearly 1.7 times greater for fringe firms than dominant firms.

VI. CONCLUSION

Since its inception in 1984, the desktop laser printer industry has seen technological advancement, product entry and exit, and firm entry and exit. This paper seeks to explore the determinants of the product life cycle, examining factors that affect both product model exit and market entry. Given the modicum of empirical work done on product exit, we have sought to incorporate a number of theories using a new data set to investigate the extent to which these factors are relevant.

The paper finds that although product life cycles in this industry are contracting in general, products on technological frontiers have longer life cycles. Exit patterns are affected less by competition than by the selected product characteristics and the position of the firm in the marketplace as a dominant or fringe player. Entry patterns, however, are affected not only by product characteristics and competition, but more so by 1) additional brand equity built up in the marketplace through previous product awards, and 2) previous experience in entering the product niche. Although fringe firms and their products have shorter life spans than their dominant counterparts, they tend to be first movers on the frontier of product characteristics development.

While our paper demonstrates the interesting and useful insights from analysis of independent aspects of the product life cycle, future work might explore the link between entry and exit in a simultaneous system. Structural models that are able to incorporate the technical, competitive, and innovation strategies of firms, and how they change over time and under uncertainty, may be quite helpful. However, until these models are further developed, we think it productive to examine the components of the product life cycle independently to explore the emergent and long-run patterns of product entry and exit in the product life cycle.

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Figure 1: Number of Firms and Products in Marketplace

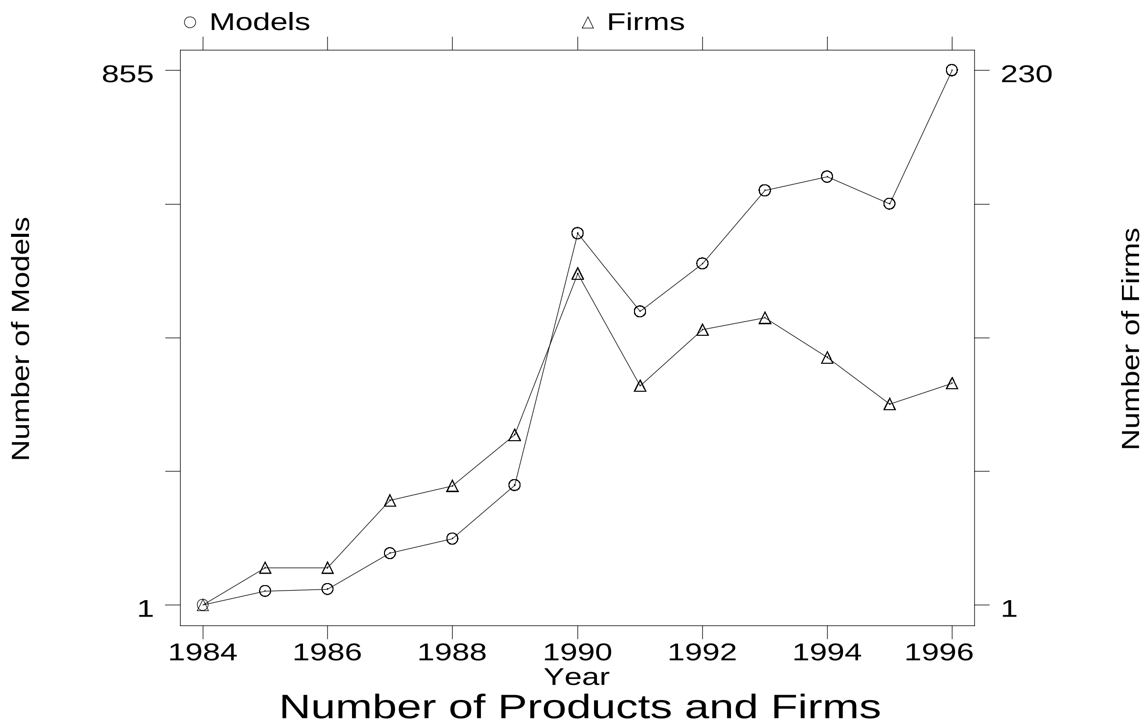
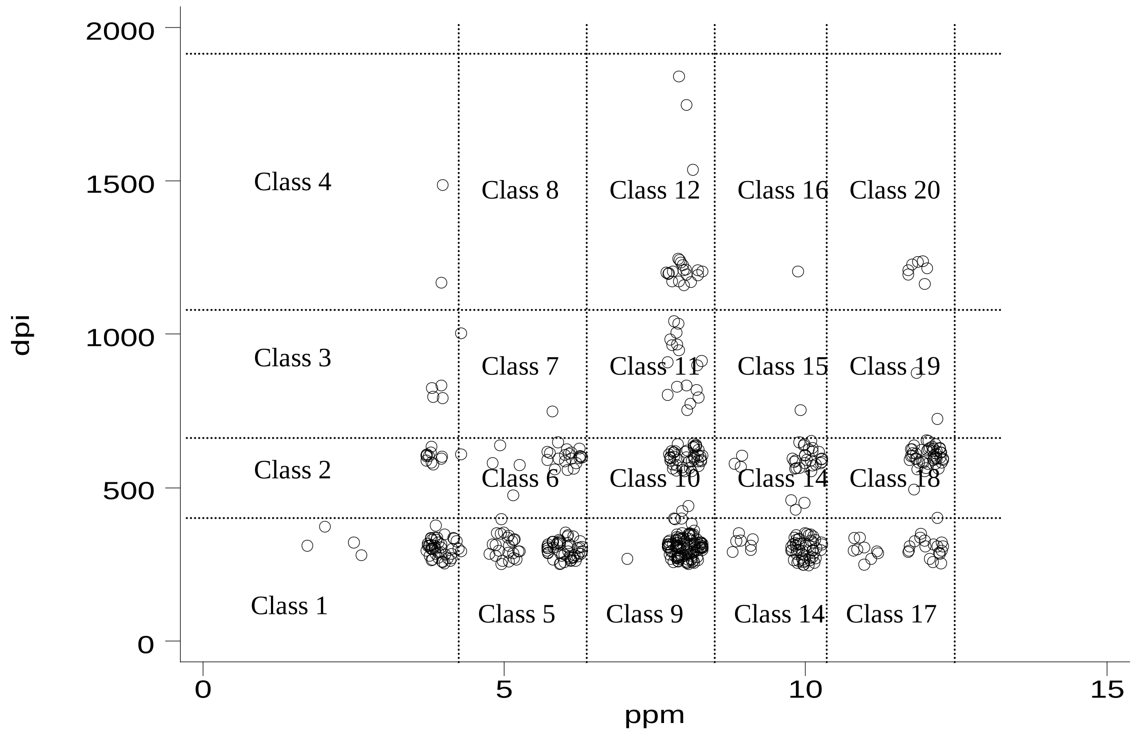


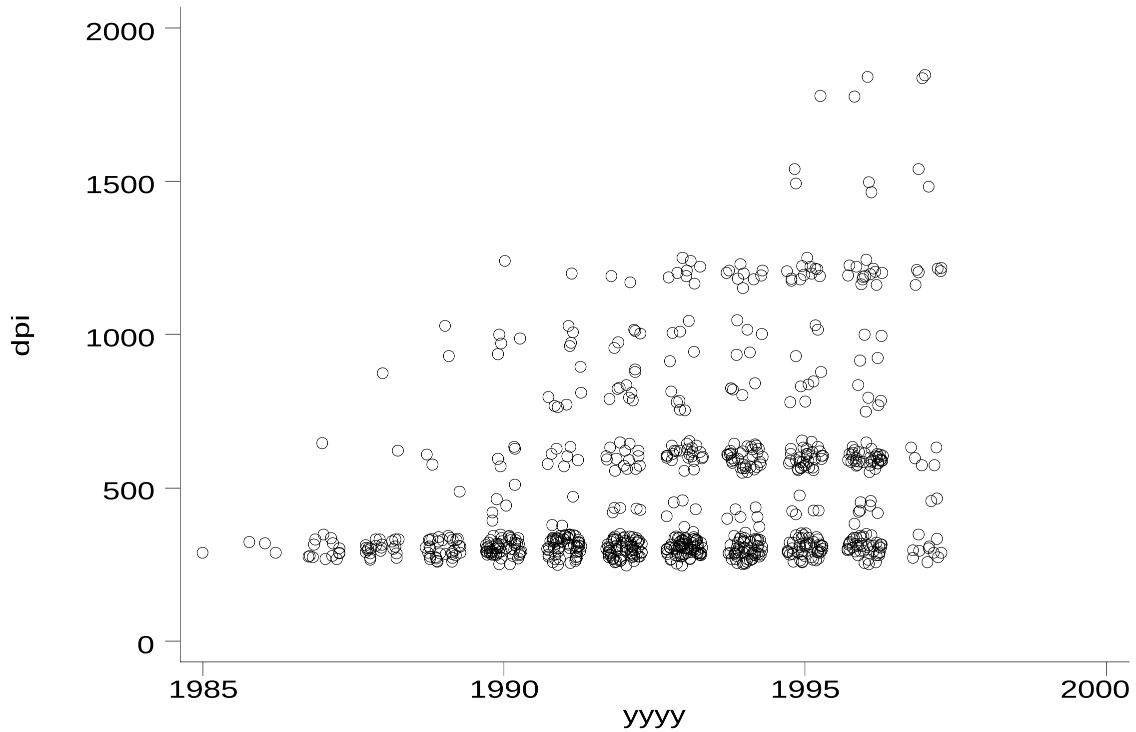
Figure 2: Product Entry and Exit

Figure 3: Product Distribution and Classes



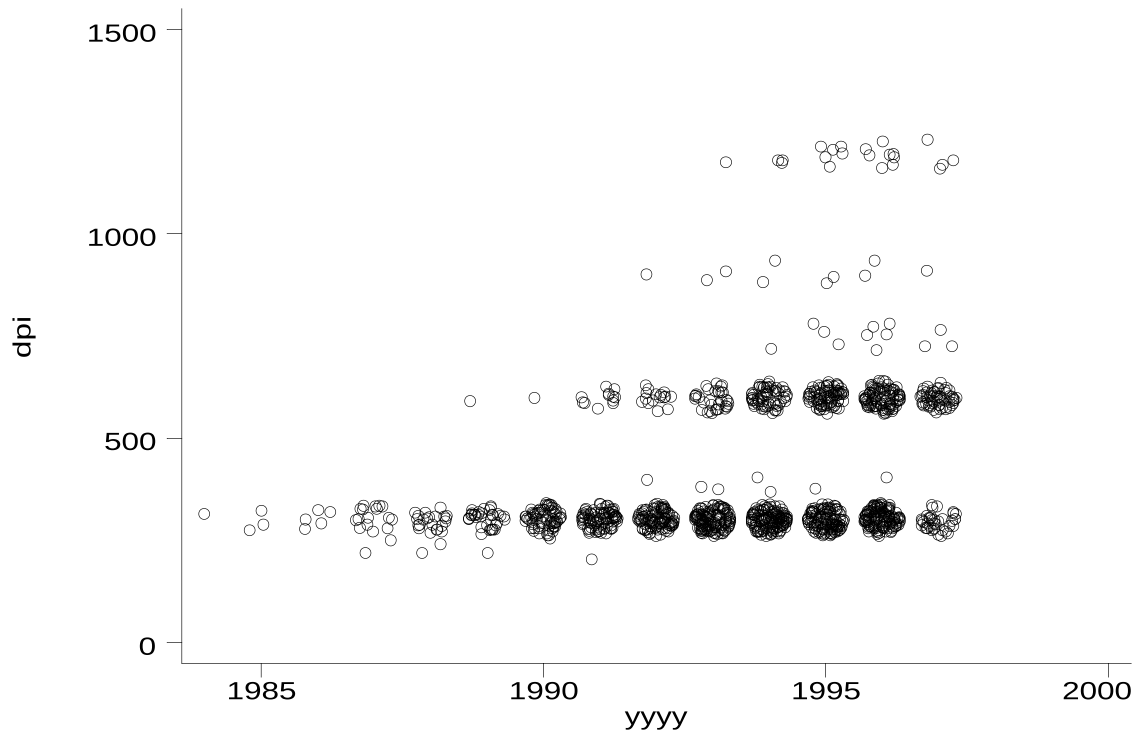
Note: Each small circle represents a printer.

Figure 4a: Fringe Firm DPI



Note: Each small circle represents a printer.

Figure 4b: Dominant Firm DPI



Note: Each small circle represents a printer.

Figure 5a: Fringe Firm PPM

Note: Each small circle represents a printer.

Figure 5b: Dominant Firm PPM

Note: Each small circle represents a printer.

Figure 6: Printer and Firm Survival Rates

Fringe Product and Firm Survival Rates

Dominant Product and Firm Survival Rates

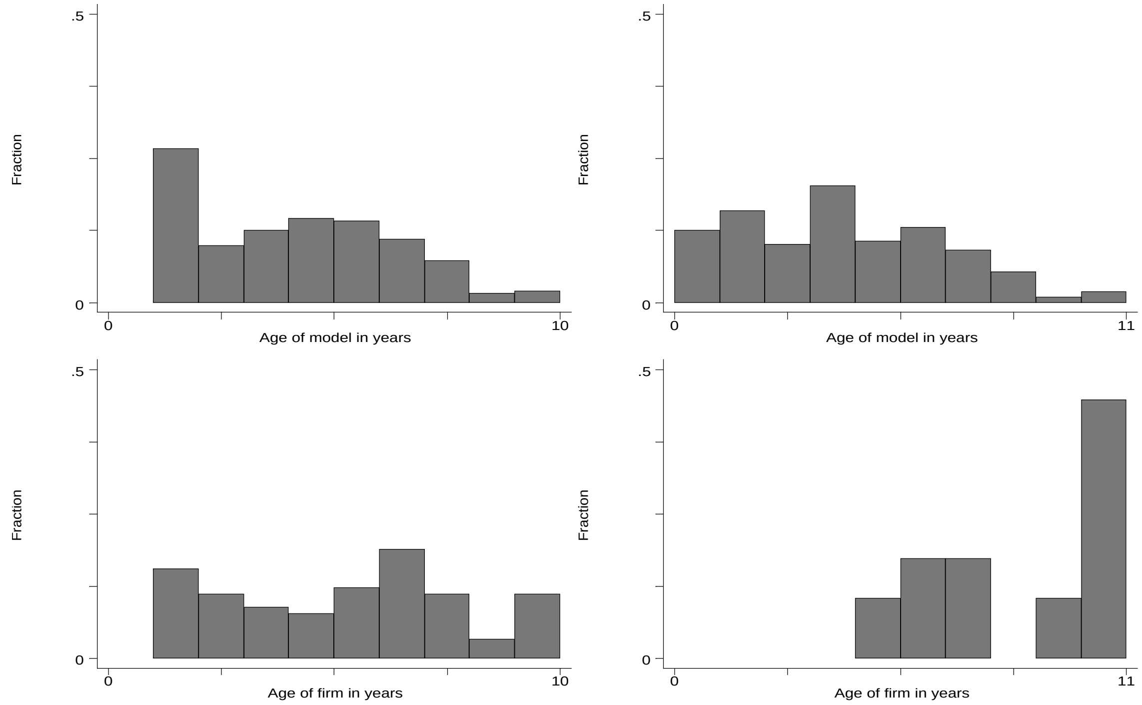


TABLE 1A: CONCENTRATION RATIOS AND TOTAL SHIPMENTS

Year	Hewlett Packard	C5 Ratio	C10 Ratio	Total Estimated Shipments
1987	58.12%	87.83%	100.00%	411,845
1988	61.66%	87.31%	99.28%	646,097
1989	49.68%	87.48%	98.47%	991,331
1990	54.89%	78.39%	87.44%	1,925,152
1991	48.80%	76.59%	90.13%	2,687,110
1992	50.58%	80.17%	92.89%	2,303,355
1993	57.08%	82.36%	92.92%	2,303,990
1994	55.88%	80.49%	94.42%	2,795,232
1995	60.53%	85.95%	99.62%	2,814,688

TABLE 1B: NUMBER OF YEARS IN TOP TEN IN SHIPMENTS

Firm	Years
HEWLETT-PACKARD_COMPANY	9
IBM/LEXMARK	9
DIGITAL_EQUIPMENT_CORP	8
PANASONIC/MATSUSHITA	8
APPLE_COMPUTER_CO	7
OKIDATA_CORP	7
TEXAS_INSTRUMENTS_INC	7
EPSON_AMERICA_INC	6
NEC_TECHNOLOGIES_INC	6
KYOCERA_UNISON	5
CANON	4
QMS_INC	4
XEROX_CORP	3
BROTHER_INTERNATIONAL_CORP	2
C-TECH_ELECTRONICS_INC	1
FUJITSU_AMERICA_INC	1
GCC_TECHNOLOGIES_INC	1
SUN_MICROSYSTEMS	1
TANDY_CORP	1

TABLE 2: DESCRIPTIVE STATISTICS

	FULL SAMPLE				FRINGE FIRMS				DOMINANT FIRMS			
Variable	Mean	Std. Dev	Min	Max	Mean	Std. Dev	Min	Max	Mean	Std. Dev	Min	Max
timetr	10.82	2.56	1.00	13.00	10.21	2.63	1.00	13.00	11.25	2.43	1.00	13.00
age	3.98	2.10	1.00	11.00	3.68	2.15	1.00	10.00	4.20	2.03	1.00	11.00
nmodels	654.47	196.01	23.00	855.00	666.88	187.25	23.00	855.00	645.73	201.80	23.00	855.00
pscript	0.50	0.50	0.00	1.00	0.49	0.50	0.00	1.00	0.51	0.50	0.00	1.00
hppcl	0.81	0.40	0.00	1.00	0.78	0.42	0.00	1.00	0.83	0.38	0.00	1.00
awardm	0.10	0.30	0.00	1.00	0.01	0.12	0.00	1.00	0.16	0.36	0.00	1.00
domfirm	0.59	0.49	0.00	1.00								
dpi	471.86	259.45	240.00	1800.00	523.54	321.38	300.00	1800.00	435.47	197.55	240.00	1200.00
ppm	7.98	2.48	2.00	12.00	8.24	2.16	2.00	12.00	7.81	2.67	2.00	12.00
ppm2	69.89	39.85	4.00	144.00	72.49	35.12	4.00	144.00	68.05	42.82	4.00	144.00
ownboth	2.69	1.90	1.00	9.00	1.95	1.53	1.00	8.00	3.21	1.97	1.00	9.00
ownall	18.24	16.89	1.00	73.00	7.68	6.20	1.00	27.00	25.67	18.04	1.00	73.00
awardf	0.22	0.42	0.00	1.00	0.02	0.15	0.00	1.00	0.36	0.48	0.00	1.00
sameppm	81.13	37.99	5.00	138.00	86.37	39.36	10.00	138.00	77.45	36.61	5.00	138.00
samedpi	171.96	96.52	1.00	320.00	172.30	104.71	1.00	320.00	171.72	90.47	4.00	320.00
sameboth	27.78	16.57	1.00	66.00	27.93	18.11	1.00	66.00	27.68	15.42	1.00	66.00
pcsales	15.15	3.00	6.80	22.60	15.32	3.47	6.80	22.60	15.02	2.62	6.80	22.60
ijprice	2.42	1.55	1.53	12.55	2.50	1.50	1.53	12.55	2.37	1.58	1.53	12.55
diablo	0.17	0.38	0.00	1.00	0.12	0.33	0.00	1.00	0.21	0.41	0.00	1.00
epson	0.21	0.41	0.00	1.00	0.22	0.41	0.00	1.00	0.21	0.41	0.00	1.00
stdmem	5.02	7.69	0.00	48.00	6.29	9.31	0.02	48.00	4.34	6.59	0.00	36.00

TABLE 3: HEDONIC MODEL
Dependent Variable: Log of List Price

VARIABLE	MODEL 1
PPM	**0.126**
	(0.010)
DPI	**0.000**
	(0.000)
STD MEMORY	**0.058**
	(0.004)
HP-PCL	**-0.206**
	(0.076)
POSTSCRIPT	**0.115**
	(0.057)
DIABLO	0.146
	(0.083)
EPSON	**-0.204**
	(0.073)
DOMINANT FIRM	**-0.181**
	(0.060)
HP	0.210
	(0.112)
IBM	-0.070
	(0.090)
DEC	0.012
	(0.153)
PANASONIC	**-0.407**
	(0.145)
CANON	-0.163
	(0.149)
1987	0.422
	(0.348)
1988	0.695
	(0.379)
1989	0.155
	(0.326)
1990	0.198
	(0.319)
1991	0.070
	(0.318)
1992	-0.146
	(0.319)
1993	-0.425
	(0.318)
1994	-0.427
	(0.319)
1995	-0.608
	(0.323)
1996	**-0.694**
	(0.329)
CONSTANT	**2.211**
	(0.336)
N Observations	354
F-Statistic	31.470
R-squared	0.686

TABLE 4: HAZARD RATE MODELS FOR PRODUCT EXIT

Variables	Full Sample		Dominant Firm Subsample		Fringe Firm Subsample	
	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
YEAR	**0.149**	**-0.368**	**0.153**	-0.283	**0.155**	**-0.367**
	(0.036)	(0.096)	(0.063)	(0.146)	(0.043)	(0.128)
	1.160	0.692	1.165	0.753	1.167	0.693
MODEL AGE	**0.152**	**0.137**	**0.203**	**0.164**	**0.099**	**0.098**
	(0.026)	(0.023)	(0.037)	(0.035)	(0.037)	(0.031)
	1.164	1.147	1.225	1.179	1.104	1.103
POSTSCRIPT	0.074	0.022	0.103	0.101	-0.008	-0.088
	(0.097)	(0.090)	(0.134)	(0.120)	(0.145)	(0.137)
	1.077	1.022	1.109	1.106	0.992	0.916
HP-PCL	**-0.541**	**-0.402**	**-0.489**	-0.275	**-0.668**	**-0.551**
	(0.117)	(0.107)	(0.161)	(0.152)	(0.172)	(0.152)
	0.582	0.669	0.613	0.760	0.513	0.577
MODEL AWARD	-0.082	-0.123	-0.177	-0.206	0.060	-0.029
	(0.165)	(0.145)	(0.178)	(0.153)	(0.862)	(0.700)
	0.921	0.884	0.838	0.814	1.062	0.972
DOMINANT FIRM	**-0.675**	**-0.490**				
	(0.121)	(0.103)				
	0.509	0.613				
DPI	**-0.001**	**-0.001**	-0.001	-0.001	**-0.001**	**-0.001**
	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)
	0.999	0.999	0.999	0.999	0.999	0.999
PPM	0.351	**0.332**	**0.399**	**0.496**	0.287	0.195
	(0.111)	(0.132)	(0.157)	(0.198)	(0.170)	(0.193)
	1.421	1.394	1.490	1.642	1.333	1.215
PPM-SQUARED	**-0.021**	**-0.019**	**-0.025**	**-0.030**	-0.017	-0.011
	(0.007)	(0.009)	(0.011)	(0.013)	(0.010)	(0.012)
	0.979	0.981	0.976	0.971	0.983	0.989
OWN LOCAL	-0.052	-0.018	0.015	0.030	**-0.142**	**-0.081**
CLASS MODELS	(0.027)	(0.024)	(0.038)	(0.034)	(0.038)	(0.035)
	0.950	0.982	1.015	1.031	0.868	0.922
OWN ALL	**0.013**	0.002	0.008	-0.006	**0.038**	0.015
MODELS	(0.005)	(0.004)	(0.006)	(0.004)	(0.011)	(0.010)
	1.013	1.002	1.008	0.994	1.039	1.015
FIRM AWARD	-0.096	-0.063	0.000	0.035	-0.473	-0.253
	(0.126)	(0.121)	(0.142)	(0.130)	(0.467)	(0.484)
	0.908	0.939	1.000	1.036	0.623	0.776
TOTAL MODELS		**0.012**		**0.014**		**0.011**
		(0.001)		(0.002)		(0.002)
		1.012		1.014		1.011
SAME PPM		-0.003		**-0.006**		-0.001
		(0.002)		(0.003)		(0.003)
		0.997		0.994		0.999
SAME DPI		**-0.005**		-0.004		-0.004
		(0.001)		(0.002)		(0.002)
		0.995		0.996		0.996
SAME LOCAL		**0.013**		0.015		0.009
CLASS MODELS		(0.006)		(0.009)		(0.009)
		1.013		1.016		1.009
PC SALES		-0.032		-0.097		0.012
		(0.031)		(0.052)		(0.039)
		0.968		0.908		1.012
INK JET PRICES		**0.442**		**0.597**		**0.319**
		(0.056)		(0.088)		(0.081)
		1.556		1.817		1.375
CONSTANT	**-4.039**	**-7.011**	**-5.318**	**-9.666**	**-3.520**	**-5.527**
	(0.523)	(0.805)	(0.858)	(1.416)	(0.770)	(1.090)
N Observations	2055	2055	1256	1256	799	799
N Subjects	517	517	298	298	219	219
N Failures	376	376	189	189	187	187
Time at risk	2063	2062	1262	1261	801	801
Log Likelihood	-487.03	-367.49	-248.87	-161.96	-231.37	-195.58

TABLE 5: NEGATIVE BINOMIAL REGRESSIONS FOR ENTRY

	Full Sample Model 8	Dominant Firm Subsample Model 9	Fringe Firm Subsample Model 10
YEAR	**-0.152**	-0.073	**-0.211**
	(0.038)	(0.055)	(0.054)
	0.859	0.929	0.810
FIRM AWARD	**0.660**	**0.517**	**1.370**
	(0.175)	(0.188)	(0.417)
	1.935	1.677	3.937
DOMINANT FIRM	**1.280**		
	(0.143)		
	3.596		
LAG OF ENTRY	**0.314**	**0.374**	**0.288**
	(0.024)	(0.040)	(0.035)
	1.369	1.453	1.334
ENGINEERING WAGES	**0.314**	**0.467**	0.184
	(0.139)	(0.202)	(0.195)
	1.369	1.596	1.202
SAME DPI	**0.004**	**0.005**	0.003
	(0.001)	(0.002)	(0.002)
	1.004	1.005	1.003
SAME PPM	**0.011**	0.004	**0.015**
	(0.002)	(0.004)	(0.003)
	1.011	1.004	1.015
SAME LOCAL CLASS MODELS	**-0.017**	-0.009	-0.018
	(0.008)	(0.012)	(0.012)
	0.983	0.991	0.982
CONSTANT	**-16.891**	**-22.114**	-11.423
	(5.255)	(7.673)	(7.364)
N observations	15757	3363	12394
Log Likelihood	-1508.159	-634.349	-849.719
Pseudo R-sq	0.155	0.175	0.106