DUKE UNIVERSITY, DEPARTMENT OF ECONOMICS

# Market entry, a vehicle for innovation?

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This paper investigates whether market entrants exhibit more product innovation than incumbent firms, and whether a firm's overall age in the industry relates to its propensity to innovate. Our study found that new entrants were no more likely to innovate than their incumbent competitors, a result that was consistent across industries and types of market entry. However, over an extended timeframe we found a positive, significant, linear relationship between a firm's age within an industry and its propensity to innovate.

Keywords: Innovation, Market Entry
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# I. Introduction

The field of macroeconomics has established that technological progress is the greatest driver of economic growth. As Robert Solow wrote in his Nobel Prize winning 1957 paper, "*Technical change and the aggregate production function,*" technical change accounts for approximately seven eighths of the increase of labor productivity (Solow, 1957). While this was a very crude estimation[1], the importance of Solow's result could not be overstated.

Innovation, the engine behind technological advancements, can be defined as "the application of new ideas to the products, processes, or other aspects of the activities of a firm" (Greenhalgh & Rogers, 2010). With his seminal 1942 work, Joseph Schumpeter sparked the widespread study of innovation within economics literature. While Schumpeter focused on innovation's relationship to firm size and market concentration, and the literature on these relationships is indeed rich, until recently economists had somewhat "neglected other, perhaps more fundamental determinants of technological progress" (Cohen, 2010). In this paper, we examine the relationship between market entry and product innovation in order to determine whether newer firms in an industry are more likely to innovate than their incumbent competitors.

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[1] Solow's residual includes questionable 'technology' categories such as education (Nelson, 1964) and mischaracterizes the role of technological change embodied in capital (Abramovitz, 1993), among other criticisms.

Business professionals, as well as the media and the general public, often consider young, nimble startups to be more likely to innovate than incumbent 'dinosaurs'. This view is not without theoretical basis. Kenneth Arrow (1962) describes a model for market entry, further developed by Gort and Klepper (1982), in which entrants are the agents of new ideas. According to this model, the only way to exploit the market value of new knowledge that is held by a firm or individual outside the industry, but not easily transferrable to an incumbent firm, is for this individual or firm to enter the industry. Case studies of the biotech, semiconductor, and computer aided design (CAD) software industries point to the viability of this model. We began the following empirical study with the hypothesis that new entrants are more likely to perform product innovation than incumbent firms. The data, however, indicate no difference in propensity to innovate between new entrants and incumbent firms.

## II. Literature Review

### Definition of Innovation

Innovation takes two forms: product innovation and process innovation. In this paper, we focus on product innovation – the creation of a new product or the improvement of an existing one – as distinguished from process innovation, which consists of a change in the methods of manufacturing and distribution of a product. Innovation also implies novelty; an idea must make a unique contribution to the relevant market in order to be considered an innovation. An improvement that is merely new to a particular firm is known as an imitation, and its study is categorized as the diffusion of innovation. Finally, innovations must already be commercialized or in use in the marketplace.  Ideas that are implemented but not yet deployed are known as inventions or discoveries (Greenhalgh & Rogers, 2010).

## Schumpeterian Views on Innovation – Size and Market Structure

Schumpeter's Theory of Creative Destruction initiated the study of innovation in economic literature.  In his book Capitalism, Socialism and Democracy (1942), Schumpeter shifts the predominant economic paradigm from a static equilibrium model, in which perfect competition is the ideal and oligopoly is a harmful state wrought with restricted output and high prices, to a dynamic model.  He argues that the constant threat of competition from disruptive entrants, whose radical ideas have the power to destroy not only the margins but the very foundations of firms' markets, "in the long run enforces behavior very similar to the perfectly competitive pattern."  This pressure forces monopolies to continue innovating in order to keep their monopoly intact and protect their hold on the market from the forces of creative destruction.

Given these assumptions, Schumpeter claims that large, monopolistic companies would be the best suited for innovation, and much of innovation literature stems from this hypothesis. Schumpeter's argument conflates two variables – size and market concentration – but later authors decouple these forces.  John Kenneth Galbraith (1952) focuses on size exclusively, isolating this variable to argue that large firms are better innovators, and many others have expanded on his works.  The theoretical support undergirding this view cites that larger firms have easier acquisition of funding, more stability/higher tolerance for risk over long periods, a fixed cost spreading effect[2], and the ability to leverage complementary assets such as legal and marketing departments (Cohen, 2010). In contrast, it has been suggested that as firms grow larger, they grow less efficient at R&D due to loss of managerial control, excessive bureaucracy, and blunted incentives for individual researchers[3] (Sah & Stiglitz, 1988) (Scherer & Ross, 1990). Empirical evidence suggests large firms are indeed more likely to perform R&D and to perform more of it than small firms (Cohen, 2010). These trends were exhibited most clearly in incremental as well as process innovation (Cohen & Klepper, 1996). Studies also found that business unit size was a much better predictor of R&D than overall firm size (Cohen, 1987).

Market structure, often measured by the number of competitors, is also a deep field of study. Schumpeter argues that oligopolistic (or monopolistic) structure reduces the rivalry and thus the uncertainty of innovation, and provides firms with the internally generated capital needed in order to fund this research and development[4]. On the other hand, others stipulate that the lack of competition would once again lead to bureaucratic inertia (Scherer, 1980), and as Porter (1990) asserts, “active pressure from rivals stimulates innovation as much from fear of falling behind as the incumbent getting ahead.” Empirically, a non-linear, ‘inverted-U’ relationship has repeatedly been found between innovation and the level of competition

[2] The cost of an improvement remains fixed whether a company sells ten units or ten thousand, so large firms can profit from innovations which would be cost-prohibitive to smaller firms.

[3] Payoffs for ideas are much sharper in startups, as one can appropriate a much higher portion of the value created.

[4] Perfect competition would not allow any firm to fund innovation, as research and development costs would cause the firm to be at a cost disadvantage, and therefore non-competitive.

(Cohen, 2010). This signifies that neither pure monopoly nor perfect competition is ideal for innovation, but rather some combination of the two.

## Industry Specific Determinants of Innovation

Three main classes of industry-specific factors dominate innovation literature: demand, technological opportunity, and appropriability. The particular industry of a given firm indicates innovation propensity to a high degree. Because of this, we will control for these industry effects in order to isolate the role of market entry.

Schmookler (1962) explores the effect of demand on innovation and therefore technological progress. When looking at time series, he finds that cycles in the production of goods (and therefore their anticipated demand) lead cycles in relevant patents[5]. Thus, he infers that innovation grows as demand for a product grows. He argues that while some reservoir of knowledge has always existed, this reservoir is only used when there is a large enough market to justify the development costs[6]. While Schmookler argues for the primacy of demand, in reality demand is merely half the story. Other studies show that while incremental innovations lag behind demand, this trend only starts following a major, exogenous breakthrough (Walsh, 1984). Indeed, "Marshallian Scissors cut with two blades": demand cannot be separated from technological opportunity when painting an image of innovation.

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[5] For example, a rise in semiconductor production would precede a comparable rise in semiconductor patents

[6] E.g. It would not make sense for a firm to optimize a computer chip to serve a function that is rarely used

The concept of technological opportunity – that it is easier to innovate in some industries than others – is surprisingly hard to measure in practice. The most common method for studying this effect is to group industries by their closest scientific or technological field. Levin and Reiss (1984) expand on this method, using instruments for industry maturity, the industry's closeness to science, as well as externally generated opportunities for privately funded R&D. Much further research has been done on the nature of technological opportunity, but it lies beyond the scope of our topic.

Appropriability considers the power of the firm to keep an innovation from being copied by competitors[7]. For centuries, it has been understood that without protections of some sort, market failure would occur as less innovation would occur than is optimal for society. Appropriability factors vary vastly across industries and countries: the efficacy of patents and other barriers (trade secrecy, first mover advantage, etc.) to entry vary vastly among different types of innovations and across different countries/regulatory regimes. While appropriability is generally seen a necessity (see Kenneth Arrow (1962)), the question is how much is conducive to the public good. As Wesley Cohen (2010) writes, "there is no clear empirical consensus about whether greater appropriability encourages economic activity", as there are many conflicting factors in play. This is also a very rich field of study, and has wide ramifications for the field of public policy.

[7] More formally, it is defined as the firm's ability to capture profits from the innovation

## Market Entry and Innovation

In the standard classical model of market entry, the choice of entry is assumed to rely on the presence or absence of economic rents, after controlling for entry costs. Much of the literature of entry focuses on the impact of new firms on reducing prices or profits by fueling competition. According to Auderetsch and Acs (1991) however, "a more evolutionary view of markets suggests a considerably different economic function for entrants – agents of change … by producing different products or employing different production techniques than the incumbent firm, entrants serve as the mechanism for change".

Gort and Klepper (1982) suggest a model for innovation (which expands on Arrow's (1962) ideas) where if an individual or firm has knowledge useful to a certain industry, but that knowledge cannot be easily transferred to incumbent firms, then the only way to exploit the market value of the knowledge is to enter the industry. This can be due to issues of appropriation (for example, if it's difficult to explain the idea without it being given away) or because of organizational factors[8]. Case study evidence in the Biotech, Semiconductor, and Computer-Aided Design industries all point to the fundamental truth of this model (Auderetsch & Acs, 1991). As Geroski and Jacquemin (1985) state "Entry is both a disciplinary and an innovatory force… as a force of innovation, entry operates by throwing up new ideas embodied in the particular challenges of individual entrant to which incumbent firms must respond".

[8] Chester Carlson, the founder of Xerox was turned down by 20 companies before starting his own. Ironically, Steve Jobs started apple because Xerox would not accept his idea of a personal computer. IBM also turned down Bill Gates and Microsoft, a decision much regretted later.

Thus, it would not be unreasonable to conjecture that new entrants would be more likely to perform product innovation.

## III. Dataset

In this next section, I will outline the datasets I used, their general characteristics, and any potential concerns.

### Source:

The primary data used comes from the **2010 Duke/Georgia Tech American Competitiveness survey (ACS)**. This survey was a study commissioned by Duke professors Wesley Cohen and Ashish Arora, as well as Georgia tech professor John Walsh. Funded by the National Science Foundation as well as the Kaufmann Foundation, the purpose of the survey was to "understand key sources of innovation and competitive advantage for American companies." Data collection was primarily completed by University of Chicago's National Opinion Research Center (NORC).

Additionally, this data is combined with the Dunn and Bradstreet (D&B) business database, which provides general information on public and private firms such as industry, size, revenues, company age, etc. Since the D&B company database was used as a list of companies to survey[9], there were no matching issues between databases.

[9] The NETS database from Walls & Associates was used to cover firms with less than 10 employees

## Characteristics:

The survey consisted of 33 questions, covering product innovation, licensing & contract R&D, and background questions about the firm. New product and innovation questions covered a three year scope. Out of the 25,890 firms that were surveyed, there were 6,644 firms that responded, for an overall response rate of 25.7%. Approximately 50% of these firms had introduced new products in the past three years, and roughly half of the new products were considered innovative. New entrants made up slightly more than 5% of respondents, two thirds being true startups and one third diversifying entrants. Public and private firms from the USA were included in this survey[10]. Industries surveyed included all manufacturing industries as well as select business services (such as telecom, software, contract engineering, etc.)[11].

A copy of the survey is attached as Appendix 1.

## Concerns:

Since this is a relatively new dataset, it is still fairly raw. The data has been mostly validated, but some re-codings are still in progress, and a few more completed questionnaires are being added. These issues should not affect our results however, since they use the already validated sections, and less than 1% of the surveys still need to be added to the dataset.

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[10] Subsidiary firms (greater than 50% control of stock by another firm) were also included, even if the parent firm was foreign. Branches – defined as secondary locations of companies with no locations reporting to it – were not included

[11] The firms were selected as a subset of NAICS 31-33, 51, 54

Another concern is over/underrepresentation of certain types of firms among the respondents (as compared to the surveyed population). As can be seen in more detail in Appendix 2, this issue does exist to some degree in the data:

(1) Certain industry categories were over/underrepresented in responses by as much as +23/-30%. However, there seems to be no particular pattern among these deviations.
(2) Small firms in general were over-sampled, at the expense of larger firms. This was to be expected however, as larger firms often have an explicit or implicit "no surveys" policies put in place in order to protect corporate secrecy. The team is attempting to correct for this deficiency by surveying more large (especially Fortune 500) firms.
(3) Age categories were reasonably represented. Most importantly, the sampling percentage of startups was near perfect.

# IV. Empirical Specification and Theoretical Framework

Having gone through the basic characteristics of the datasets, I will go in some depth about the variables we use, and the theoretical models we utilize to put them together.

## Dependent Variable: Product Innovation

Our study focuses on the drivers of innovation, specifically product innovation, and therefore innovation is our dependent/left hand variable. Since the ACS was designed to study just this purpose, ways to quantify innovation were built in. There are several variables that measure propensity to innovate in slightly different ways, and they are as follows. All of these variables were used in the regressions, to check for robustness of the findings.

**Q7**: Taken from the seventh survey question (hence the name 'Q7'), this term measures whether the firm introduced a particular product innovation before any other company in its industry. This is a direct subset of firms who answered affirmatively to Q3, which asks whether the firm had released a new or significantly improved product in the last 3 years.[12]

**Q7_new**: While the previous term captures only firms that have released new products, this term includes the firms that had not. Firms that did not release a new product are non innovators for the purposes of this category. <u>This variable is our base measure, as it has the largest sample size of the three innovation variables.</u>

**Q6Q7**: This variable is essentially the union of Q7 and Q6 (whether the company patented any part of their new product). This allows the inclusion of firms who were not first to market with an innovation but received patents for their products to be considered innovators.

In the results, there was little difference between these three variables.

<u>**Concerns About Dependent Variables**</u>: Because of data gathering cost constraints, Q6 and Q7[13] only refer to a firm's most profitable product. Thus, these questions would not differentiate if all the firms products were innovative, or just the most profitable one was. Therefore, we must make the explicit assumption that at least on average, the firm's most profitable product is

[12] Any firms who answered 'No' to Q3 were dropped for the purposes of this category
[13] As well as their derivatives, and many other variables included in the survey but not used in this study)

representative for its products as a whole. While this should not be so much of a problem for new entrants, as they are less likely to have more than one new product in an industry, it could potentially skew incumbents' innovation propensity upward if innovative products have a tendency to be more profitable than copy cat ones.

## Independent Variable: Market Entry/Incumbency

Since we are studying whether entry is a vehicle for innovation, market entry is naturally the acting variable. We will mainly be using Q27b, a binary value judging whether the firm has been in the industry for more or less than five years. However, we will look into whether the results are robust for both true startups (Q27_startup) and diversifying entrants (Q27_diversifying).[14] These variables are both derivatives of the firm age variable (db_YearEstablished_b). Finally, Q27, a continuous version of Q27b with a few hundred fewer observations, will be used to look into the general trend for age of incumbency (how long a firm has been in a market).

## Control Variables: Size, Industry

To control for size, we use number of employees in the industry (Q29) as our main measure. We use a quadratic specification, as it is shown to be a much stronger predictor than the linear term. Total firm size (all industries) was also tried, but it was shown to be an inferior measurement.

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[14] Startup firms are defined as firm age < 5 years. The rest are diversifying entrants, meaning existing firms entering new markets

Two sets of dummy variables are used to control for industry. The primary one is [max_industry], which refers to the three digit NAICS industry classification code of the company, as reported by the respondents. These NAICS codes had to go through a significant amount of processing, but they should be much accurate than the D&B database codings. Due to the low number of new entrants and startups in individual industries, a more coarse grain approach is also needed for looking at trends within industry groups. For this purpose, industries were generalized to 4 main categories: Durables, Non-Durables, Chemicals/Pharmaceuticals, and Electronics/IT.[15]

**<u>Note about Market Concentration</u>**: Since Q11 (How many competitors does the firm have, or can expect to have in relation to the aforementioned product) was only asked of innovators, it was not possible to control for market structure. However, given the quadratic 'inverted U' observed in our size variable (and the inherent correlation between size and market concentration), it is likely that the size variable is picking up some of the variation due to market concentration.

## Models:

Three different theoretical models will be used to see whether market entry is a vehicle for innovation.

[15] Naturally, using such coarse groups with such varying sub-industry characteristics does invite measurement error, and likely dampens and conflates some trends as a result

The first model will be a naïve one: a probit[16] of market entry and innovation, without any control variables. This will essentially let us see in general terms if there is a trend, even if it is caused by other factors.

**Equation 1:**

$$Innovation = \beta_1 * NewEntrant + \varepsilon$$

Once the general trend is known, the second model will go into more detail, extracting the true effect of market entry from confounding industry and size effects. Once again, we will be using a probit model. As mentioned earlier, industry size will be a quadratic term.

**Equation 2:**

$$Innovation = \beta_1 * NewEntrant + \beta_2 * Size + \beta_3 * Size^2 + \sum_n (\beta_n * Industry_n) + \varepsilon$$

Finally, a third model will be used to see if there are differences in this relationship at the industry level.

**Equation 3:**

$$For\ Each\ Industry:$$

$$Innovation = \beta_1 * NewEntrant + \beta_2 * Size + \beta_3 * Size^2 + \varepsilon$$

[16] The probit model is used due to the binary nature of the dependent variable

# V. Results

## Initial Results

After a first look at the data, an unexpected trend appears. New market entrants are no more likely to perform product innovation than incumbent firms. The magnitude estimates for market entry's effect on innovations were negative, minute and insignificant, as can be seen in Table 1 below. This finding is robust across all three innovation variables (only Q7_new will be shown in the tables). Similarly non-significant results are found when only true startups are used, or only diversifying entrants.

**<u>Table 1</u>: Naïve, Binary Model**

| Analysis of Maximum Likelihood Estimates | | | | | |
|---|---|---|---|---|---|
| Parameter | DF | Estimate | Standard Error | Chi-Square | Pr > ChiSq |
| Intercept | 1 | -0.5959 | 0.0181 | 1079.895 | <.0001 |
| New Entrant | 1 | -0.0032 | 0.0742 | 0.0019 | **0.9656** |

**Sample Size = 5788**

When the continuous 'age of industry incumbency' variable q27 is run, there is a small but positive and significant relationship between incumbency and innovation (once again, robust across all three dependent variables). This is particularly interesting, because it implies that more incumbent firms are more likely to perform product innovation than younger firms. (Note, q27 and q27b have opposite signs)

**<u>Table 2</u>: Naïve, Continuous Model**

| Analysis of Maximum Likelihood Estimates | | | | | |
|---|---|---|---|---|---|
| Parameter | DF | Estimate | Standard Error | Chi-Square | Pr > ChiSq |

| | | | | | |
|---|---|---|---|---|---|
| Intercept | 1 | -0.669 | 0.0266 | 630.203 | <.0001 |
| Age of Incb | 1 | 2.10E-03 | 5.70E-04 | 13.5291 | 0.0002 |

**Sample Size = 5685**

## Full Model

When industry and size effects are controlled for, the results remain the same. The new entrants are once again shown not to be more likely to innovate than incumbent firms. Similar results are shown regardless of which innovation variable is used, and once again, it did not matter if a firm is a true startup or merely a diversifying entrant.

As expected, the new (re-coded) industry codes give much more significant industry dummies, and using a non-linear size term greatly improves the standard error. Both also lend stronger significance to the other variables. The directions and relative magnitudes of the industry dummies are as expected, with Pharmaceutical, Semiconductor, and Software industries innovating most often. Finally, firm size in industry (q29) is shown to be a better predictor than total firm size (db_EmploymentAllSites_b), as expected.[17]

**Table 3: Full Model Specification for New Entrants (Industry Effects Not Shown)**

| Analysis of Maximum Likelihood Estimates | | | | | |
|---|---|---|---|---|---|
| Parameter | DF | Estimate | Standard Error | Chi-Square | Pr > ChiSq |
| Intercept | 1 | -0.6936 | 0.0739 | 88.046 | <.0001 |
| New Entry | 1 | 1.08E-02 | 7.97E-02 | 0.0182 | **0.8926** |
| Size | 1 | 2.70E-05 | 3.70E-06 | 52.061 | <.0001 |
| Size^2 | 1 | -8.11E-11 | 1.77E-11 | 20.987 | <.0001 |

**Sample Size = 5315**

[17] q29 was converted to a discrete variable to match db_EmploymentAllSites_b for this comparison

The positive and significant relationship between industry incumbency age and innovation persisted once size and industry are controlled for.[18] These results are robust across innovation variables, but once again have the most strength under q7_new. Industry incumbency age does not seem to be quadratic: not only is the square term insignificant but the F-Test joint significance of Age of Incumbency and Age of Incumbency squared is 0.0174, or much less than the significance of Age of incumbency alone (0.0001).

**<u>Table 4</u>: Full Model Specification by Industry Incumbency Age**

| Analysis of Maximum Likelihood Estimates | | | | | | |
|---|---|---|---|---|---|---|
| Parameter | | DF | Estimate | Standard Error | Chi-Square | Pr > ChiSq |
| Intercept | | 1 | -0.7485 | 0.0743 | 101.4151 | <.0001 |
| Age of Incb | | 1 | 2.52E-03 | 6.47E-04 | 15.1239 | 0.0001 |
| Size | | 1 | 2.50E-05 | 3.74E-06 | 45.4306 | <.0001 |
| Size^2 | | 1 | -8.06E-11 | 1.77E-11 | 20.7659 | <.0001 |
| Industry | 311 Food Manufacturing | 1 | -0.2208 | 0.1142 | 3.7348 | 0.0533 |
| Industry | 312 Beverage and Tobacco Product Manufacturing | 1 | -0.1452 | 0.2014 | 0.52 | 0.4709 |
| Industry | 313 Textile Mills | 1 | -0.0644 | 0.2479 | 0.0675 | 0.7951 |
| Industry | 314 Textile Product Mills | 1 | 0.00646 | 0.1788 | 0.0013 | 0.9712 |
| Industry | 315 Apparel Manufacturing | 1 | -0.3453 | 0.1843 | 3.5088 | 0.061 |
| Industry | 316 Leather and Allied Product Manufacturing | 1 | -3.6995 | 63.2421 | 0.0034 | 0.9534 |
| Industry | 321 Wood Product Manufacturing | 1 | -0.6408 | 0.2162 | 8.7812 | 0.003 |
| Industry | 322 Paper Manufacturing | 1 | -0.1226 | 0.152 | 0.6505 | 0.4199 |
| Industry | 323 Printing and Related Support Activities | 1 | -0.5615 | 0.146 | 14.7873 | 0.0001 |

[18] Company age (db_YearEstablished_B) was also tested in place of q27. Similar but less significant results were found.

| | | | | | | |
|---|---|---|---|---|---|---|
| Industry | 324 Petroleum and Coal Products Manufacturing | 1 | -0.3573 | 0.259 | 1.9035 | 0.1677 |
| Industry | 325 Chemical Manufacturing (except Pharmaceutical and Medicine) | 1 | 0.3115 | 0.1051 | 8.7877 | 0.003 |
| Industry | 3254 Pharmaceutical and Medicine Manufacturing | 1 | 0.3874 | 0.1446 | 7.1765 | 0.0074 |
| Industry | 326 Plastics and Rubber Products Manufacturing | 1 | 0.0524 | 0.1067 | 0.2413 | 0.6233 |
| Industry | 327 Nonmetallic Mineral Product Manufacturing | 1 | -0.3846 | 0.1139 | 11.3994 | 0.0007 |
| Industry | 331 Primary Metal Manufacturing | 1 | -0.3753 | 0.1135 | 10.9241 | 0.0009 |
| Industry | 332 Fabricated Metal Product Manufacturing | 1 | -0.2906 | 0.1064 | 7.4549 | 0.0063 |
| Industry | 333 Machinery Manufacturing | 1 | 0.1078 | 0.1006 | 1.1488 | 0.2838 |
| Industry | 334 Computer and Electronic Product Manufacturing (except Semicon) | 1 | 0.4438 | 0.1044 | 18.0644 | <.0001 |
| Industry | 3344 Semiconductor and Other Electronic Component Manufacturing | 1 | 0.5634 | 0.1163 | 23.4868 | <.0001 |
| Industry | 335 Electrical Equipment, Appliance, and Component Manufacturing | 1 | 0.2406 | 0.1031 | 5.4395 | 0.0197 |
| Industry | 336 Transportation Equipment Manufacturing | 1 | 0.204 | 0.1047 | 3.7941 | 0.0514 |
| Industry | 337 Furniture and Related Product Manufacturing | 1 | -0.2108 | 0.1159 | 3.309 | 0.0689 |
| Industry | 339 Miscellaneous Manufacturing | 1 | 0.1898 | 0.1006 | 3.5611 | 0.0591 |
| Industry | 511 Publishing Industries (except Internet) | 1 | 0.4499 | 0.1831 | 6.0401 | 0.014 |
| Industry | 512 Motion Picture and Sound Recording Industries | 1 | -0.0864 | 0.1974 | 0.1914 | 0.6617 |
| Industry | 517 Telecommunications | 1 | 0.0698 | 0.1602 | 0.1897 | 0.6631 |
| Industry | 518 Data Processing, Hosting and Related Services | 1 | -0.1015 | 0.1869 | 0.2947 | 0.5872 |
| Industry | 533 Lessors of Nonfinancial Intangible Assets (except Copyrighted Works) | 1 | 0.0316 | 0.487 | 0.0042 | 0.9483 |

**Sample Size = 5263**

## By Industry

When running the results by the three digit NAICS industry, there were not enough entrant firms to be significant, so the coarse grained industry divisions are used. Furthermore, the 5 top innovating industries[19], as well as the 5 bottom innovating industries[20] in our sample are grouped together and analyzed as a category.

Table 5 again shows that the relationship between new entry and innovation is not significant (though somewhat closer). However, there is one interesting anomaly to possibly explore further with more data. Namely, most innovative industries seem to differ from the least innovative ones in the direction of this result.

Table 6 shows the relationships between Age of Incumbency and Innovation. Though some Industries do not show significance at the 5% level, the magnitude of the relationship is similar across these industries, and is always positive. Once again, however, there seems to be a trend that could be explored further with more data: in more innovating industries, the positive relationship between age of incumbency and innovation is stronger.

Using the other measures of innovation gave very similar estimates, but the significance is much lower. Using startups instead and diversifying firms instead of new entrants also has little difference.

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[19] Semiconductors, Software, Computer and Electronic Product Manufacturing, Pharmaceuticals, and Chemicals were the most likely to innovate

[20] Leather and Allied Products, Wood Products, Printing and Related Support, Non-Metallic mineral products, and Primary metal manufacturing

**Table 5:** **New Entry and Innovation, by Industry**

| Analysis of Maximum Likelihood Estimates | | | | | |
|---|---|---|---|---|---|
| Parameter | DF | Estimate | Standard Error | Chi-Square | Pr > ChiSq |
| Industry: Chem/Pharma | | | **n = 392** | | |
| Intercept | 1 | -0.3837 | 0.0744 | 26.593 | <.0001 |
| New Entry | 1 | -0.1351 | 0.219 | 0.3804 | 0.5374 |
| Size | 1 | 0.000094 | 0.000035 | 7.1668 | 0.0074 |
| Size^2 | 1 | -1.1E-09 | 1.21E-09 | 0.8229 | 0.3643 |
| Industry: Durables | | | **n = 2326** | | |
| Intercept | 1 | -0.7597 | 0.0304 | 623.94 | <.0001 |
| New Entry | 1 | 0.1818 | 0.1228 | 2.1916 | 0.1388 |
| Size | 1 | 0.000031 | 5.76E-06 | 28.001 | <.0001 |
| Size^2 | 1 | -7.88E-11 | 2.61E-11 | 9.1244 | 0.0025 |
| Industry: Electronics/IT | | | **n = 1064** | | |
| Intercept | 1 | -0.3561 | 0.0423 | 70.903 | <.0001 |
| New Entry | 1 | -0.18360 | 1.75E-01 | 1.098 | 0.2947 |
| Size | 1 | 0.000042 | 0.000012 | 12.002 | 0.0005 |
| Size^2 | 1 | -3.79E-10 | 1.44E-10 | 6.986 | 0.0082 |
| Industry: Non-Durables | | | **n=1120** | | |
| Intercept | 1 | -0.8671 | 0.0457 | 360.22 | <.0001 |
| New Entry | 1 | -0.0999 | 0.1926 | 0.2689 | 0.604 |
| Size | 1 | 0.00008 | 0.000015 | 27.516 | <.0001 |
| Size^2 | 1 | -7.93E-10 | 1.85E-10 | 18.268 | <.0001 |
| Industry: 5 least innovative IND | | | **n=898** | | |
| Intercept | 1 | -1.0834 | 0.0543 | 397.55 | <.0001 |
| New Entry | 1 | 0.1871 | 0.2079 | 0.8097 | 0.3682 |
| Size | 1 | 0.000016 | 8.63E-06 | 3.2353 | 0.0721 |
| Size^2 | 1 | -1.79E-11 | 3.93E-11 | 0.207 | 0.6491 |
| Industry: 5 most innovative IND | | | **n=985** | | |
| Intercept | 1 | -0.2947 | 0.0441 | 44.579 | <.0001 |
| New Entry | 1 | -0.2459 | 0.1571 | 2.4496 | 0.1176 |
| Size | 1 | 0.000051 | 0.000014 | 12.682 | 0.0004 |
| Size^2 | 1 | -4.66E-10 | 1.58E-10 | 8.6626 | 0.0032 |

**Table 6:** **Age of Incumbency and Innovation, by Industry**

| Analysis of Maximum Likelihood Estimates | | | | | |
|---|---|---|---|---|---|
| Parameter | DF | Estimate | Standard Error | Chi-Square | Pr > ChiSq |
| Industry: Chem/Pharma | | | **n = 392** | | |
| Intercept | 1 | -0.4561 | 0.0939 | 23.608 | <.0001 |
| Age of Incumbency | 1 | 0.00201 | 0.00209 | 0.9184 | 0.3379 |
| Size | 1 | 0.000087 | 0.000036 | 5.775 | 0.0163 |
| Size^2 | 1 | -1.02E-09 | 1.24E-09 | 0.6704 | 0.4129 |
| Industry: Durables | | | **n = 2326** | | |
| Intercept | 1 | -0.8321 | 0.0453 | 336.76 | <.0001 |
| Age of Incumbency | 1 | 0.00215 | 0.000929 | 5.3529 | 0.0207 |
| Size | 1 | 0.000028 | 5.79E-06 | 24.214 | <.0001 |
| Size^2 | 1 | -7.61E-11 | 2.67E-11 | 8.1525 | 0.0043 |
| Industry: Electronics/IT | | | **n = 1064** | | |
| Intercept | 1 | -0.4109 | 0.0617 | 44.382 | <.0001 |
| Age of Incumbency | 1 | 0.00170 | 1.81E-03 | 0.8792 | 0.3484 |
| Size | 1 | 0.000042 | 0.000013 | 11.146 | 0.0008 |
| Size^2 | 1 | -3.77E-10 | 1.46E-10 | 6.647 | 0.0099 |
| Industry: Non-Durables | | | **n=1120** | | |
| Intercept | 1 | -0.9211 | 0.0643 | 205.06 | <.0001 |
| Age of Incumbency | 1 | 0.0014 | 0.00128 | 1.1931 | 0.2747 |
| Size | 1 | 0.000086 | 0.000017 | 26.851 | <.0001 |
| Size^2 | 1 | -8.61E-10 | 1.95E-10 | 19.401 | <.0001 |
| Industry: 5 least innovative IND | | | **n=898** | | |
| Intercept | 1 | -1.1452 | 0.0775 | 218.09 | <.0001 |
| Age of Incumbency | 1 | 0.00182 | 0.00144 | 1.605 | 0.2052 |
| Size | 1 | 0.000015 | 8.69E-06 | 2.9091 | 0.0881 |
| Size^2 | 1 | -1.86E-11 | 4.06E-11 | 0.2101 | 0.6467 |
| Industry: 5 most innovative IND | | | **n=985** | | |
| Intercept | 1 | -0.4078 | 0.0613 | 44.2 | <.0001 |
| Age of Incumbency | 1 | 0.00372 | 0.00169 | 4.8452 | 0.0277 |
| Size | 1 | 0.000043 | 0.000015 | 8.588 | 0.0034 |
| Size^2 | 1 | -3.91E-10 | 1.61E-10 | 5.8819 | 0.0153 |

# Conclusion

It is indeed surprising to find that new entrants are no more likely to innovate than incumbent firms, especially considering this finding is consistent across industries, and across types of market entry. This result, however, can still be reconciled with the previous theory. It could be the case that even though firms with innovative ideas enter the market, they may be drowned out by multiple imitators, especially in new markets and when the barriers to entry are low. For example, when social networking had just begun, an innovator first created this new market, but Facebook, MySpace, and dozens of other imitators joined for the chance to take control with better execution. One can easily find many more examples such as this one: as William Baumol (2002) wrote, "the financial success of one innovator makes entry into the activity more attractive for others." In layman's terms, once gold is struck, the gold rush begins.

The second finding is potentially even more interesting, as it shows that the longer a firm stays in an industry, the higher its propensity to innovate. While at first I suspected market concentration was at play, this seems unlikely. Incumbency and concentration show no correlation, and if they were linked, incumbency should have a quadratic trend (as opposed to the linear one shown).

A more likely culprit for this result would be the knowhow gained from learning by doing. Under this hypothesis, the longer a firm stays in an industry, the better it would become at conducting research in that field, regardless of the size of the firm. This could be caused through mechanisms such as the gain of institutional knowledge, specialized complimentary skills/best practice, capital (such as internal databases), or intangibles assets (such as prestige or a reputation for conducting research e.g. IBM).

Another, competing hypothesis is that there is an issue with endogeneity and survivorship bias: namely that firms who innovate are more likely to survive. To test this, one would have to find an instrumental variable that correlates with survival but not innovation and link it to the dataset. Two possibilities to explore could be whether the company has a parent company, and the average R&D intensity of the parent company's industry. While testing these hypotheses would be beyond the current scope, I will look into them for my further research.

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