Influence of the Number of Patents on Stock Performance

A quantitative analysis focussing on IBM

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Abstract

Companies on average acquired more and more patents throughout time. What explains this trend of increased patenting? According to the market hypothesis the amount of patents a company holds should be of positive influence on its stock performance through a competitive advantage. Moreover, previous research shows that patents are of significant positive influence on company's financial performances. This study tries to quantitatively analyse the influence of the number of patents on stock performance, as this hasn't been researched yet. Our paper extends the study of Bhaskarabhatla and Hedge (2014) by performing similar regression analyses using comparable control variables while changing the dependent variable to stock price. Results show that the number of patents a company holds has a significant positive influence on its stock performance. In addition to that investors started to value patents higher when companies started this trend of increased patenting and, after most firms adopted this trend, the valuation decreased but remained positive.

Introduction

Patents are instruments created to protect intellectual property and encourage innovation in companies. This is done by granting innovating companies a temporary competitive advantage over other companies by legally protecting their invention and their intellectual property by means of a patent (WIPO, 2008).

However, since the late 1980's the way of patenting changed. IBM, world's largest patentee, adapted to the practice of 'pro-patent management' at the beginning of 1989, in which patenting is encouraged and publication of inventions discouraged (Bhaskarabhatla & Hedge, 2014). This trend of increasing patenting continued throughout the years.

Figure 1

In contrast to IBM other firms that operate in the same industry sector(s) (electronics and semiconductors) already adapted to a form of 'pro-patent management' during 1983. This new way of patenting was because of changes made in the US legal system (Kortum & Lerner, 1999). These changes led to the strengthening of patent rights, which subsequently led to increased patenting (Hall, Jaffe & Trajtenberg, 2005). However, at this time not all companies immediately adapted to pro-patent management.

Figure 2

During these years 'patent wars' emerged. The goal of companies during these wars wasn't solely to secure their property rights on their intellectual properties by acquiring patents, but more and more companies started to use patents offensively to deter other companies from using certain technology. This strategy aims to strengthen the companies' competitive position. These wars mainly occur within the technology sector, which subsequently is the source of most existing patents (Shaver, 2012). Though it is argued by Business Insider, that time and resources spent on these patent wars could have better been allocated towards research and development itself instead of blocking the diffusion of knowledge throughout the industry (Smith, 2014). The question arises why large technology companies engage in these patent wars. Do companies benefit from requesting and receiving large amounts of defensive[1] and/or offensive patents[2]?

[1] *Defensive patenting: This is the practise of buying patents to ensure that other companies cannot enforce them against operating companies (Papst, 2013).*

[2] *Offensive patenting: This is the practise of buying patents to ensure that other companies cannot use inventions protected by these patents granting the owner the position to ask for licensing fees or royalties (Papst, 2013).*

If so, this should be reflected in the stock prices (market value) of these companies. This value reflects, according to the efficient-market hypothesis (EMH), the value of all future expectations in the market. According to EMH all available information is included in stock prices. Thus possible fruitful patents, and therefore valuable intellectual property, and thereby expected competitive advantages, are taken into account by a company's stock price (Clarke, 2001). This way of reasoning will be explicated in the theoretical framework. Following this reasoning, having large numbers of patents as a company within a specific industry implies that this company in general has a competitive advantage over companies from the same sector that hold fewer patents.

Previous research is in general related to the importance of patents for the financial performance of companies. A research study by Neuhäusler, Frietsch, Schubert and Blind (2011) analysed how a firm's technology base, and its protection by means of patenting, can influence its market value. They divided patents into different categories according to their expected value, and concluded that especially the number of forward citations (Number of patent citations) and the family size (Number of patent office's/countries at which a patent has been applied) of patents significantly positively influence the market value, measured by Tobin's q (Tobin's q is a measure of stock valuation calculated by dividing the total market value of a firm by total asset value of that firm), of the company that has acquired them. Another study by Bhaskarabhatla and Hedge (2014) examined the effects of IBM's adaption towards pro-patent management. A result of this paper is that it's likely that pro-patent management, which led to increased patenting and restricted publications/restricting knowledge spill overs, augmented IBM's private returns positively.

This paper will extend the previously mentioned research study by Bhaskarabhatla and Hedge (2014). This extension consists of analysing the effect between the number of patents a company holds and its stock performance. The extension entails adding stock performance as a variable, while controlling for variables based on previous research and specifically the study of Bhaskarabhatla and Hedge (2014). As in the study by Bhaskarabhatla and Hedge (2014) the focus will be on IBM. In contrast to research of Neuhäusler, Frietsch, Schubert and Blind (2011), which focussed on the effect of patents, issued from the EPO (European Patent Office), on Tobin's q and ROI (Return on Investment), this paper will focus solely on the stock performance of companies and patents issued by the USPTO (United States Patent and Trademark Office). The reason for this is that the dataset consists of patents issued by the USPTO. Moreover the focus will be solely on stock market performance because previous research already investigated the relationships between patents and Tobin's q/Return On Investment (ROI).

Our research question will thus be:

In what way and to what extent is the number of patents a (electronics/semiconductors) company holds of positive influence on its stock performance?

The structure of this paper is as follows: First the theoretical framework explicates why patenting should be beneficial for the firm's market value by means of the concept of patenting and the EMH. This will provide the theoretical foundation for the expectation that patenting should be of positive influence on stock market performance of a firm in line with research previously done. After that the data that has been used will be discussed and justified. In the methodology section the method of regressing, the chosen variables and control variables will be elaborated upon. Furthermore the results will be analysed and the formed hypothesis will be evaluated. At last the conclusion will provide the answer for the research question as well as recommendations for further research and shortcomings of this research itself.

Theoretic Framework

Use of patents

Patents are instruments by which the government or a supranational body such as the European Union legally grants protection over an invention. This is done in exchange for the agreement that inventors share details about the invention with the public and to ensure that companies keep investing in R&D (Grupp & Schmoch, 1999). Because patents grant a legal protection over inventions they are implied to grant a competitive advantage over other companies that operate within the same industry (Cornish, Llewelyn & Aplin, 2013). Of course the competitive advantage of firms depends on various factors but it is recognized that innovative capability itself is a self-sustained competition parameter (Schubert, 2010). Innovative capability is defined as the ability of a company to commercialize its own innovations. This is inherently related to patenting these innovations, as it is a necessity to legally protect innovations in order to profit from innovations, and thereby profit from R&D investments (Neuhäusler. et al, 2011). Therefore the number of patents a company holds should reflect the competitive advantage that company has within a certain industry. Subsequently this implies that the more patents a company acquires, the bigger this competitive advantage will be.

Competitive advantage of owning patents

Patents grant a competitive advantage by legally protecting the legal rights for an innovation. Patents visibly reflect, to a certain extent, the technology base of a firm as previous research has shown (OECD, 2004). This technology base of a firm can lead to a competitive advantage as is shown by the 'product cycle model', which assumes there is a dynamic change of production technology within an industry. This implies that there are various ways of exploiting new technologies between the firms within that industry. In addition to that this model assumes there is an imitation lag meaning that for late adopters of the new technologies it will take time and money to incorporate these technologies in their manufacturing processes (Dosi & Soete, 1983:1991). The 'product cycle model' implies that the early adopters of the new technologies have a competitive advantage over the late adopters. These early adopters are likely to be the inventors of the new technologies and will logically protect their inventions by patenting them. They do this because it will lead to a stronger legal protection of the competitive position gained as other firms cannot freely incorporate the new technologies in their manufacturing process (Bessen & Maskin, 2009).

Previous research done concludes that (certain) patents and R&D expenses have a significant impact on a company's financial performance. For example, past R&D expenses and the number of patents of large U.S. firms are significantly positively correlated with sales and profits of companies (Narin & Noma, 1987). R&D and patent activity of large Australian companies are significantly positively correlated with market value measured by Tobin's q (Bosworth & Rogers, 2011). The patent stock of German manufacturing firms has a significantly positive correlation with the firm's profitability (Czarnitzki & Kraft). As mentioned in the research of Neuhäusler, Frietsch, Schubert and Blind (2011) multiple researches have been done studying the relationship between R&D expenses or patent stock, which in some researches has been divided in categories weighting their importance on the value of patents, and financial/economic performance of firms in various industries and countries (Neuhäusler. et al, 2011). The general trend shows that a company's R&D expenses and patent stock are in general both significantly positively related to its financial/economic performance.

Efficient Market Hypothesis (EMH)

According to the EMH stock markets are efficient implying that stock prices incorporate and reflect all relevant information. This implies that all stocks on the stock market are never valued below or above the fair values of the stocks. This hypothesis has been criticized by various economic research studies but in contrast it has also been used in lots of research. The EMH was tested multiple times using different methods and in general the conclusion is that stock prices do not reflect all relevant information available (Basu, 1977). However, a study done by Burton (2003), in which research papers that criticized the EMH between 1970-2000, were analysed and reviewed, concluded that not all relevant information available is reflected and incorporated in stock prices but that markets are in general highly efficient in reflecting available information over longer periods of time. They argue that bubbles and irregularities in the market are exceptions rather than rule and usually do not provide opportunities to capture extraordinary results (Burton, 2003). Because over longer periods of time stock prices tend to reflect large proportions of relevant information available and the fact that this research incorporates data of a nineteen year period we assume the EMH holds to a measurable extend.

EMH and competitive advantage by means of patents

Following this argumentation the stock prices of companies should, according to the EMH and research done on the effect of patents on financial performance, reflect the competitive advantage patents grant. Thus the more patents a company receives the higher it's competitive advantage and this should be reflected in stock prices being significantly positively related to the number of patents a company holds.

Hypothesis: on average, ceteris paribus, the more patents a company holds the higher its stock price.

Data

For this research the same dataset is used as the one in the research of Bhaskarabhatla and Hedge (2014). This dataset includes data points from 115 different companies. These 115 companies consist of IBM, the company that will be analysed, and 114 companies functioning as control group. The companies included in this research are companies operating in the electronics/semiconductors industry classified by sic codes (see figure 3). The data of this research covers the period 1979 to 1998. This time span was chosen because of the balanced panel dataset, obtained from the study by Bhaskarabhatla and Hedge (2014), is limited to this period. In addition to that a time span of nineteen years allows us to use yearly averages of stock prices so that possible temporary distortions of the EMH are smoothed out and corrected for as stated in the theoretical framework. The source of the data is Compustat, which is regarded, by universities and financial institutions, as a reliable source of financial, statistical and market information (UTK, 2014). The variables included in the dataset consist of: company name, number (sum) of patents, sic code (in order to divide the companies in similar industries), average stock price during fiscal year, number of employees, sales, age, R&D and property, plant and equipment costs (PPE).

Researchers Bhaskarabhatla and Hedge previously investigated a similar field of interest by using this dataset. Furthermore by using this dataset we can successfully extend the research by Bhaskarabhatla and Hedge (2014) without problematic differences regarding the used data. The main difference between this study and the one from Bhaskarabhatla and Hedge is that our main variable of interest is pcfyr, the average closing stock price of a company in the specific fiscal year.

The problem of missing data is solved by generating using the same method as explicated in the paper of Bhaskarabhatla and Hedge (2014), resembled by the variable gaps, which will be explained in the methodology section. In the end the regressions are based on in total 2009 observations.

Methodology

Patents differ in their economic and technological value as has been shown by Neuhäusler, Frietsch, Schubert and Blind (2011). However, this study was based upon data from 479 firms from various industries, while the values of patents can highly differ between industry sectors (Acs & Audretsch, 1988).

In this paper 115 companies are included which have been classified by the mentioned sic codes classification. This implies that the companies included in this research operate in similar sectors namely the electronics and semiconductors sector. These sectors are selected because the focus is on IBM, a company that operates within multiple sub-industries in the electronics and semiconductors sectors. In addition to that data was not publicly available upon the specific characteristics of the patents in stock of the companies included in this research. Because of this we do not take characteristics that determine the economic value as well as the technological value of the patents into account.

The method used in this paper for answering our hypothesis is building a regression using Stata to regress the number of patents a company holds in a specific year (independent variable) on the stock price of the company in the same year (dependent variable). A do file is created in which first the dataset is formed and the missing gaps are generated, followed by the regression analyses. In order to ensure the best possible estimate of the coefficient of the number of patents a company holds it is essential to include control variables besides our main variable of interest. Control variables are incorporated to ensure there is no omitted variable bias through which the coefficients are upwards or downwards biased. Below the used control variables are listed:

- Log_(Employees). The log of the number of employees per company. This variable controls for differences in size of companies (see Lsale_3avg_intS for justification). The logarithm here and those below are there to eliminate outliers found in the number of employees/other variables.
- Lrnd_3avg_intS. The logarithm of the three-year average research and development costs of the company. R&D costs are directly related to the amount of patents a company holds and the value of these patents. Moreover it influences the way companies perform during negative economic shocks and can lead to higher profit margins (Chan, Lakonishok, Sougiannis, 2002). This in turn affects the stock price valuation of companies and therefore it has to be controlled for. The mentioned effects can be a result of contemporaneous as well as past-year R&D costs. Hence we control for years T, T-1 and T-2.

- IbmXlrnd_3avg_intS. The interaction effect between IBM and the logarithm of the three-year average research and development costs. (For justification see Lrnd_3avg_intS)
- Lppe_3avg_intS. The logarithm of the three-year average of property, plant and equipment costs (PPE). This variable functions as a measure of capital intensity as this can be of negative influence on the stock valuation of a company as shown by research of Morgan Stanley. Capital intense companies primarily make use of tangible assets, which are easy replicated in contrast to non-tangible assets, which are primarily used by asset light companies. If assets are more easily copied they are, according to the research done, not able to sustain a competitive advantage (Elmasr, 2007). The mentioned effects can be a result of contemporaneous as well as past-year PPE costs. Hence we control for years T, T-1 and T-2.
- IbmXlppe_3avg_intS. The interaction effect between IBM and the logarithm of the three-year average of property, plant and equipment. (For justification see Lppe_3avg_intS)
- Lsale_3avg_intS. This variable entails the logarithm of the three-year average of sales. Sales are an indicator for the size of a company (Berk, 1997). The size of a firm influences it's stock performance as can be seen in the small firm effect, which is a theory that holds and predicts that smaller firms outperform larger firms amongst other things in stock performance (Okada, 2006). Because sales can differ each year we control for the years T, T-1 and T-2.
- Lage. This variable is the logarithm of the age. The age of a company significantly correlates with stock performance positively or negatively depending on the industry sector. Specifically for technological companies there is a significant negative correlation between company age and stock performance and hence need to be controlled for (Clark, 2002).
- Drnd. This is a dummy variable concerning research and development. It is set to zero if the selected companies were not participating in research and development during the years T, T-1 and T-2.

An additional reason for choosing these control variables is that similar control variables have been used in previous research similar to this paper. As mentioned in the study by Bhaskarabhatla & Hedge (2014): 'Several others before us, including Hall and Ziedonis (2001), Bessen and Hunt (2007), Somaya et al. (2007), and Hegde et al. (2009) have estimated the patent production function with the above set of variables but in different empirical contexts'. They control for most of the effects that have to be filtered out and therefore results into a more precise estimate of the effect patents have on stock performance.

The nineteen-year timespan of the data will be divided into the following four periods 1979-1983, 1984-1988, 1989-1993 and 1994-1998. An individual regression analysis will be performed for all periods mentioned. This in order to analyse the changes in the effect the amount patents a company holds has on their stock price during these periods. Hence this allows us to interpret how the stock market and subsequently investors value patents throughout the years. More specifically, during the period 1979-1983 most of the companies in the sectors of interest had yet to adopt the practise of 'pro patent management' while IBM already patented more than the average control firm. After that, during the period 1984-1988, these companies started to increase their patenting progressively leading to increasing amounts of patents hold while IBM had yet to adopt the practise of 'pro patent management'. During 1989-1993 IBM adopted the practise of pro patent management making it possible to compare the effects this focus on patenting had on IBM's stock value. The period 1994-1998 is the most recent period for which we have sufficient data implying that the results of the analysis from this period is most representative for firms currently operating.

Results

The results include four regressions, one for each specific time period, for which the output can be found in table 1. These regressions try to estimate the coefficient in which the number of patents influences the stock performance. First the results of the regressions will be discussed and afterwards the previously formed hypothesis will be discussed. At last the implications of this observation will be argued.

Table 1: Influence Patents for IBM and Control-Group Firms

Parameter	1979-1983	1984-1988	1989-1993	1994-1998
Patents	0.015 [0.032]	0.038* [0.014]	0.037* [0.012]	0.023* [0.008]
IBM	10890.98* [82.47]	580.16* [9.32]	214.54* [7.07]	1019.57* [5.21]
log(Employees)	7.84 [4.54]	5.12 [3.18]	-0.50 [2.10]	0.74 [1.95]
IBM x Patents	0.437 [0.032]	0.116 [0.014]	-0.094 [0.012]	-0.065 [0.008]
log(3 year average research and development costs)	120.70 [37.43]	21.03 [22.95]	-9.24 [18.67]	-20.21 [19.72]
IBM x log (3 year average research and development costs)	-145258.70 [1082.11]	-3469.84 [47.01]	-4486.41 [59.98]	-13091.01 [23.95]
log (3 year average plant, property and equipment)	-15.06 [12.24]	-9.62 [7.83]	8.51 [8.48]	-3.69 [8.45]
IBM x log (3 year average plant, property and equipment)	-6693.92 [48.90]	-1035.94 [9.46]	667.12 [13.50]	-224.08 [8.98]
log (3 year average sales)	-1.48 [4.34]	0.71 [2.69]	4.71 [2.02]	4.89 [1.80]
log (Age)	6.44 [3.03]	3.88 [1.87]	1.39 [1.56]	1.95 [1.76]
Research and development not zero	-4.65 [3.94]	1.45 [3.90]	0.73 [2.55]	-0.12 [3.56]
No. of years missing	-0.025 [0.552]	0.588 [0.454]	-0.466 [0.334]	0.134 [0.537]
Constant	12.58	-2.43	-17.01	-11.97
Observations	400	547	550	512
R^ 2	0.504	0.602	0.630	0.651

Notes: The dependent variable is the common stock price, fiscal year close. Robust standard errors, clustered at the firm level, standard error adjusted for clusters. $* p < 0.05$ $** p < 0.01$

The results show several important implications. First of all the effect of patents on the stock performance is positive throughout all time periods. However, in the first time period 1979-1983 this coefficient is not significant (p-value of 0.65). For the following time periods the coefficient is highly significant (p-value of 0.009, 0.002 and 0.006). The coefficient can be interpreted the following way: if a company during the time period 1994-1998 holds an additional 1000 patents, ceteris paribus, its stock price will on average rise with 23 dollars.

As can be seen IBM has, compared to the control companies, during all four periods a substantial higher stock value. However, during the period 1984-1988, when IBM lacked in adapting to the pro patent management, this higher stock value declined sharply but remained positive and this decline continued during the period 1989-1993. In contrast to that, after IBM adopted the pro-patent management for a couple of years it’s stock value, in comparison with the stock values of the control companies, rose sharply during the period 1994-1998.

IBM's patents show a significant positive influence on their stock price during the period 1979-1983, more specifically thirty times greater than for the average control company. During this period IBM patented more than the average company in the electronics and semiconductor sectors. However, the effect of IBM's patents on its stock price became less strong, but still significant and three times higher than for the average control company, during 1984-1988 when IBM lacked in adopting pro-patent management in comparison with the average control company. Moreover, after IBM adopted pro-patent management in 1989 the effect became significant and negative, implying that more patents led to a decrease in stock price. This significant negative effect, although less strong, remained during 1994-1998.

The significant control variable(s), $p<0.05$, throughout all four periods are IbmXlrnd_3avg_intS and IbmXlppe_3avg_intS, during 1979-1983 Lrnd_3avg_intS and Lage, during 1984-1988 Lage, and during 1989-1993 & 1994-1998 Lsale_3avg_intS.

Therefore, coming back to the hypothesis, an effect of the number of patents on the stock performance is observed. This effect is positive, implying that more patents lead to on average a higher stock price. The difference in the coefficient between time periods shows that markets value patents differently in time and that after 1983 patents were valued higher. The patent coefficient became highly significant after 1979-1983, even on a 1% significance level. This leads to the conclusion that the hypothesis cannot be rejected and that on average companies with more patents have a higher stock price. Looking at the IBM interaction effects, this is significantly different for IBM.

Conclusion & Discussion

During all four periods, except 1979-1983, the number of patents has a significant positive influence on the control company's stock performances. During 1984-1988 company's started to focus more on acquiring patents and this was valued by investors as can be seen in the increased positive effect patents have on stock prices. However, it could also be that investors started to value patents higher and companies decided to therefore start focussing on acquiring patents. When IBM joined this focus on patenting by adapting to pro-patent management during 1989-1993, patents became of negative influence on its stock price while for the control firms the positive effect remained similar to 1984-1988. After that, during 1994-1998, the influence of IBM's patents on its stock value remained negative but less negative, in comparison with the prior period, while for the control firms the positive influence was less strong compared to the prior period.

Investors possibly hyped patenting during 1984-1993 when companies started to focus on patenting and patents became, according to the stock market, more valuable and became less valuable after most companies in the electronics and semiconductor sector had adapted to the practice of pro-patent management. As all companies started patenting more and more the competitive advantage of having large numbers of patents decreases. This can be seen because IBM's advantage of patenting on its stock price decreased, in comparison to the period in which they were patenting more than the average control company, when other companies started to increase their patenting. The negative relationship, during 1989-1998, between the number of patents and stock price for IBM could indicate that IBM reacted too late to this change in the industry or acquired too much patents, not being favourable for the firm any longer.

However, there are important limitations to this research. First of all in this study there is no differentiation in the value between patents. Because of the huge numbers of patents and the difficulty of measuring the future value of patents this is not included. A second limitation is the dataset, which could be regarded as rather old, certainly for the fact that the legal environment of this subject is heavily influenced by time differences. This makes it difficult to use the coefficients as forecast variable today. Another limitation is the lack of testing if the output is correct, through for example HAC standard errors to exclude the effect of autocorrelation in stock prices.

Suggestions for further research are to incorporate forward/backward citations of papers. This makes it possible to account for differences in the economic value of patents. The number of times a patent has been cited is namely an indicator of its value. A second suggestion is updating the dataset in order to reveal the effect of patents on stock prices today. The trend of increased patenting continued after 1998 and therefore it may be interesting to update the dataset and test if the effect of patents on stock performance changed over time, similar to the four time period analyses in this research paper.

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Appendix

Figure 1

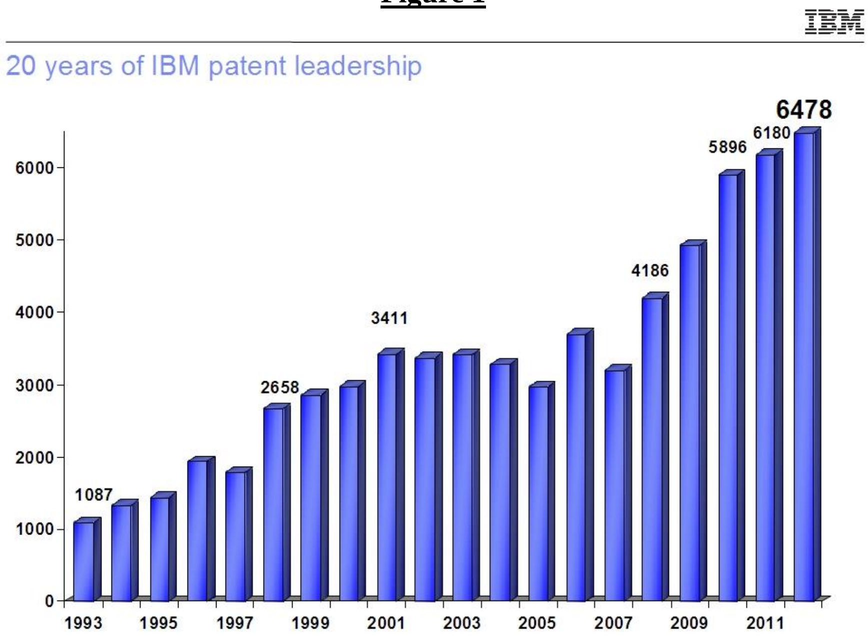

Figure 1 notes: This graph shows the amount of U.S. patents received each year from 1993-2012, which in total adds up to nearly 67.000 U.S. patents received during this period. The graph shows that throughout time IBM received more and more patents each year. Subsequently this is a general trend for the technology sector as a whole.

Source: Andrews, C. (2013). *IBM Tops U.S. Patent List for 20th consecutive Year*. IBM Press Release: New York.

Figure 2

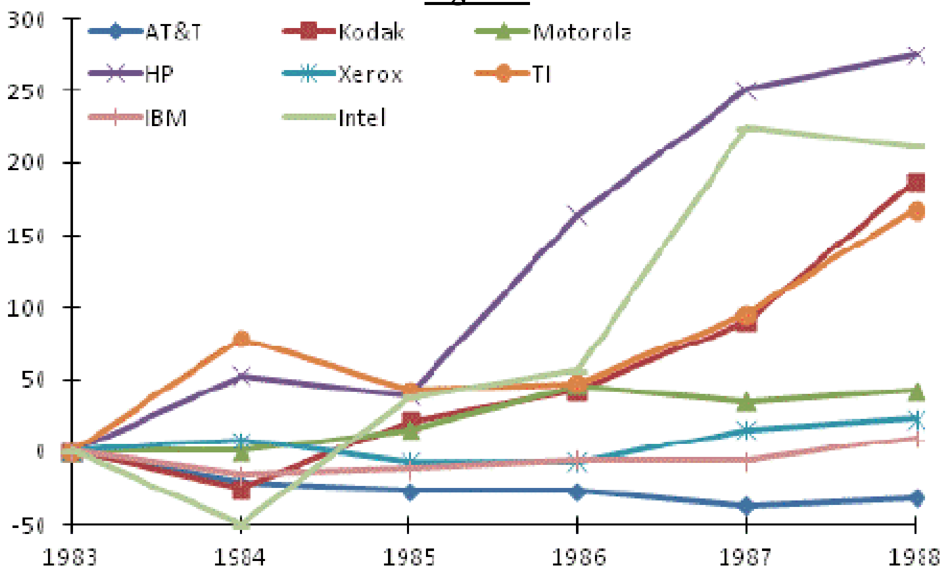

Figure 2 notes: This graph shows the growth of successful patent applications in percentages per year of the eight largest patentees in the electronics and semiconductor industries with 1983 as reference year. In this reference year IBM had 580, AT&T 493, Motorola 250, Kodak 242, Xerox 216, TI 132, HP 59 and Intel 16 successful patent applications.

Source: Bhaskarabhatla, A., & Hedge, D. (2014). An Organizational Perspective on Patenting and Open Innovation. *Organization Science*, Vol. 25, No. 6, pp 1744-1763.

<u>Figure 3</u>

1	sic	n	sic4_desc	keep	keep2
2	3510	86	Engines & Turbines	1	0
3	3523	63	Farm Machinery & Equipment	1	0
4	3524	18	Lawn & Garden Tractors & Home Lawn & Gardens Equipment	1	0
5	3530	23	Construction, Mining & Materials Handling Machinery & Equipment	1	0
6	3531	106	Construction Machinery & Equipment	1	0
7	3533	44	Oil & Gas Field Machinery & Equipment	1	0
8	3537	83	Industrial Trucks, Tractors, Trailers & Stackers	1	0
9	3540	124	Metalworking Machinery & Equipment	1	0
10	3541	21	Machine Tools, Metal Cutting Types	1	0
11	3550	22	Special Industry Machinery - except Metalworking Machinery	1	0
12	3559	118	Special Industry Machinery, NEC	1	0
13	3560	149	General Industrial Machinery & Equipment	1	0
14	3561	66	Pumps & Pumping Equipment	1	0
15	3562	58	Ball & Roller Bearings	1	0
16	3564	62	Industrial & Commercial Fans & Blowers & Air Purifying Equipment	1	0
17	3567	21	Industrial Process Furnaces & Ovens	1	0
18	3569	94	General Industrial Machinery & Equipment, NEC	1	0
19	3570	87	Computer & Office Equipment	1	1
20	3571	77	Electronic Computers	1	1
21	3572	77	Computer Storage Devices	1	1
22	3575	23	Computer Terminals	1	1
23	3576	52	Computer Communications Equipment	0	1
24	3577	90	Computer Peripheral Equipment, NEC	1	1
25	3578	56	Calculating & Accounting Machines - except Electronic Computers	1	1
26	3579	46	Office Machines, NEC	1	1
27	3600	21	Electronic & Other Electrical Equipment - except Computer Equipment	1	1
28	3661	132	Telephone & Telegraph Apparatus	1	1
29	3663	235	Radio & TV Broadcasting & Communications Equipment	1	1
30	3669	60	Communications Equipment, NEC	1	1
31	3670	23	Electronic Components & Accessories	1	1
32	3672	23	Printed Circuit Boards	1	1
33	3674	430	Semiconductors & Related Devices	1	1
34	3677	17	Electronic Coils, Transformers & Other Inductors	1	1
35	3678	107	Electronic Connectors	1	1
36	3679	186	Electronic Components, NEC	1	1
37	3690	107	Miscellaneous Electrical Machinery, Equipment & Supplies	1	1
38	3823	136	Industrial Instruments for Measurement, Display & Control	1	0
39	3825	184	Instruments for Measuring & Testing of Electricity & Electrical Signals	1	1
40	3844	41	X-Ray Apparatus & Tubes & Related Irradiation Apparatus 3	1	1
41	3845	179	Electromedical & Electrotherapeutic Apparatus	1	0
42	3861	103	Photographic Equipment & Supplies	1	1
43	4813	55	Telephone Communications - except Radiotelephone	1	1
44	7370	23	Services - Computer Programming, Data Processing, Etc.	1	1
45	7372	1	Services - Prepackaged Software	1	1
46	7373	179	Services - Computer Integrated Systems Design	1	1
47					

Figure 3 notes: This overview shows the enlisted industries that will be used in our research, sorted by their sic codes.