

Patent positions and start-up success

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Critics of the IP system often argue that patents have little or no role to play in the success of start-ups and their ability to secure funding. However, a recent study of early-stage businesses backed by French investors would suggest otherwise

For several years the BBC has broadcast a show called *Dragons' Den*, in which would-be entrepreneurs pitch their ideas to investors. One of the most frequently asked questions is whether a larger company could not pick up the entrepreneur's idea and bring it to market with more resources and hence more successfully. Entrepreneurs in turn often mention the patent protection that they have secured.

But so far, few studies have highlighted the impact of IP rights on the survival of small and medium-sized enterprises (SME). Cockburn and Wagner (2007) tested whether the patent portfolios of companies listed on Nasdaq influenced their survival after the dotcom bubble bust in the late 1990s. Helmers and Rogers (2010) measured how the patent and trademark portfolios of the 162,000 LLC companies created in the United Kingdom in 2001 influenced their survival rate after five years. In each case fewer than half of companies in the study owned patents. However, those patent-owning companies had a significantly higher survival rate (34% in the first study and 16% in the second). Survival rates were even higher for companies where patents had international extensions, suggesting that not only IP ownership but also the strength of IP positions matters when it comes to survival.

In our June 2014 study *Can Patent Data Predict the Success of Start-ups?*, we took a similar approach to assess whether indicators based on patent portfolios can predict the future success of start-ups. We considered 829 SMEs and start-ups in which one of the nine most active venture capital (VC) funds in France invested between 2002 and 2012. Taking the perspective of the VC funds, we defined 'success' as the occurrence of an initial public offering (IPO), merger, acquisition or leveraged buy-out (LBO) before the end of 2012. The questions we aimed to address were twofold:

- Are patents a good signal for VC investors? Our aim here was to determine whether patents provide a good benchmark indicator for VC funds to make their investment decisions. To answer this, we considered the patent position of each start-up immediately before the VC investment. We then estimated whether holding at least one patent at this time affected the probability of success in the post-investment period.
- Is there a link between patent positions and the probability of success? Here, we aimed to assess the predictive power of various indicators of patent positions (eg, existence,

international coverage, size and quality of patent portfolio) for start-ups that are already backed by VC funds. Since VC funds already influence the start-up in such cases, patent indicators can no longer be interpreted as an external signal of future success. A positive impact of patent positions on subsequent success would nevertheless highlight the importance for VC funds of promoting good IP management and building strong patent portfolios within their portfolio companies.

We found strong evidence supporting positive answers to both questions. We first showed that, on average, a start-up has about a 2.5 greater chance of achieving success within 10 years of the VC investment if it holds patents before that investment. This link between patent ownership and success is particularly strong for start-ups in the software and biotechnology sectors. Second, we found that the predictive power of patent ownership after VC investment is even stronger (it multiplies the probability of success by a factor of between 3.2 and 3.6), and that this is consistent throughout all sectors. Moreover, refined indicators of the strength of patent positions have substantially better predictive power for success.

Before exploring these results in more detail, we briefly present the database and methodology in the following sections.

The link between patent ownership and success is particularly strong for start-ups in the software and biotechnology sectors

Database

We used an original database of 829 European SMEs and start-ups, which was compiled by Thomson Reuters at the request of France Brevets. The population covered by the database corresponds to all start-ups identified by Thomson Reuters in which at least one of the nine most active VC funds in France invested between 2002 and 2012. Accordingly, the sample of start-ups that we consider has been subject to pre-selection: all of these companies have been considered to be profitable investment targets by established VC funds and therefore constitute more likely candidates for subsequent success than the average start-up at the seed or pre-seed stage.

We define an investment as ‘successful’ if we identify a successful exit of the company from the VC portfolio. A successful exit could be an IPO, merger, acquisition or LBO. Table 1 below presents summary statistics for key variables in the database at the global and sector level. Overall, about one-third of the observed start-ups experienced a successful exit between 2002 and 2012, and 20% of these held at least one patent in 2007. The start-ups belong to a large variety of sectors, among which the software, manufacturing, web, telecommunications and biotech sectors are the most represented. Table 1 shows that companies differ across sectors with respect to their success rate, the frequency of patent ownership and the average size of patent portfolios. In particular, success rates are higher in software, manufacturing and biotech, and the percentage of start-ups holding patents is higher for manufacturing and biotech.

Table 1. **Summary statistics**

	Number of start-ups (A)	Success rate	Patent-owning companies (B)	Share (A/B)	Average portfolio size*
All sectors	829	31%	138	20%	3.7
Software	180	37%	29	16%	0.8
Manufacturing	105	38%	31	30%	7.0
Web	88	27%	9	10%	0.3
Telecom	68	25%	13	19%	8.9
Biotech	50	44%	13	26%	6.3
Other	338	26%	43	13%	3.7

* The average portfolio size is the average over all start-ups of the number of patents granted or applied for until 2012

The database includes information on the type and dates of successful exits that occurred before the end of 2012. It also contains information on the creation dates and funding rounds of the start-ups. The availability of this data is important in order to identify and neutralise other potential determinants of the probability of success.

Using econometric models to isolate effect of patents

The methodological challenge is to properly isolate the effect of patent indicators from the effect of other variables – namely, the company age, received funding and sector of activity – which may influence success and/or the patent indicators themselves. An older start-up may, for instance, be more likely to hold patents and to succeed, thus making it difficult to attribute success to its age or its patents.

In order to do this, we employ econometric techniques that make it possible to simultaneously estimate the respective correlations of all these variables with the probability of success and thus isolate the predictive power of patent indicators, all other variables being held equal. We can then calculate the probability of success of a particular start-up with a given age, funding and sector of activity, regardless of whether it holds patents.

We use semi-parametric Cox proportional hazard regression models for this purpose. The Cox model is a survival model that makes it possible to estimate the likelihood of an event (here, success) within each short time interval over a long period. In order to correctly account for differences between sectors, we use a stratified version of the Cox model which allows for different expected time to success in each main sector covered by the database. Our reference model also accounts for specific impacts of age, funding and patent indicators within each sector.

Are patents a good signal for VC investors?

We focus first on the patent portfolio of start-ups immediately before VC investment, in order to assess whether patent ownership can be a good predictor of subsequent success. We thus adopt the perspective of the VC fund before it makes an investment decision. At this point, the fund must form expectations about future returns by using all available information. Obviously, it has no direct influence yet on the start-up's patent portfolio.

We address this question by estimating a survival model over a panel of 749 distinct start-ups observed annually between 1994 and 2012, with an average success rate of 29%. Besides patent ownership, we include age, prior funding and the sector as other variables predicting future success. Our results demonstrate a significant correlation between patent ownership and subsequent success.

Figure 1. **Cumulative probability of success of a representative start-up**

To appreciate this patent effect, it is convenient to represent it over time as a first step. Figure 1 illustrates the cumulative probability of success of a representative start-up over the period of the study, depending on whether it owned patents before the VC investment. As an example, the dotted vertical line shows that a start-up initially holding patents has about a 50% chance of achieving success within 10 years of the VC investment – without patents, this falls to about 30%. More generally, we can see that patent ownership leads to a significantly higher probability of success in the five to 15 years following the VC investment.

Figure 2. **Success factor of patent ownership**

However, defining a ‘representative’ start-up at the level of the entire database does not properly account for differences between sectors. Indeed, closer analysis reveals that the link between initial patents and success is not uniform in this respect. As reported in Figure 2, patent ownership has a very strong correlation with subsequent success in the software and biotech sectors: in these sectors, start-up companies which own patents before the VC investment are respectively 2.89 and 2.99 times more likely to succeed afterwards. By contrast, patent ownership has a much weaker predictive power in the other sectors, with a modest (though statistically significant) success factor of 1.02.

These results suggest that patent ownership is a strong signal of future success for VC investors. However, this is true mainly in the biotech and software sectors – where patent ownership almost trebles the chances of success.

Link between patent positions and probability of success?

We next examine whether active companies in the VC funds’ portfolios are more likely to be listed or acquired if they own patents. To do so, we consider a sub-sample of 587 VC-backed start-ups as of January 2007 and observe their evolution until the end of 2012. The main difference from the previous approach is that we now focus on the post-investment stage: as the start-ups were already in the VCs’ portfolio in 2007, the patent portfolios observed at this time are already subject to the influence of the VC funds.

Besides patent ownership and the sector of activity of the start-ups, we use their age and total funding as of 2007 as other control parameters to predict future success. Our results again demonstrate a significant correlation between patent ownership and subsequent success.

Figure 3. **Cumulative probability of success**

We first report the cumulative probability of success of a representative start-up between 2007 and 2012 (Figure 3). Again, it appears that success is more likely when the start-up has one or more patents at the beginning of the period. Moreover, the ratio of success probability with and without patents appears remarkably stable over the entire six-year period.

The estimate makes it possible to infer the probability of success of a representative start-up between January 2007 and December 2012, depending on whether it owns patents at the beginning of the period. As indicated in Figure 4, patent ownership is associated with a 30% likelihood of success in the following six years, compared to 8% without patents. Patent ownership thus generates a success premium of 22% – or multiplies the chances of success in the next six years by 2.75.

Figure 4. **Probability of success between 2007 and 2012**

Since we consider here the average start-up in the sample, this general result does not correctly account for sector heterogeneity. A more detailed approach, accounting for different expected time to success and different effects of key factors (eg, age, funding or patents) between the main sectors nevertheless confirms our general finding. We find in this case that patent ownership consistently and significantly multiplies the probability of success by a factor of 3.6 in all sectors. Our estimates suggest stronger effects in some sectors, such as software and biotech; but these differences are not statistically significant, due to the limited number of observations.

The management of IP policy is a powerful strategic leverage for any VC-backed start-up to achieve economic success

As compared with the pre-investment analysis, these results indicate that in the post-investment period, patent ownership is strongly related to success in all sectors, although its impact is probably stronger in software and biotech. This suggests that the management of IP policy is a powerful strategic leverage for any VC-backed start-up to achieve economic success.

It is therefore interesting to take a closer look at the start-ups' patent portfolios in order to refine the analysis. To do so, we estimate another set of econometric models, in which patent ownership is replaced by alternative patent indicators. We first use ownership of triadic patents (ie, with protection in Japan, the United States and Europe) to approximate the international coverage of patent portfolios in 2007. We also construct two groups of patent holding start-ups with, respectively, the top 25% largest patent portfolios and the top 25% portfolio quality scores in 2007. The latter indicator is based on the sum of patent scores calculated by Thomson Innovation, based in particular on the number of subsequent citations and other qualitative patent indicators.

The results of this analysis are reported in Figure 5. They clearly show that refined patent indicators can better predict the probability of success than mere patent ownership. In line with our previous estimates, we find that patent ownership multiplies the probability of success by 3.1, thereby generating a success premium of 210%. By contrast, start-ups that own a triadic patent are 3.5 times more likely to succeed in the next six years. This factor in turn increases to 4.1 and 5.1 for the top 25% portfolio scores and portfolio sizes respectively.

Figure 5. **Predictive power of different patent indicators**

Lessons for investors

For investors used to considering patents, this study is merely evidence of the obvious. Indeed, we noticed several examples in the industry of how patents can be helpful in a start-up's strategy:

- Patents may become your start-up's main asset. Many analysts have commented that Apple's acquisition of Authentec was primarily driven by the latter's fingerprinting patent portfolio. This was confirmed by the analysis of backward/forward citations and the fact that Apple went on to sell Authentec's operating business in the months following the acquisition.
- Patents may be a secondary asset with their own value. MIPS is a good example of this phenomenon. The operating company was sold to Imagination, while the patents were sold to an industrial consortium led by ARM and others. This was due to a strong perception in the industry that MIPS's patent portfolio was essential to ARM's architecture, and that control over these patents was necessary to mitigate the risks associated with the portfolio.
- Patents may be a way for a start-up to secure financing. While IP-backed loans are not yet developed for start-ups, except in Asia, they can be extremely helpful for start-ups where the assets are primarily intangible. A few years ago, Alcatel-Lucent secured an impressive loan of several billions of dollars to save the company, using its patent portfolio as the primary security.
- Patents may be a good exit strategy when things turn bad. Nortel is probably the best example of this. More generally, when a company files for bankruptcy, its patents may be its only asset.

Looking more specifically at the results of the study, for an investor, the key takeaway is to consider patents as a specific class of asset and not just as a form of legal protection. In many cases, investors' due diligence is primarily limited to confidentiality, ownership of inventions and freedom to exploit aspects (ie, ensuring that the company owns its patents and can sell its products and services). Only rarely is proper due diligence carried out to evaluate the value of the patents themselves, independently of the company's business. Our study shows clearly that quality matters. While we observed patent quality through scoring, real examples are also very clear on this point. In many of our interactions with companies' boards, we were extremely surprised by the lack of knowledge of the value of the patent portfolio. However, we have seen examples of directors requesting that the company's management improve the prosecution of specific patents.

Lessons for start-ups

Similarly to investors, start-ups need to stop considering patents as merely a form of protection and more as a specific asset. The first reason is that you are most likely to be wrong about the protection that a patent confers. Owning a patent does not mean that you are free from infringement, even by implementing the invention described by the patent. The second reason is that any company asserting a patent against you may not be infringing your own patent and the patent will thus provide no protection in such case. Thinking of your patents as an asset will force you to consider their intrinsic value and then develop it. This will allow you to choose between using patents as a form of protection and leveraging them independently.

You need a specific budget and an action plan in order to develop your patent portfolio and negotiate with investors. Because patents are long term and many things are short term, attention must be paid to this when you launch the company.

Predictive power

Our results clearly highlight the strong predictive power of patent positions for the chances of successful exit for VC-backed start-ups:

- There is evidence of a significant signalling effect of patent ownership prior to VC investment – patents significantly increase the likelihood of subsequent success, especially in the software and biotech sectors, where patent-holding start-ups are respectively 2.89 and 2.99 times more likely to succeed.
- Active start-ups in VC portfolios are about 3.5 times more likely to succeed in the following six years if they own at least one patent. Interestingly, the impact on the likelihood of success is even stronger when we consider refined patent indicators which better capture the strength of the start-ups' patent positions. The success premium raises from +210% to +250% when only triadic patents are taken into account, and to respectively +312% and +422% for the top 25% start-ups in terms of patent portfolio rating (as measured by Thomson Reuters) and size. Beyond the mere need for patent protection, this clearly highlights the importance of being able to build strong IP positions for start-ups.

It is important to keep in mind that we formally establish the existence of correlations – not causal effects – between patent positions and success. In other words, filing a first patent will not automatically multiply the applicant's chances of success by 3.5. There are other important drivers of success which we cannot observe and some of these (eg, good management and technology) are likely to influence patent positions.

The strong correlations that we observe probably also reflect their influence – the unobserved factors being then captured by patent indicators. This again implies that simply filing patents is not sufficient: the key driver of success is in fact the start-up's ability to build a strong and relevant IP position.

Action plan

When considering investing in a start-up:

- do not check only the legal when it comes to patents;
- this means assessing their value as such (eg, can they be licensed to other companies or can they become a strategic asset for a large player?); and
- do not trust the executive team to take care of this alone – it should be considered by the board, which should request regular updates from the executive team.

When developing your patents as part of a start-up's executive team:

- consider your patents as assets (ie, do not consider them merely as a way to protect your company's business);
- take the time to care about them – even if patents represent a long-term value, the patent system does not allow the possibility of patenting things later; and
- leverage them when needed to secure financing for your company through patent sales, patent back loans or licensing.

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