

EC261: Management of New Technology

Term Paper 2014/15

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Q1. 'A venture capital market implies that more innovations are created, and that these become better developed' Discuss.

Introduction:

What is a venture capital market?

Venture capital can be defined as the provided money to be used for a start-up of a new business, by a financial intermediary (venture capitalist) which collects the investment money from other interested investors. Venture capital markets allow young and small businesses to receive funding that they would otherwise struggle to gain from other financial institutions and firms, such as banks, due to their high risk levels and the associated with them uncertainty. This type of funding doesn't require interest rate payments, but instead, the venture capitalist becomes a partial owner of the new company, and holds a certain % of its shares, often allowing the investor to hold the last say in many decisions regarding the progression of the new business. Private investors are much less likely to invest in new companies without a venture capitalist due to asymmetric information (the innovator holding more information on the possible success of the product/service and its limitations). Therefore these intermediaries are often familiar with the industries in which the new business is based in; they also require full disclosure of the details of the innovation and other important financial and production factors (Gompers and Lerner, 2001). The venture capitalist then makes money off of the success of the new firm, and either pays out

the returns to the investors or gives them the equivalent in shares of the new publicly available now company.

Discussion of studies:

Many papers have studied the causal effects of venture capital availability on higher levels of innovation and most of them have noted a very strong positive correlation between the two; the following discussion will be on the specific results of the papers, as well as whether innovations become better developed as a result of extra funds.

The paper by Kortum and Lerner (2000) assess the correlation using data of US patents in 20 different industries to see whether the effect of venture capital was higher in some sectors than others, from 1965 to 1997. They look patent number relative to R&D expenditure to determine the strength of possible causality. Using the linear specification equation, they calculate that a dollar of venture capital has a mathematically 7 times more power in increasing innovation than traditional R&D funding. Showing that, indeed, VC must have a strong positive impact on innovation, especially compared to other forms of funding.

Through natural deduction we can explain this via the raise in capital available to the newly starting-up businesses that can be used for the introduction and production processes which induce innovation as such. Patenting data is being used in this and most other studies to account for innovation possibly because firms either don't tend to patent products that they know they won't be able to produce due to no funds, as much; or maybe because the patenting process (and research) are too expensive to carry out by some innovators.

A paper entitled 'Does venture capital really foster innovation?' by Faria and Barbosa (2014) also uses patent and R&D data but for 17 European countries, but uses a different approach in estimating effects of venture capital, by adopting the number of patents as a ratio of the country's GDP using the following formula:

$$\text{Patents}_{it} = \beta_1 \text{Patents}_{it-1} + \beta_2 \text{VC}_{it} + \beta_3 X_{it} + \varepsilon_{it} \quad (\text{Faria and Barbosa (2014)})$$

With VC being venture capital invested, and X being the aggregate investment. The authors' results show that indeed there does seem to be a very strong and steady correlation in the number of patent applications following raising venture capital availability and quantity. But their results also expose that VC funding has a more significant effect on innovation at later-stages, after the firm has already received some initial funding from elsewhere and theoretically entered the market with the new innovation. This means that VC has a positive impact on upholding new innovations and their commercialization, but not necessarily on their creation.

Da Rin and Penas (2007) add to this with their study of innovation strategies of both firms who have, and haven't received some VC funding, using data from about 10,000 Dutch companies. Their study explores mechanisms through which venture capital affects innovation, which may bring many to a closer understanding and assessment of whether the quality of innovations affected by VC is also higher. The two main channels they study are: investors are seen as 'company builders', and provide new businesses with advice and access to industry experts that make sure the new product or service is a success, which leads the innovators to be more likely to create new and better products.

This theory suggests that via the added expertise of the given sector's specialist which is introduced by the venture capitalist; the owner of the company is more likely to develop better, quality wise, inventions. Another view may be that venture capitalists have such a substantial effect on innovation and positively affect its quality because it is in their best interest to make sure the innovation is fully ready and of the best possible quality before entering the market. The reason for this is simple, the venture capitalist only start earning money when the innovation become successful and starts yielding high profits; this is the only thing the investors are interested in- the return. Conversely, if the invention is say, ground-breaking for the technology or science industry, the investor's main aims are for it to be noticed by specialists in the field and possibly awarder, not for it to give high market returns. (Gompers and Lerner, 2001) Awarded, revolutionary inventions are often a subject of press interest which, if it attracts the innovator, might mean reduced interest in the development of the invention, and time put into marketing it; which will reduce potential earnings, and the quality of the creation.

One more disadvantage of the innovator not having the support and funding from venture capitalists is that following a success of an invention, whether it be in the scientific field only or also in the market place, the subsequent innovations may tend to be of a lesser quality. This is because the inventor may rush new creation to put it out to the market quicker, or not develop it to its full potential to reap the profits from following it with a better, slightly developed version (like Apple iPhones facing only slight improvement year on year, 4iPhone 4 to 4s, 5 to 5s, to increase potential earnings).

The reason why venture capital might have such a substantial impact on creation and development of inventions is because it effectively overcomes all of the discussed issues.

This is due to the fact that investments via venture capitalists involve, as mentioned previously, not only financial funding but also expert help, and their presence and active participation during management and sometimes even board of directors meetings. VCs often also hold a large share of the company itself to allow them to have the last word in all decisions. This ensures that all the actions undertaken by the company regarding development and release of the innovation are in the best interest of customers, in order to maximize profits, which is of a the greatest importance for all the investors who used the venture capitalists as financial intermediaries to make the best use of their money, as well as VCs themselves.

Due to this discussion's hypothetical approach, another method of assessing the effects of VC on the development of new innovations should be discussed. A study entitled 'Venture Capital and Innovation in Europe' mentions a way to measure development through the use of the data of the numbers of patents granted instead of patent applications, as patents granted show that the innovation is of a certain quality (Geronikolaou and Papachristou, 2008), which could mean that it has been better developed.

The issue with using granted patents and the reason why impacts of venture capital on the successful patents haven't been examined in detail is because every patent takes a different amount of time to get accepted or rejected, and therefore, it is thought to be much harder to examine the effects of VC due to the timing issue. A way to overcome this could be to calculate the average time it has taken to accept or reject a patent during the given, studied time period. Using this, a new table of data could be created, subtracting the average time taken to assess an application from each granted patent; and sorted into according months and years. Then, using this data, we could see which successful (of high quality- 'better

developed') patents have indeed been affected by the increases in venture capital funding. This type of study, although limited, due the assumption of granted patents being meaning higher quality of an innovation, could give a more realistic view of the actual impacts of VC on innovation's quality, not just its quantity; as well as of its statistical significance.

Going back to the other examined by Da Rin and Penas (2007) channel: it states that the reason why venture capitalists' funds affect innovation is because they only fund companies that they think are most likely to success so patent numbers rise following their investments, which can also possibly induce more innovation in the long term. Their results show that the companies that receive the most VC funding are more likely to be using the 'Make and Buy' strategy, which is based on increasing the absorptive capacity- which is often seen as highly correlated to firms that are open and ready to use new information= creation of new innovations. This study therefore indeed confirms that venture capital market has a large impact on the creation of new innovations.

Limitations:

What if though, it was in fact the arrival of new technological opportunities that co-occurred in time with the increase in capital venture, and so the effects of new funding are not actually as high as it may seem from most studies.

This links well with a theory of possible reverse causality whereby it's not the capital venture that spurts innovation, but the other way round. Tying in with the previous argument, if there was a sudden arrival of new technologies that was adapted by many

innovators in their businesses; their need for funding increased the supply of investment opportunities available through venture capitalists, expanding the market.

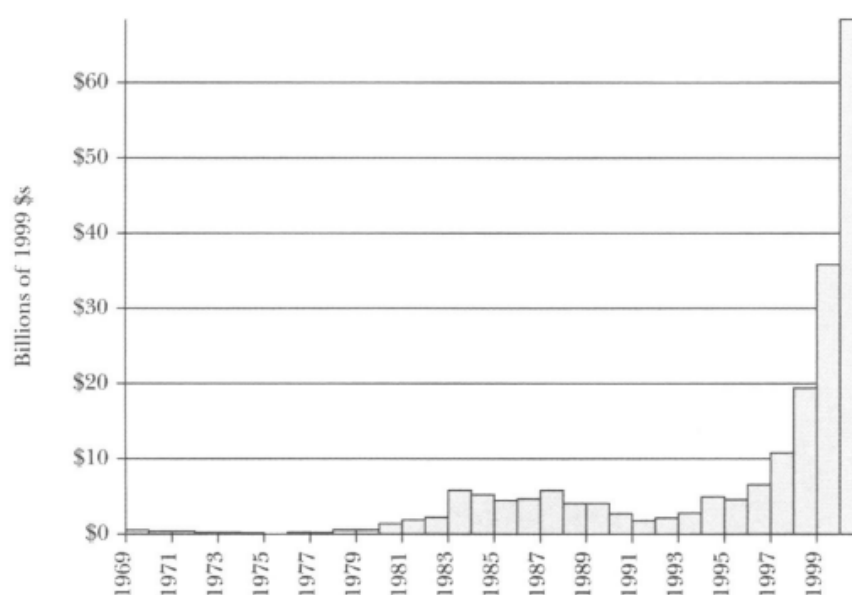
But these questions have been answered by Kortum and Lerner (1998, 2000) who use two ways to avoid the bias of new technology introduction, one of them being calculating the amount of innovation at the time of a change in pension laws in the United States, which allowed larger percentages of pensions to be invested in venture capital in 1979. This increased the percentage of pensions contributions from around 15% in 1978, to over half of all contributions only 8 years later. This great increase has been mirrored by numbers of patent applications and so innovations, which proves that without introductions of new technologies that could spurt innovation, VC investments still have a large impact on their creation.

There is a possibility that the reason why VC investments account for such a strong impact on innovation is because they're the biggest source of funds available to new businesses ('Wetzel's [1990] survey shows that VC accounts for about 2/3 of all external financing'). Which is still a positive aspect of these types of investments, because like mentioned earlier, since its introduction, innovation has been on a steady rise. (Kortum and Lerner, 1998).

Also through reverse causality, it might have been the successes of new businesses that have increased the demand for such investments and so increased venture capital, in the long run increasing innovation. Let's look at a time period right before the substantial increases in the venture capital market, the main companies we know have achieved success due to venture capital are: 'most successful high-technology companies during the 1980s and 1990s, including AppleComputer, Cisco Systems, Genentech, Microsoft, Netscape, and Sun Microsystems. A substantial number of service firms (including Staples,

Starbucks, and TCBY) also received venture financing.' (Gompers, Lerner, 2001). The way this information could be used is to create a table showing these companies' earnings between say 1990 and 2000, to see whether the venture capital investments have risen following most of these companies' success, during them, or before, which would suggest that indeed, VC does imply creation of more innovation.

Figure 1
Commitments to the Venture Capital Industry (billions of 1999 dollars)



Note: Commitments are defined as the amount of money that is pledged to U.S. venture capital funds in that year.

Source: Venture Economics and Asset Alternatives.

(this graph could be used to see that most of the earlier mentioned companies' growth has spurred during the time of drastic increases in venture capital markets, 1997-2000) (pg.148 of a paper entitled 'The Venture Capital Revolution' by Gompers and Lerner, published in The Journal of Economic Perspectives, Vol. 15, No. 2 (Spring, 2001), pp. 145-168)

The most prominent limitation of this data is the fact that it is not in fact the amount of innovation that it shows, but rather the number of patents given out each year; the problem arises because patents do not necessarily equal innovation. Inventors may apply for patenting right to make their firm appear more stable and make it more attractive to venture capitalists and their investors. Another possibility for patenting a product/service before it we would regard it as an innovation is the worry of the inventor that their idea might be copied or stolen by one of the investors who receive full disclosure on the potential innovation. Another reason why patent data could induce errors is suggested because the high spurt of patent applications in the US followed a creation of a 'centralized appellate court for patent cases' in 1982. (Kortum, Lerner, 2000)

In order to make sure this limitation of data has not driven the results higher than they were realistically, the authors use three methods to assess the 'importance' of a patent as such, to show whether the increase in patenting was only of un-important and non-ready innovations. Three methods are used to check the validity of using patent numbers as proof of innovation- 2 of them being measures of intellectual property activity. And the last one- number of patent citations; following a study by Jaffe, Trajtenberg, Fogarty (2000), who have shown that the number of patent citations are a good representation of the economic importance of a patent. Via the three methods the authors conclude that the results were not affected by the use of patent data, as it is a very good portrayal of innovation.

Conclusion:

A natural conclusion to make would be that due to the expansion of the venture capital market, more funds are available to the newly set up businesses and therefore this must lead to much more innovations entering our market. But as this paper has attempted to discuss, this is not necessarily the case. Most of the earlier mentioned studies do in fact prove that innovation surged following increases in venture capital markets, via data sets mostly revolving around numbers of patent applications and financial stats on how much share does venture capital account for, in the market. Although there are many limitations to this data, it has been examined to be a good reflection of the amount of innovation. But if we wanted to verify the causality effects of VC further, studies should be developed to find alternative ways of representing innovation, and compared with the current results. In addition, to test whether the relationship between innovation and VC is the same regardless of social variables within a country, an aggregate study could be completed, using data from a large number of other countries.

Another point raised in this paper was of whether innovations are also better developed due to the expansion of the venture capital market; but this is a much more difficult question to answer, due to our limited ideas and hence also data on how to measure development levels and quality of innovations. Following this paper's discussion, a consequential suggestion for further study could be put forward. If we assume that well developed inventions are more likely to have subsequent products/services, we could make a comparison of all subsequent patents granted to companies which were supported by venture capital, and those that weren't. This way we would get a measure of whether companies with VC funding are more likely to have successive patented innovations, which

would suggest that their development and quality are superior to those that weren't backed by venture capitalists.

Whether in the case of venture capital markets and creation and development of innovation, we are facing normal or reverse causality, is not as important as the fact that venture capital markets do positively influence number of innovations in the market place, and therefore governments should do their best to not limit, but expand this type of funding for new businesses, if we want to keep experiencing fantastic growth of new innovations.

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