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Nascent Entrepreneurs, Innovation and Financing Constraints

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Abstract:

Innovative nascent entrepreneurs face the problem of obtaining finance, mainly due to information problems. We use new data on capital seeking start-ups allowing distinction between planning stage and early stage. Being innovative does not affect the probability of having external finance in the planning stage but has a positive effect in the early stage. Early start-ups with patents have a significantly higher probability of having equity whereas debt is not affected. Patents, coupled with prototypes have a higher probability for external finance which may be due to reduced uncertainties and learning. The most important determinant of debt is house ownership.

Key words: Innovation; Entrepreneurship; Finance; Information Asymmetries

Jel codes: M13; G32; O32; O47

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1 Introduction

The assumption of perfect capital markets implicitly assumed away any problems that might arise in obtaining finance for any ideas, innovative or otherwise. As recently as 1988, Alan S. Blinder pointed out the prevalence of the assumption that capital markets operate in a perfect manner,"A few years ago, in revising my graduate course reading list, I looked for some modern literature on liquidity constraints and investment. There was none" (Blinder, 1988, p.196).

Blinder might be right. Only a few papers for example, Stiglitz and Weiss (1981) dealt with this issue. They showed financing will not be made readily available, even at the market interest rate, when Information is asymmetric and uncertainty exists. Rather, according to the model posited by Stiglitz and Weiss , the likelihood of credit rationing increases as uncertainty and asymmetries regarding information increase. later, new literature emerged challenging the assumption of perfect capital markets, and suggesting that, in fact, certain types of economic activity might be subject to severe financing or liquidity constraints.

As scholars sought to empirically validate the theory of imperfect capital markets leading to financing constraints, they developed data bases at the firm level linking the investment behavior of firms to firm-specific balance sheet characteristics. For example, Fazzari, Hubbard, and Petersen (1988) found systematic evidence that liquidity constraints tend to be more binding for smaller firms than for their larger counterparts. These findings have been replicated so consistently that Petersen and Rajan (1992) conclude , "Small and young firms are most likely to face this kind of credit rationing. Most potential lenders have little information on the managerial capabilities or investment opportunities of such firms and are unlikely to be able to screen out poor credit risks or to have control over a borrower's investments".

Still, after reviewing the empirical evidence concerning the impact and extent of financing constraints, Chirinko (1993, p.1904) expressed doubts, "While the recently generated evidence points to the importance of financial structure and liquidity constraints, their sources and severity remain open questions."

One reason for the inability to identify the extent to which investments in new ideas are constrained is that the samples estimating the extent of financing constraints are essentially truncated to include those ideas and projects which have developed sufficiently to have already generated existing or incumbent firms. In fact, a more recent literature highlighting the role of incipient firms not yet started by what has been termed as nascent entrepreneurs S. Parker (2006), suggests that new ideas are not at all limited to existing, incumbent enterprises. Rather, as Gompers and Lerner (2004) and Hsu (2004) show, the innovative process leading to new products and growth can often start well before a new firm is even started.

Just as entrepreneurs start new firms, nascent entrepreneurs consider starting new firms. Thus, by the very nature of studies estimating the extent and impact of financing constraints being limited to existing, incumbent firms, a potentially severe bias, or at least limitation is introduced. The existing studies estimating the impact of financing constraints have been limited to a truncated distribution, where the left side of the smallest and earliest of ideas and projects have been excluded. Such a bias is particularly alarming giving the well established finding that the impact of financing constraints is the most severe as the ventures become newer and smaller. As Davidsson (2006, p.3) points out, analyzing only existing incumbent firms will lead to a "selection bias resulting from including only start-up efforts that actually resulted in up-and-running businesses".

Thus, while the existing literature has been able to shed considerable light on the extent to which existing, incumbent firms have been subject to financing constraints, perhaps the even greater and more alarming impact of financing constraints which has deterred potential entrepreneurs from actually pursuing their innovative ideas by starting a new firms has remained unexplored.

The purpose of this paper is to fill this gap in the literature on new ventures and liquidity constraints by shifting the lens away from existing, incumbent firms to potential, or nascent, entrepreneurs. Thus, in the second section of this paper, the theories of financing constraints which have been developed to

explain firm investment behavior are applied to explain the entrepreneurial behavior of potential entrepreneurs. The existing firm-based data sets are of little use in trying to explain the behavior of nascent entrepreneurs rather than that of firms, so in the third section a new large scale data base identifying nascent entrepreneurs is introduced and explained. In the fourth section, the econometric model to be estimated is specified. The empirical results are presented in the fifth section. Finally, in the last section a summary and conclusions are presented. In particular, shifting the lens away from existing, incumbent firms and to potential entrepreneurs reveals that just as firms are subject to financing constraints, so too are nascent entrepreneurs. However, through procuring protection of intellectual property, such nascent entrepreneurs can reduce the extent to which they are subjected to financing constraints.

2 Financing Innovation in Firms and Nascent Entrepreneurs

Theories of financing innovative activity have made considerable strides in recent years. However, most of the theoretical models as well as their empirical validation have been based on financing innovative activity in existing, incumbent firms (Hall, 2002). These studies start with an exogenous firm and then determine its financial structure, in some cases analyzing how the extent of innovative activity will influence that financial structure. For example Aghion et al. (2004) show that the financial behavior of more innovative firms differs from that of their less innovative counterparts. In addition, they find that the use of debt decreases with R&D intensity because more innovative firms issue equity in order to meet the investor's participation constraint, even though it would mean sharing ownership.

There are three main sources why innovative activity and new ideas tend to be subjected to financing constraints. The first factor involves knowledge asymmetries, which arise if the firm has better information about the returns of their investment in intangible assets than do potential investors. Firstly, such knowledge asymmetries will be exacerbated because intangible assets tend to

have low collateral value. Hence, "external finance may be expensive, if available at all, because of adverse selection and moral hazard problems" (Carpenter & Petersen, 2002).

The second factor involves the fundamental uncertainty in knowledge and new ideas. As Arrow (1962) pointed out, this uncertainty characterizes the relationship between innovative efforts, or inputs into the innovation process, and their resulting outcomes. New knowledge is intrinsically uncertain in its potential economic value (Arrow, 1962). Thus, "the challenge to decision making is ignorance, the fact that nobody really knows anything" (O'Sullivan, 2006), or at least, anything for sure. Thus, the degree of uncertainty inherent in the innovative process, renders the decisions by potential investors to be based on subjective judgements which may or may not coincide with the assessment by the firm.. This implies that innovative activity may be burdened with difficulties in obtaining finance, even at the prevailing market interest rates.

The third factor, also pointed out by Arrow (1962), involves the propensity for knowledge to exhibit, at least partly, characteristics and properties of a public good, i.e. it is non-excludable and non-rival in use. Thus, in order to fully appropriate investments in innovative activity, the associated intellectual property must be protected through some regime such as patents, copyrights or secrecy. If knowledge spills over to other firms, the benefits accruing from innovation cannot be fully appropriated by the innovating firm.

Taken together, these three conditions involving uncertainty, knowledge asymmetries, and the potential nonexclusive nature of investments in intangible assets make it difficult to evaluate the expected value of an innovative firm as compared to non- or less innovative firm (Audretsch & Weigand, 2005).

The empirical evidence has generally found that the extent and impact of liquidity constraints tend to increase as both firm size and age decrease, that is for smaller and younger firms, and as the innovative activity of the firm increases. Nascent entrepreneurs reflect potential firms that have not even started, and in some sense are to the left of the distribution of a firm age of zero and a firm size of zero. Thus, at least two of the conditions inherent in knowledge

triggering financing constraints are likely to be even more extreme for nascent entrepreneurs than for existing, incumbent firms - knowledge asymmetries and uncertainty.

In the Jovanovic (1982) model of noisy selection and learning, entrepreneurs, and implicitly along with them their investors, learn about the market potential of entrepreneurs and their underlying ideas only through observing actual market experience. If the entrepreneurial idea is viable and compatible with the market, the firm will survive and grow. If not, it will stagnate and ultimately fail. Thus, as the actual pre-startup ideas become transformed into post-entry performance, the actual amount of uncertainty associated with the entrepreneurial start up decreases. The uncertainty and knowledge asymmetries associated with nascent entrepreneurship should exceed that as the new venture is actually launched and the startup subsequently matures over its life cycle. Thus, nascent entrepreneurs would be expected to face financing constraints at least as great, but presumably even greater, than do new ventures subsequent to the startup.

As a result of the reduction in the uncertainty inherent in the new venture resulting from learning about market compatibility as the firm evolves over time, the capital structure would also be expected to evolve over the firm life cycle. In particular, equity capital will tend to play a more important role in the early stages of the life cycle. To the degree that there are observable characteristics predicting subsequent performance of the new venture, obtaining such equity capital, including venture capital, will be easier. One important signal reducing the extent of uncertainty is intellectual property, particularly if it is legally protected in the form of patented inventions. As Audretsch and Lehmann (2004), Scellato (2007) and Rossi (2005) show, high technology firms with patented inventions have a capital structure with a greater reliance on equity as the source of finance. In particular, high technology firms with patented intellectual property exhibit both a higher propensity for the capital structure to rely more on venture capital finance, while at the same time a lower propensity to be subject to financing constraints.

2.1 Appropriability and Financial Constraints

As is well known, the markets for knowledge create opportunities for increasing investment in innovation. From the policy perspective too the intellectual property system is being pushed mainly to ensure the appropriability of innovation and increase investment further. As the European Commission¹ opines, "One direct means (to stop leakage of knowledge) is the strengthening of the appropriability conditions through an effective system of intellectual property rights. Even though the commission feels that public financial support would also be a solution, not all the necessary investment comes from public support. Entrepreneurs have to resort to private financing too. Most of the nascent entrepreneurs invest in innovation with their own money (self-financing) and try to gain protection mechanisms which per se ensure appropriability. In this case, the questions remain as to the length of time until which the self-financing has to be done and whether appropriability can serve as an efficient signal to external investors.

Due to the emergence of various equity stakeholders (VCs, Business Angels etc) it has become important for them to ensure that the entrepreneur signals profitability and survival prospects. Ideally, financial constraints should not be a problem once appropriability conditions are efficient. Remaining useful life(RUL), expected income generation (through IP valuation) are some of the measures through which private equity suppliers verify the profitability and survival prospects of the clients. A nascent entrepreneur therefore would either be able to win the investment or lose it. Loosing the investment comes when IP is available but either the value is too low and RUL is very less. This manner of assessment depends on whether the VC for example, is willing to take up the cost of valuation and scrutiny. If the responsibility lies on the client, then it depends on whether the client resorts to valuation and bears the cost. Given that the nascent entrepreneurs mostly run on own money any additional cost (which of course does not reduce all the uncertainty), will be compromised upon and eventually investment may be very less or nil.

¹ (*European Competitiveness Report 2006*, 2006)

The easiest way therefore to ensure appropriability (at least for signaling to the investor, in the short run) perhaps is to build a prototype. This would make sure the entrepreneur does not have to resort to high valuation costs (if the purpose is only to get investment) and will also make sure the production possibilities and whether actually someone can imitate the idea and subsequently the product. If in this case the appropriability conditions are signaled to be high, through a prototype, the chances of obtaining external finance may ease for the nascent entrepreneur.

2.2 Patents and Prototypes as Signals to Investors

It has been long established in the literature that agents take advantage in situations of adverse selection faced by the principal, when information is private and hence distorts contracts. A patent or a prototype renders information public (not necessarily complete), and in the case that information is public, the contracts cannot be distorted and the agent cannot act in a selfish manner. If the patents and prototypes are not shown, the principal will be unable to design contracts that take into account the possible information asymmetry entirely. To decrease moral hazard by the agent the principal will therefore offer contracts which are contingent upon the results.

Such contingent contracts influence the information which the agent will choose to disclose, along with investment decisions. In particular, the agent will choose to disclose her intellectual property and capabilities in the form of a patent and prototype to signal her underlying capabilities and know how, provided the public information makes her better off ²(Macho-Stadler & Perez-Castrillo, 1997)

How do these signals matter when an entrepreneur has to choose or is confronted with a choice of financing sources? Certainly each of the principals has a different yardstick on perceiving the signal received and processing it. In this paper we consider mainly the role of a signal in influencing any external source of finance.

²A 'signal' is defined as "some activity, or some decision, that proves that the agent concerned has a certain ability or characteristic, or possesses certain information

For further development some notation is required. Let us denote the effort involved in terms of time required to come up with signals as T_p and T_{pr} . There are two types of entrepreneurs, Good and Bad. The probability of success of the two agents is P_g & P_b such that $P_b < P_g$. Let us assume that the principal is informed about the quality of signals and the expected benefits from successful and failed ventures are π_s & π_f .

2.2.1 Patents, Prototypes and Financial Constraints

Patents are the result of government intervention through which appropriability can be ensured from research and development and further investments can be encouraged (in the line of thought followed by Arrow (1962), Nelson (1959), and Levin et al. (1987)). Anton and Yao (2004) suggests that whether intellectual property becomes patented depends on the amount of the information to be disclosed to the intellectual property markets leading to "little patents and big secrets". In this manner patents signal other market participants to anticipate the true value of an innovation, which also incurs the cost of imitation. If the signaling benefits are greater than imitation costs, entrepreneurs would have an incentive to disclose the patents to market participants (customers etc).

Patents may act as a signal not just to market participants, but also to potential investors. As indicated above the signal through patents acts in the mode of *information* and *characteristic*. Development of an invention from an idea and a concept to a patent indicates that the firm has prospective competent characteristics required in the market. The benefit to the investor π_f when the firm fails to commercialize successfully generally includes rights and conditions which may frequently also share royalties accruing from the patent along with other intellectual property monetary benefits. In this way investments in start-ups by entrepreneurs holding patents may be considered partly secured, provided contracts are properly drawn.

Another dimension of patenting behavior stems from the fact that the propensity to patent intellectual property tends to follow a trend of the patenting activities of other market participants. In this case if every agent patents and

there is no other signal that could decrease the adverse selection problem, then the signal would become non-informative. The principal is considered to evaluate the signals using Baye's rule, with prior probabilities p_g and p_b . If the probabilities with respect to the success/failure, given the signal, are $p_g(T_P, T_{pr})$ and $p_b(0, 0)$, then in the pooling equilibrium case both are treated equally (Macho-Stadler & Perez-Castrillo, 1997) i.e. $p(T_P, T_{pr}) = P$. Pooling equilibrium creates a similar situation to the principal as with the adverse selection problem. Hence the principal offers contracts that give her prior established expected utilities $E(U_g)$ & $E(U_b)$ dependent upon π_s & π_f , independent of the signals provided.

The second case is where all the agents do not use the same signal, Good agents signal T_P & T_{pr} and bad agents choose $T = 0$. This leads to the separating equilibria case where the principal would set $p_g(T_P, T_{pr}) = 1$ and $p_b(0, 0) = 0$. As a result, the principal assesses the signal type and this would decrease the adverse selection problem. It can be therefore understood that patenting behavior by every agent leads to greater financial constraints. Our point however, is that since all agents, in reality cannot resort to the same signal, attracting investment will be easier and the probability of obtaining finance external to the firm becomes easier as long as the patent is 'strong' in terms of remaining useful life, novelty, and commercialisability. In terms of the financing contracts, we expect the above signals to work well with equity suppliers rather than banks since banks cannot afford costly verification and process the signals for each contract, while benchmarks like collateralization and credit ratings are easier filters (in terms of credit rationing). In order to overcome the information inefficiencies with respect to debt, equity therefore serves as an option (Hillier, 1997). Innovating nascent entrepreneurs therefore would find it difficult to signal to the banks as well as equity suppliers, since the type of signals needed are different.

While patenting indicates the *characteristics* and *information* the agent is endowed with, a prototype particularly acts as a signal for the *ability* of the agent. What is ability in the eyes of an investor? Broadly we can think of manufacturing ability, ability to ensure a sound pricing and costing strategy.

This would mean a big step ahead of the business plan. Every principal seeks to find such agents that would signal future plans and profitability as accurately as possible. Even though planning techniques exist as well as advanced to provide accurate numeric forecasts, the ability of a prototype to signal success/failure of the start-up is higher.

As observed earlier, a reduction of information asymmetries and the quality of a signal remains a crucial step in reducing financing constraints. A stronger signal that can substantially reduce information asymmetry is the development of a prototype.

Prototyping is a crucial step in the commercialization process. In some cases prototyping makes patenting easier, and in some cases it serves as a crucial link to the patent and final realization of the finished marketable product. When an agent possesses a prototype, she can clearly determine the processes required for large-scale production, the resources needed and the best suppliers can be charted out. Hence production plans can be strengthened. Once the production plans are clearly defined the costs and hence the pricing strategy can be accurately approximated by the agent. Business plan projections become much accurate and hence having a prototype serves as a signal to decrease information asymmetry. It also increases the scope and scale of appropriability by enabling the agent to benefit from subsequent intellectual property rights, such as design rights (on the prototype and production designs), copyrights and trademarks etc. Therefore, the expected benefit from investing in a start-up having prototypes tends to be high for investors, thus increasing the probability of the agent to obtain external finance. As is well known therefore, the higher the ability, the higher will be the likelihood of obtaining external funding. This tends to be most relevant in the case of nascent entrepreneurs confronting the most severe credit rationing, as well as information asymmetry problems. A nascent entrepreneur who possesses both a patent and prototype therefore has an advantage in terms of obtaining external finance. This tendency may not be straightforward and may be affected by the sector (in some sectors patenting is not the first priority) and risk taking attitude of the investor, even though

the signals are strong and reduce extent of information asymmetry. Such a case would happen mainly when the entrepreneur is in the juncture between the idea and an actual start-up.

The above analysis leads us to formulate two hypotheses, mainly,

- Hypothesis 1: The probability of obtaining external finance (hence decrease in financial constraints) is greater if the nascent entrepreneur signals underlying knowledge by holding a patent.
- Hypothesis 2: The probability of obtaining external finance is greater for the nascent entrepreneur when she holds both a patent and a prototype.

3 Data

To test the two main hypotheses linking the capital structure of nascent entrepreneurs to their ability to undertake and signal innovative activity, the types of data sets providing information about the financial structure of (new) firms that have been used in previous studies are of little use. This is because of the focus in this paper on nascent entrepreneurs rather than established firms, however young they may be. Thus, a very different type of data set providing information on both individuals who are considering launching a new venture, that is nascent entrepreneurs, as well as their innovative activity and financial prospects is required to test the hypotheses posited in the previous section.

3.1 The Innovative Nascent Entrepreneurs Database (INED)

Thus, in this paper a new data set is developed and applied, which consists of 4,122 entrepreneurs (including individuals who are considering launching a new business), investors and others. The data set was created for the Ewing Marion Kauffman Foundation by the Center for Innovative Entrepreneurship (CIE) in May-June, 2005 and consists of a web-based survey of potential entrepreneurs. The aim of that project was to investigate whether the web site of a venture capital directory can be used as a research tool. For this purpose, CIE surveyed visitors of the web site <http://www.vfinance.com>, which is a location

for entrepreneurs seeking finance and interested in finding the names of potential angel investors or venture capital firms. CIE implemented the survey using two methods. This first was to send each web site visitor an email inviting her to participate in the survey. The second method involved soliciting a random sample of web site visitors to participate in the survey. An important qualification of this data base involves selection bias. The data base consists solely of individuals sufficiently interested in obtaining finance that they visited the web site. Thus, individuals not interested in obtaining finance for a new venture are not included in the data base. However, it is important to emphasize that the two major hypotheses do not imply starting with a sample of individuals representative of the overall working population and then identifying which ones constitute nascent entrepreneurs. Rather, in this study the starting point should consist of individuals who are already nascent entrepreneurs. Thus, the appropriate data base should exclude those not considering launching a new venture and include only those individuals who can be reasonably classified as being a nascent entrepreneur. Thus, while the well-known PSED (Panel Study of Entrepreneurial Dynamics), for instance, is a representative sample of American adults and was initiated to "provide systematic, reliable and generalizable data on important features of the entrepreneurial or start-up process" (Reynolds, Carter, Gartner, & Greene, 2004), it is more appropriate for testing hypotheses distinguishing between nascent and non-nascent entrepreneurs. While the sampling mechanism used in PSED is appropriate to generate a sample that is nationally representative with respect to population characteristics, like age or education, it might not be ideal to analyze innovative nascent entrepreneurs' sources of external finance, where a data base consisting solely of innovative nascent entrepreneurs is more appropriate.

As pointed out by Davidsson (2006, p. 55) the downside of the 'representative' sample provided by the PSED "is that the sample will be very heterogenous and dominated by imitative, low-potential ventures." He therefore suggests to "use other sampling mechanisms than probability sampling in order to get sufficient numbers of high-tech firms, for instance" (Davidsson, 2006,

p.56). In this respect, the data base used in this paper based on the CIE survey is a valuable source of information about innovative nascent entrepreneurs, who are, by definition, *seeking capital*. Moreover, As the descriptive statistics presented in Section 4 show, the fraction of innovative entrepreneurs included in this data base is strikingly high.

3.2 Defining and Measuring nascent entrepreneurs

While the PSED data base consists of a sample presumably reflecting characteristics of the overall population, We created the Innovative Nascent Entrepreneurs Database (INED) from the CIE survey to consist solely of nascent entrepreneurs. However, in creating the INED, the similar criteria were used that a respondent had to meet in order to be considered as a nascent entrepreneur. In particular, for an individual to be classified as a nascent entrepreneur in the PSED, this involved each record meeting three criteria: (1) “now trying to start a new business, (2) “currently active in a startup effort and ”anticipates part or full ownership of the new business”, and (3) “has NOT yet attained positive monthly cash flow that covered expenses and the owner-manager salaries for more than three months (Reynolds et al., 2004, p. 268).

For the Innovative Nascent Entrepreneurs Database (INED), an individual was similarly classified as being a nascent entrepreneur if the three following analogous conditions were met:

- the individual is seeking capital to start a new business,
- the individual intends to be owner or part owner of the business, and
- business has not generated revenues in 2004 and 2005,

Respondents claiming zero percent ownership or that positive revenues were generated in 2004-2005 were not classified as being nascent entrepreneurs. The questions included in the survey are included in the appendix. The sample can be distinguished as consisting of two major groups, or sub-samples - a group of individuals engaged in the planning stage for starting a new firm and the group of individuals actually engaged in the launch of a new venture. An individual

was classified as a planning stage nascent entrepreneur, or belonging to the former group, if she was (1) planning to start a new business, and (2) the start-up is not a business, in that it is not in operation and no products or services have been launched or offered for sale. By contrast, a respondent was classified as being in the latter group if a venture has been launched but is not generating revenue, and if at least a concept has been developed.

Those who reported that they started their business before 2005 and/or that the number of employees, not counting the owners, exceeds one were excluded from the first group (planning stage nascent entrepreneurs). Similarly, those respondents reporting that they started their business before 2003 and/or that the number of employees exceeds ten were excluded from the second group (incipient start-ups). These stringent criteria were for classifying nascent entrepreneurs as either planning stage or incipient start-ups were applied to maintain the integrity and consistency of the data.

External source of finance: The data set contains information about the sources of business financing. Entrepreneurs reported whether they used the following external financing sources to establish their business: 1) bank loans to the business, 2) home equity loan in an owner's name, 3) other bank loans in an owner's name, 4) venture funds in exchange for stock/ownership in company and 5) individual investors or companies in exchange for stock/ownership in company. While the first three sources are indicators for debt, the last two sources represent indicators for equity. The consistency of the responses were checked and verified. First, those records where respondents reported equity finance and 100 percent ownership were excluded from the sample. Second, those records where a respondent reported owning zero percent of the business and at the same time reported having equity as a source of business financing were also excluded from the sample.

Innovation: In the survey entrepreneurs were asked the following question, "Does your business own or have you applied for a patent that is essential to the business?" A nascent entrepreneur is classified as being innovative or at least

engaged in a knowledge-based start-up if the answer is YES. Alternatively, the development of a prototype can be viewed as an indicator of innovation. The dataset provides information about this and it will be discussed in Section 6.

Business relevant information: The data set contains additional information about the entrepreneur and the proposed startup. In particular, records indicate whether a business plan was written, whether the business has international links, whether the respondent is a serial entrepreneur, whether the business was started by a single person or a team of people and whether the respondent owns a house that can be used as collateral (see Appendix for the questions asked).

4 External source of finance and start-up characteristics

The means and standard deviations of all variables are reported in 1. As can be seen from the table, 12 percent of the nascent entrepreneurs in the planning stage use debt as an external source of finance. By contrast, 19 nascent incipient entrepreneurs in the very early stage of the venture rely on debt. With respect to equity finance, the difference between both the planning and incipient entrepreneurs is even larger. While only 6 percent of nascent entrepreneurs in the planning stage have equity finance, more than 20 percent of the nascent entrepreneurs in the early start-stage have equity finance. These differences are statistically significant at the 1 percent level. Nascent entrepreneurs in the planning stage choose either debt (25) or equity (50), whereas only one entrepreneur of this group relies on both, debt and equity. In the early start-up stage 19 entrepreneurs rely on both sources of external finance while 73 choose only equity and 79 choose only debt.

The fraction of innovative nascent entrepreneurs, which includes those with a patent application or ownership of a business related patent, increases from 15.5 percent in the planning stage to more than 20 percent in the early start-up stage. An even stronger increase can be observed for the fraction of en-

trepreneurs who report to have developed prototypes. It is 6.1 percent in the planning stage and 25.2 percent in the early start-up stage. In the group of entrepreneurs in the planning stage, 66 applied for a patent or own one and 32 percent of these have also developed a prototype. In the early start-up stage, 155 new ventures have patents or have applied for patents, and 47 percent of these innovative start-ups have also developed a prototype. Although we do not know whether the patents are related to the prototype, it is likely that at least some of the nascent entrepreneurs try to protect their business relevant innovation (prototype) through patents.

[insert table 1 about here]

As can be seen from the table, 63 percent of the nascent entrepreneurs in the planning stage have developed a concept while 30 percent of them are still in the process of developing a concept. As can be expected, the fraction of nascent entrepreneurs that have developed only a concept is significantly smaller for the group of nascent entrepreneurs in an early start-up stage. Most of them report 'start-up operation' but only 4.6 percent have already launched a product or services. However, this is not surprising since these are start-ups that have not yet generated revenue.

There are also significant differences between both groups with respect to the fraction of those entrepreneurs who have written a business plan, who have established links with international partners and who have previously started a business.. In the group of incipient nascent entrepreneurs, these fractions are larger. Moreover, there are more serial entrepreneurs in this group and more team start-ups. The large fraction of teams (50 percent) is consistent with the prevalence of teams reported by the PSED.

[insert table 2 about here]

Table 2 reports the number and share of nascent entrepreneurs who have chosen debt and/or equity finance for sub-samples of innovative (with a patent) and non-innovative (without a patent) nascent entrepreneurs. In the planning stage the fraction of innovative nascent entrepreneurs without external finance (14.6 percent) corresponds with their fraction in the total sample (15.5). With

respect to debt and equity they are slightly over-represented in this stage. In the incipient stage, however, they are under-represented in the category 'no external finance' and they are over-represented with respect to equity finance. This points to a remarkable change in the capital structure between these early stages of the new venture.

One obvious explanation for the significant differences between nascent entrepreneurs in the planning stage and their counterparts in the incipient stage of launching a new venture is that at least some of the start-up characteristics may reflect the probability of making a transition from the a nascent entrepreneur in the planning stage to a nascent entrepreneur in the early start-up stage. Consequently, the fraction of start-ups with these characteristics would be higher in later stages of the start-up. (S. C. Parker & Belghitar, 2006) investigated the decision of nascent entrepreneurs to quit, to remain a nascent entrepreneur or to start a new firm. They found, for instance, that preparing business plans and having experience in business ownership do not influence the decision by nascent entrepreneurs, whereas team ventures are less likely to make the transition from planning stage to launching the new venture. Another interpretation is that many nascent entrepreneurs may begin to write business plans, intensify their innovation efforts or try to establish links to international partners once they have taken the decision to launch a new venture.

In summary, the descriptive statistics suggest that the decomposition of the sample into two groups is reasonable since both groups differ with respect to relevant business characteristics. In the econometric analysis we will therefore investigate each group separately to test how innovative activity influences the capital structure of nascent entrepreneurs.

5 Econometric Model

Suppose that a nascent entrepreneur i can choose between sources of finance j which differ with respect to the expected profit, i.e. each of them is associated with certain costs. A profit-maximizing entrepreneur will opt for the alternative (denoted π_{ij}) which yields the maximum profit among the four financing

alternatives (no external finance, debt, equity and debt & equity).

$$\pi_{ij} = \text{Max}(\pi_{i0}, \pi_{i1}, \pi_{i2}, \pi_{i3}) \quad (1)$$

The profit associated with each of these sources of finance is assumed to be determined by business-specific factors x ,

$$\pi_{ij} = x_{ij}\beta + u_{ij}, \quad i = 1, \dots, N \quad j = 0, \dots, 3. \quad (2)$$

where β is a parameter vector, u_{ij} is an error term and i denotes the nascent entrepreneur. The profit associated with each financial decision is an unobservable latent variable. What can be observed, however, are the entrepreneurs' choices of financial sources. If source j is chosen, we assume that this decision is the most profitable one ($\text{Prob}(\pi_{ij})$).

The business-specific factors x might be, for instance, patents, developed products, a business plan, international links or collaterals. These factors may have different effects on the costs of each alternative and may consequently influence the relative profits. A venture capitalist, for instance, will usually call for a sound business plan. For a nascent entrepreneur without such a business plan, it might be very costly to elaborate and write it and therefore other sources of finance might be preferred. As explained in the Section, endowments of a start-up are only given in the short run.

If the J disturbances of equation (2) are independent and identically distributed with type I extreme distribution, then the multinomial logit model can be written as follows ³

$$P_{ij} = \text{Prob}(\pi_{ij} = 1 \mid x_i) = \frac{e^{\beta_j' x_i}}{1 + \sum_{k=0}^3 e^{\beta_k' x_i}} \quad \text{for } j = 0, \dots, 3, \beta_0 = 0. \quad (3)$$

where one of the coefficient vectors is normalized to zero in order to achieve identification. The multinomial logit model implies that the log ratio of the probabilities for any two financial decisions j and k is given by

$$\ln \left[\frac{P_{ij}}{P_{ik}} \right] = x_i'(\beta_j - \beta_k) = x_i' \beta_j \quad \text{with } \beta_k = 0. \quad (4)$$

³See Greene, 2003, pp.720-723.

This means that the estimates of β_j reflect the marginal effect of a change in an explanatory variable x_i on the log-odds ratio of j and the baseline category k . Note, that sign and magnitude of this coefficient are not necessarily identical with the marginal effect of a change in x_i on probability P_{ij} . The latter can be calculated as follows

$$\frac{\partial P_j}{\partial x_i} = P_j \left[\beta_j - \sum_{k=0}^3 P_k \beta_k \right] = P_j [\beta_j - \bar{\beta}]. \quad (5)$$

In order to analyze the determinants of nascent entrepreneur's choice between debt, equity or no external finance at all we estimate a multinomial logit model (MNL). Estimates of the marginal effects of changes in explanatory variables on probabilities of each financial decision will be presented in section 6.1.

6 Results

6.1 Estimation Results

In this section we will present estimates which are obtained from separate estimations of the MNL model for nascent entrepreneurs in the planning stage and nascent entrepreneurs in the early start-up stage. We did not differentiate between nascent entrepreneurs who rely only on equity finance and those who rely on both, equity and debt. Instead, we estimated the MNL model with the three categories 'no external finance', 'debt finance' and 'both sources of external finance'.⁴

A basic assumption of the MNL model is that irrelevant alternatives are stochastically independent from each other (Independence from Irrelevant Alternatives (IIA)-assumption), i.e. the odds ratios in the MNL model are independent of the probabilities of other alternatives (Greene, 2003, p.724). Intuitively, the IIA assumption is not very plausible if nascent entrepreneurs view two alternatives as similar rather than independent. Therefore, we tested for

⁴For the group of entrepreneurs in the planning stage this distinction would be since only one entrepreneur has both, debt and equity. For the other group a Wald test of whether the two categories 'only equity finance' and 'both sources of finance' can be combined suggest that this is the case. Further Wald tests reject the Null hypothesis that these categories can be further collapsed indicating that significant differences between the determinants of external sources of finance exist. Test results are available from the authors upon request.

the validity of this assumption. We performed a Hausman-test and the test results suggest that the null hypothesis of IIA cannot be rejected for both groups (planning stage, early start-up stage).⁵

The *marginal effects* of the explanatory variables on the probabilities of each category are reported for the group of nascent entrepreneurs in the planning stage and for the group of nascent entrepreneurs in an early start-up stage in Table 3. As can be seen from this table, nascent entrepreneurs in the planning stage who have a business plan, who have started a business before and who (or family members) own a house have a lower probability of having no external sources of finance. The probability of having debt finance is positively affected by the existence of a business plan and by house ownership. Obviously, the existence of collateral is very relevant for bank loans – as expected. In contrast, a business plan and a developed concept have a positive impact on getting equity. Moreover, being a team start-up reduces the probability of debt finance whereas it is positive for equity.

Results are different for the early start-up stage. Here, the probability of having no external sources of finance decreases if a start-up owns a patent or has applied for patent, has developed a prototype, has launched products/services or has established international links. Again, serial entrepreneurs and team start-ups have a higher probability of choosing external finance. The probability of debt finance is higher if a start-up has launched product/services and as in the planning stage team start-ups have a lower probability of debt finance and existence of collateral increases this probability. The probability of equity finance is higher for start-ups that have developed a prototype and that have contracted with companies or individuals outside the United States for goods or services. As in the planning stage, team start-ups and start-ups with a business plan are more likely to choose equity.

[insert table 3 about here]

[insert table 4 about here]

⁵This test compares the estimated coefficients of a model using all three categories and a subset where one of the categories is excluded. If the IIA assumption holds, then the estimation of the restricted and the unrestricted model should provide similar estimates.

The statistically insignificant effect of patents for equity finance might be explained by the fact that many start-ups with a prototype do also report that they have applied for a patent or own a patent. Therefore, we performed additional estimations which take this into account by differentiating between start-ups that report only a patent, start-ups that have a prototype but no patent and start-ups that have both. The estimation results are reported in Table 3. For the group of entrepreneurs in the planning stage the estimations results are hardly affected. For the group of entrepreneurs in an early start-up stage, however, results do now show that especially start-ups that report both, patents and prototypes, have a higher probability of being externally financed and in particular the probability of equity finance is positively affected. However, results also show that start-ups with a prototype but no patent have a higher probability of equity finance while this is not the case for start-ups with patents but no prototype.

Although not reported here, we have also conducted estimations where we controlled for industry effects as well as personal characteristics of the NEs, like education, age or gender. The basic results with respect to the relevance of patents and prototype are, however, not affected.⁶

6.2 Discussion of estimation results

The empirical results suggest that innovative start-ups - with patents and prototype - are more likely to be externally financed, especially by business angels and venture capitalists. It seems that technical knowledge per se does not have a positive influence on the mode of finance. A significant effect only emerges if patents are combined with the development of a prototype. One explanation for this result is that the development of a prototype reduces information asymmetries and resolves the problem of uncertainty associated with the outcome of innovation efforts. Hence, the expected value of an innovative new venture may be more predictable than for non-innovative new ventures. The finding that a prototype in combination with patent activity has a higher marginal and

⁶The estimation results are available from the authors upon request

statistically more significant effect on the probability of equity finance as compared to the development of a prototype without having a patent suggests that a new venture is better situated to appropriate the benefits from innovative activity, when the underlying intellectual property is, in fact, legally protected by patents. On the one hand, innovation cannot be easily imitated by competitors. On the other hand, opportunistic behavior of the investor is also less likely which may make the NE more willing to accept equity, i.e. a close relationship and share of ownership with the investor.

Our results extend the findings of empirical studies by looking at the stage-wise preference for finance. Studies like Audretsch and Lehmann (2004)⁷ posit that small, young and innovative firms find it difficult to obtain external finance and their general preference would be towards new equity since debt is unavailable and in some cases not enough to finance subsequent innovative activity. We argue that even though this may be true, the preference or for that matter the combinations that the entrepreneurs confront may change depending on the new venture stage. Acs (2002) finds that small innovative firms have a greater propensity for debt, which we view depends on the stage of the firm. These firms may rely on more risky sources of finance until sufficient retained earnings are established, since internal finance is found to be crucial for further R&D (Himmelberg & Petersen, 1994), and then the next option would be debt, since the collateral requirements in terms of fixed assets, cash position, may be met.

This supports a proposition that the *pecking order* financing (Myers & Majluf, 1984) may change not in its usual order of retained earnings, debt, inside equity and outside equity, right from the stage 1 of firm growth, but rather this ordering may change in very early stages. We suspect that the ordering hierarchies keep changing until the firm sufficiently matures enabling it to build its retained earnings and fixed assets and then the usual pecking order could be followed. What follows therefore is that in the very early stages, the start-ups may have to accept the risk in return for a lower likelihood of survival. The

⁷some more examples are: Stewart Thornhill (2004), Carpenter and Petersen (2002), Mueller and Zimmermann (2006), Baldwin and Gellatly (2004)

other interesting finding is that the probability of obtaining external finance and the tendency toward equity increases with the knowledge endowments of the new venture, which suggests that the mode of finance depends on the growth of knowledge endowments and this growth, in turn, may be an investee induced growth or investor encouraged growth, which we term as learning effects on financing strategy.

7 Conclusion

Perhaps in response to a growing concern that financing constraints (adversely) impact innovative activity and ultimately growth, a large and compelling literature has recently emerged analyzing the links between the mode of finance and firm characteristics. However, these studies have been restricted to analyzing how existing, incumbent firms are subjected to financing constraints. Yet, it may be that financing constraints have the greatest impact on potential entrepreneurs' deterrence from even starting their firm. In this paper we therefore shift the lens away from established, incumbent firms, to nascent entrepreneurs. In particular, the relationship between the innovation activities of nascent entrepreneurs and their financial decisions is analyzed. The paper argues that innovative nascent entrepreneurs are especially vulnerable to problems in procuring external finance because of uncertainty, appropriability problems and information asymmetries.

We developed two hypotheses in this paper: First, nascent entrepreneurs who can protect their proprietary intellectual property through patents have a higher probability of getting obtaining finance, and second, nascent entrepreneurs who can signal reduced uncertainty with respect to innovation outcome have a higher probability of obtaining external finance. The estimation results provide evidence in support of both hypotheses. In particular, our results indicate that innovative nascent entrepreneurs have a higher probability of obtaining equity than do non-innovative entrepreneurs. In contrast, the likelihood of debt finance is not affected by innovative activity. However, the positive effect on equity does only occur if nascent entrepreneurs have successfully developed a prototype and

also have patented an invention or have applied for a patent. One interpretation of this result is that the development of a prototype reduces information asymmetries and resolves the problem of uncertainty associated with the outcome of innovation efforts. While prototypes may signal less risk, patents may signal that the nascent entrepreneur is well positioned to appropriate the returns from her investment in intangible assets.

Moreover, the share of new ventures which are innovative increases remarkably between the planning stage of a start-up and the incipient or early start-up stage. Other business related characteristics, such as international orientation, participating in a team venture, or the existence of a business plan also influence the likelihood of obtaining external finance. While a large literature has emerged analyzing the financial decisions of firms, virtually no study has yet been undertaking examining the financial decisions of innovative nascent entrepreneurs. Previous studies in the fields of economics and finance focused primarily on firm characteristics, industry characteristics or macroeconomic effects. Few studies have considered the decision making by potential entrepreneurs that can ultimately lead to the start-up of a new venture and what the role of finance plays in shaping the process by which such new ventures are launched. Hence, this paper contributes to the existing literature.

Future theoretical research could formalize the learning process of innovative nascent entrepreneurs and investors through the signals that are exchanged. Another fruitful research opportunity involves the construction and application of panel data sets to analyze the financial decisions of innovative nascent entrepreneurs. This would, for example, enable new insights into the impact of financial decisions on the performance of new ventures as they evolve over the life cycle. One thing is clear from this paper, however. The ease to which external finance can be obtained impacts considerably more than existing, incumbent firms. Rather, it also impacts the decision and ability of potential or nascent entrepreneurs in launching new ventures as well.

A Questions

Defining and identifying nascent entrepreneurs

- Which category best describes you? (Answer: Entrepreneur seeking capital to start a new business, Entrepreneur seeking capital for an operating business; Entrepreneur interested in business planning services or seminars; Visitor searching for general information about raising capital; Investor interested in investment opportunities; vFinance Investments Client; vFinance Employee or Associate.)
- Are you actively involved in running this business? (Answer: YES/NO)
- What percent of this business do you own? (Answer: 0, 1 - 25, 26 - 50, 51 - 75, 76 - 99, 100)
- Did your business generate revenue in the first quarter of 2005 (January 2005 through March 2005)? (Answer: YES/NO)
- 2004 revenue. In U.S. dollars? (Answer: Over 10 million, 5 million to 10 million, 1 million to 5 million, 500,000 to 999,999, 250,000 to 499,999, 150,000 to 249,999, 100,000 to 149,999, 75,000 to 99,999, 50,000 to 74,999, 25,000 to 49,999, 1 to 24,999, No revenue in 2004.)

Distinguishing between planning stage and early start-up stage

- Which of these best describes you? (Answer: I currently own and operate a business; I am planning to start a new business; I am interested in private investments in businesses; None of the above.),
- Where is your business in the start-up process?”. (Answer: concept in development, concept developed, prototype developed, start-up operation or product/service launched.)

External sources of finance

- What sources of business financing have you already used to establish this business? (Answer: bank loans to the business, home equity loan in an owner's name, other bank loans in an owner's name, venture funds in exchange for stock/ownership in company, individual investors or companies in exchange for stock/ownership in company.)

Business characteristics

- Does your business own or have you applied for a patent that is essential to the business? (Answer: YES/NO)
- Has your business contracted with any companies or individuals outside the United States for goods or services? (Answer: YES/NO)
- Do you have a written business plan for your business? (Answer: YES/NO)
- Have you started another business before this business? (Answer: YES/NO)
- Do you or anyone in your household own your residence? (Answer: YES/NO)
- Which of the following best describes how your business was started? (Answer: A new business created by a single person; A new business created by a team of people; A business inherited from someone else; Purchase of an existing business; Purchase of a franchise)

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Table 1: Descriptive statistics

Variable	planning stage		early start-up stage		Z-test
	Mean	Std. Dev.	Mean	Std. Dev.	
Debt	0.120	0.325	0.192	0.394	3.0*
Equity	0.061	0.240	0.204	0.404	6.3*
Patents	0.155	0.362	0.323	0.468	5.9*
Concept in development	0.296	0.457	N.A.	N.A.	N.A.
Concept developed	0.636	0.482	0.304	0.461	-10.0*
Prototype developed	0.068	0.252	0.260	0.439	7.7*
Start-up operation	N.A.	N.A.	0.390	0.488	N.A.
Product/service	N.A.	N.A.	0.046	0.209	N.A.
Business plan	0.601	0.490	0.835	0.371	7.9*
Serial entrepreneur	0.467	0.500	0.600	0.490	4.0*
International links	0.110	0.314	0.215	0.411	4.2*
Team	0.340	0.474	0.479	0.500	4.2*
House	0.587	0.493	0.625	0.485	1.2

Notes: All variables are dummy variables that take on the values one or zero. N.A. means not applicable. Z-test for the equality between two proportions: * denotes significant at the 1 percent level.

Table 2: Descriptive statistics: patents and sources of finance

planning stage					
	no external	debt	equity	both	Total
no patents	299 (85.4)	40 (80.0)	20 (80.0)	1 (100.0)	360 (84.5)
patents	51 (14.6)	10 (20.0)	5 (20.0)	0 (0.0)	66 (15.5)
	350 (100)	50 (100)	25 (100)	1 (100)	426 (100)
early start-up stage					
no patents	229 (74.1)	49 (67.1)	34 (43.0)	13 (68.4)	325 (67.7)
patents	80 (25.9)	24 (32.3)	45 (56.7)	6 (31.6)	155 (32.3)
	309 (100)	73 (100)	79 (100)	19 (100)	480 (100)

Notes: Percentage in parentheses.

Table 3: Determinants of nascent entrepreneurs' external sources of finance

Variable	planning stage			early start-up stage		
	No	Debt	Both	No	Debt	Both
Patents	-0.019 (0.048)	0.028 (0.045)	-0.009 (0.017)	-0.105** (0.052)	0.041 (0.041)	0.064 (0.039)
Prototype devel.	-0.139 (0.13)	-0.021 (0.048)	0.160 (0.14)	-0.122* (0.065)	-0.0335 (0.044)	0.155*** (0.058)
Concept devel.	0.0192 (0.039)	-0.0547 (0.034)	0.036* (0.020)	N.A.	N.A.	N.A.
Start-up oper.	N.A.	N.A.	N.A.	-0.037 (0.055)	0.036 (0.042)	0.001 (0.043)
Product/service	N.A.	N.A.	N.A.	-0.211* (0.12)	0.211* (0.12)	-0.001 (0.093)
Business plan	-0.095*** (0.031)	0.0558** (0.027)	0.0394** (0.018)	-0.0178 (0.059)	-0.056 (0.049)	0.074* (0.040)
Serial entrep.	-0.053* (0.031)	0.0323 (0.028)	0.0202 (0.016)	-0.106** (0.044)	0.060* (0.033)	0.046 (0.035)
Internat.links	-0.079 (0.059)	0.0346 (0.050)	0.0445 (0.036)	-0.116** (0.058)	0.0094 (0.043)	0.107** (0.047)
Team	0.024 (0.033)	-0.0615** (0.026)	0.0373* (0.021)	-0.135*** (0.046)	-0.0616* (0.034)	0.197*** (0.037)
House	-0.094*** (0.032)	0.115*** (0.028)	-0.0215 (0.016)	-0.132*** (0.043)	0.114*** (0.032)	0.0178 (0.035)
χ^2 -statistic	60.48			109.9		
Pseudo R ²	0.122			0.128		
Actual Frequ.	350	50	26	309	73	98
Pred. Frequ.	373	39	14	334	71	75

Notes: Multinomial Logit Estimation results. The standard errors are reported in parentheses.

The asterisks *, ** and *** denote significant at the 10, 5 and 1 percent level respectively.

The estimates reflect the marginal effects of a change of the respective dummy variables from 0 to 1.

Table 4: Determinants of nascent entrepreneurs' external sources of finance

	planning stage			early start-up stage		
Variable	No	Debt	Both	No	Debt	Both
Patents/protot.	-0.140 (0.13)	-0.005 (0.057)	0.145 (0.13)	-0.272*** (0.080)	0.009 (0.057)	0.263*** (0.081)
Only prototype	-0.121 (0.17)	0.0162 (0.11)	0.105 (0.15)	-0.0929 (0.089)	-0.067 (0.047)	0.160* (0.087)
Only patents	-0.020 (0.052)	0.035 (0.050)	-0.015 (0.017)	-0.077 (0.065)	0.016 (0.048)	0.061 (0.054)
Concept devel.	0.019 (0.039)	-0.055 (0.034)	0.036* (0.020)	N.A.	N.A.	N.A.
Start-up oper.	N.A.	N.A.	N.A.	-0.036 (0.054)	0.035 (0.042)	0.001 (0.043)
Product/service	N.A.	N.A.	N.A.	-0.215* (0.12)	0.216* (0.12)	-0.001 (0.094)
Business plan	-0.094*** (0.031)	0.055** (0.027)	0.039** (0.018)	-0.021 (0.059)	-0.053 (0.049)	0.074* (0.040)
Serial entrep.	-0.052* (0.031)	0.032 (0.028)	0.020 (0.016)	-0.107** (0.044)	0.061* (0.033)	0.047 (0.035)
Internat.links	-0.080 (0.059)	0.035 (0.050)	0.045 (0.036)	-0.116** (0.058)	0.010 (0.043)	0.107** (0.047)
Team	0.025 (0.033)	-0.063** (0.026)	0.038* (0.021)	-0.137*** (0.046)	-0.060* (0.034)	0.197*** (0.038)
House	-0.094*** (0.032)	0.115*** (0.028)	-0.021 (0.016)	-0.135*** (0.044)	0.117*** (0.032)	0.019 (0.035)
χ^2 -statistic	60.58			111.1		
Pseudo R ²	0.122			0.129		
Actual Frequ.	350	50	26	309	73	98
Pred. Frequ.	373	39	14	334	71	75

Notes: Multinomial Logit Estimation results. The standard errors are reported in parentheses.

The asterisks *, ** and *** denote significant at the 10, 5 and 1 percent level respectively.

The estimates reflect the marginal effects of a change of the respective dummy variables from 0 to 1.