

# “Capital structure decision of new technology-based firms: evidence from youth entrepreneurship”

## AUTHORS

Lucio Cassia  
Tommaso Minola

## ARTICLE INFO

Lucio Cassia and Tommaso Minola (2011). Capital structure decision of new technology-based firms: evidence from youth entrepreneurship. *Investment Management and Financial Innovations*, 8(4)

## RELEASED ON

Friday, 20 January 2012

## JOURNAL

"Investment Management and Financial Innovations"

## FOUNDER

LLC “Consulting Publishing Company “Business Perspectives”



NUMBER OF REFERENCES

0



NUMBER OF FIGURES

0



NUMBER OF TABLES

0

© The author(s) 2025. This publication is an open access article.

Lucio Cassia (Italy), Tommaso Minola (Italy)

## Capital structure decision of new technology-based firms: evidence from youth entrepreneurship

### Abstract

The paper investigates the existence of a pecking order in new technology-based firms (NTBFs) financing, and provides an evidence on factors determining what source of capital NTBFs try to access. The authors pay particular attention to aspects of human capital such as age, education and experience and focus on potential singularities exhibited by young novice entrepreneurs and potential constraints that they experience. These entrepreneurs are found not to be financially constrained. The findings also contribute to the academic debate on the existence of a reversed pecking order for NTBFs. Results confirm traditional pecking order patterns and show that NTBFs do rely heavily on external debt, contradicting the most common theoretical predictions. However data also suggest that (as a new perspective) some light can be shed on the hierarchy between debt and equity as financial source preferred by NTBF when it is investigated from a longitudinal rather than a cross-sectional perspective.

**Keywords:** pecking order, venture capital, bank, NTBFs, entrepreneurial finance.

**JEL Classification:** G32, G24, M13, O32.

### Introduction

This paper addresses emerging issues in entrepreneurial finance by investigating funding decisions made by new firms in their initial years of operation. We pay particular attention to new technology-based firms (henceforth NTBFs) because they are widely considered as important in the development of innovation and competitiveness in modern economies (Acs and Muller, 2006; Audretsch, 1995; Cassar, 2004). Our work also attempts to shed light on the phenomenon of youth entrepreneurship by investigating the degree to which the fact that an entrepreneur is young and inexperienced in business relates to financial decision-making and the capital structure of a firm. In this work, NTBFs run by owners under the age of forty with no previous entrepreneurial experience are referred to as young novice NTBFs.

Our work aims to contribute to research on human capital in NTBFs and to the debate on policies for youth entrepreneurship. Even though the importance of entrepreneurship in the development of national economies is widely recognized there is a specific lack of systematic planning and implementation of activities and programs directed towards boosting youth entrepreneurship and this is even more relevant when considering such social issues as the high level of unemployment affecting young people (Schoof, 2006). Entrepreneurship can play a role in reducing the risk of social exclusion and there are more and more employment opportunities for a

number of highly educated young people in new ventures in the field of ICT and biotechnologies (Xheneti, 2007).

The paper describes an empirical study on restricted-access data taken from the Kauffman Firm Survey (KFS) (a survey that annually tracks nearly 5,000 US firms in business since 2004) and is built on previous works dealing with financial choices of new firms in the same dataset which found that NTBFs rely heavily on external debt sources and less so on friends and family-based sources (Robb and Robinson, 2009). These findings are robust, surprising and demand more thorough investigation since heavy reliance on external debt implies that well functioning credit markets are essential if nascent businesses are to be successful. The findings are also somewhat counterintuitive when the extensive literature on new venture financing is consulted (e.g., Carpenter and Petersen, 2002). Such literature has introduced the idea of a revised version of the pecking order in the case of innovative firms; these firms may resort to bank financing only after having attempted to obtain funding from business angels and venture capital firms (henceforth BAs and VCs respectively) (Sau, 2007), since these investors may assess business ideas more clearly than other investors and have the facilities to finance and support NTBFs.

Coherently with Atherton (2009) we believe that by including the aspect of human capital into this research perspective theoretical added value can be provided. As a contribution to the literature, the research attempts to associate human capital determinants (age, experience and education) with recourse to external capital. Based on extant literature, we investigate the determinants of selection of funding source by NTBFs and make a distinction between young novice NTBFs (see definition above) and more mature and experienced NTBFs.

---

© Lucio Cassia, Tommaso Minola, 2011.

Authors wish to thank A. Robb and E.J. Reedy and the Kauffman Foundation for the support in the access to data and suggestions while developing the research. Authors are also grateful to the participants to the KFS Workshop in Lausanne (Switzerland, June 2010) and Second International Symposium Entrepreneurship Today 2010 in Bergamo (Italy, September 2010).

The paper is structured as follows. Section 1 recalls the main theories of corporate and entrepreneurial finance; section 2 discusses the relevance of age, experience and other human capital variables to the issue of NTBF funding; section 3 sets out the research objectives, shows why the research is original and the reasoning behind the methodology used. Section 4 presents the empirical evidence of the study and the conclusions are presented in the final section.

## 1. Review of literature on NTBF financing

One of the most relevant questions of entrepreneurship research is how innovative business start-ups are normally financed and how they should be financed. Since the type of capital sourcing can have important implications for the potential for future business expansion, and bearing in mind the role played by new enterprises in providing employment, in innovation and in the development of national economies (Cassar, 2004), decision-making regarding sourcing of capital has a strong impact on economic literature and policy. NTBFs play a key role in translating scientific progress into commercial product and in spreading innovation. Understanding the dynamics of financial constraints that they face, especially at start-up, and what influences them, may help policy makers to come to decisions about the best way to support these new businesses (Hogan and Hutson, 2005).

The theoretical frameworks most often used to explain the capital structure of firms tend to refer to either trade-off or pecking order theory. Trade-off theory takes account of several aspects which heavily influence the financing of new firms: agency costs due to external financing (Myers, 1977); the exposure of firms to the risk of bankruptcy and related costs (Harris and Raviv, 1991) and the availability of tax benefits associated with debt use (DeAngelo and Masulis, 1980). As put forward by Myers and Majluf (1984), pecking order theory (POT henceforth) suggests that in the presence of information asymmetries regarding future prospects, firms will exhibit a preference for inside finance to debt, and for debt to outside equity. However, empirical studies testing this theoretical framework on the whole look at financial decisions taken by large public companies whose preferred method for raising capital is to issue corporate debt or public equity (Zingales, 2000).

POT is also found to hold true in the case of established SMEs; in a study of Spanish SMEs, López-Gracia and Sogorb-Mira (2008) found that these firms face significant information asymmetries, which is reflected in a higher use of internal rather than external sources of capital except for when they

have greater investment opportunities or face a lack of cash-flow in which case they tend to seek debt financing.

Examining the capital structure of new ventures involves consideration of many specific factors which may have a potential influence the possibility of obtaining capital. Offering finance to business start-ups is a high risk operation because the opaqueness of new ventures makes it difficult to obtain clear information (Cassar, 2004) and high risk is associated with higher costs – interest rates for debt repayment are higher and the expected rate of return on equity is higher. Kon and Storey (2003) found that extreme information asymmetries with finance providers lead to adverse selection mechanism and discourage founders seeking external finance. In particular, new ventures normally encounter greater asymmetries with lenders which leads to a revised POT order: internal finance is preferred, followed by external equity, short-term debt, and finally long-term debt.

Elston and Audretsch (2011) evaluated the impact of various forms of personal capital on the decision to start a new venture. They found evidence that personal capital is one of the most important sources of capital for high tech firms. They also found that start-ups of new firms is commonly supported by financing from credit cards and income from second jobs. This finding is consistent with Manigart and Struyf (1997), who conducted an exploratory study of financing sources for a sample of high-technology start-ups in Belgium, and discovered that the entrepreneurs themselves were the most important source of financing, followed by bank financing. The study undertaken by Hogan and Hutson (2005) surveyed a sample of software companies in Ireland. Although their results are consistent with a pecking order strategy (internal sources of capital are prevalent), they also provide evidence that these firms used external equity rather than debt. The authors observed that VCs and BAs are able to provide not only capital but also added value, time and expertise. On the other hand, banks are not the most ideal sources of capital for high-tech firms because they usually require collateral for loans and they are not specialized added value investors. Based on this evidence, literature has posited a revised version of finance source pecking order in the case of innovative firms (Sau, 2007).

From an entrepreneurial perspective, the choice between different providers of capital is an argument for discussion. As de Bettignes and Brander (2007) observed, with bank financing the entrepreneur keeps full control of the firm and has a strong

incentive to extend effort on the performance of the firm. With VC financing the entrepreneur benefits from the VC firm's managerial support, but surrenders partial ownership, which can lower incentive to extend effort. De Bettignes and Brander (2007) addressed the question of when an individual would rationally seek VC finance instead of bank finance and observed that a key role is played by a double moral hazard: a higher equity share for the VC weakens entrepreneurs' effort on firm performance, although this is somewhat compensated by the VC firm's effort. With bank finance, entrepreneurs keep full control of the firm, which leads to greater effort on performance, but they do not enjoy the advantage of managerial input from a VC. The trade-off between these two choices is determined by how involved a VC will be in the business and what level of managerial skills and experience they can bring to the firm.

Literature presents a theoretical puzzle on which hierarchy (POT or reversed POT) in particular characterizes NTBFs; most research on start-up finance predicts that entrepreneurs are more likely to seek equity-based financial contracts, and are so the more risky their projects are. Other authors (such as Robb and Coleman, 2011) find that entrepreneurs at start-up choose debt, and argue that debt contracts are of relatively more value for a loan-financed firm (Schäfer et al., 2004). Our work wants to make a first step to resolve this puzzle empirically.

## 2. Human capital and its impact on fundraising

On the basis of the inconclusive literature on small business financing patterns, Atherton (2009) extended the POT to incorporate the influence of the founder. His findings suggested a number of important factors: an individual's prior experience and knowledge, the influence of relational capital, the type of financial sources accessed (the study showed that equity is more likely to be sought by entrepreneurs endowed with high human capital) and the amount of capital raised.

An entrepreneur's financial decisions can also be influenced by behavioral factors: when studying an entrepreneur's preference for VC or BA financing, Fairchild (2009) suggested that entrepreneurs tend to have a closer empathetic relationship with BAs.

Experience is found to play an important role in fund raising activity: Zhang (2007) suggested that prior start-up experience helps entrepreneurs to perform better when obtaining funds from VCs. The importance of learning by doing was emphasized: the experience of starting up a firm gives entrepreneurs a more complete set of skills and the opportunity to work with a wide range of people, such as

bankers, VCs, BAs and consultants. This human capital is an asset for entrepreneurs in their process of acquiring capital. The age and the type and level of education of a person starting a firm is found to influence the choice of financial source. Vos et al. (2007) observed that younger and less educated owners more actively use external financing; this is to some extent surprising, given the generally held view that this type of person lacks credibility and would therefore not have ready access to capital.

Although previous studies have shown that a firm owner's characteristics may be helpful in predicting the capital structure of new ventures, Cassar (2004) tested the influence of experience and education level on the access to debt and equity of start-ups firms and his findings showed that these characteristics are not particularly significant in predicting start-up financing because investors tend to focus more on the firm rather than the owner, looking at factors such as the size of the firm and the composition of its assets.

Vos et al. (2007) provided evidence that younger entrepreneurs make more use of bank overdrafts, bank loans and personal capital than older business owners. In turn, older owners rely less on external financing and more on retained profit and personal wealth.

Zhang (2007) suggested that in the fund raising process prior funding activities give experienced entrepreneurs faster access to VC than novice entrepreneurs. This advantage is also attributable to skills and social connections acquired before setting up a company. The study further showed that VC-backed owners are likely to raise larger sums than novices.

In our paper we aim to shed new light on the specific context of NTBFs founded and lead by young novice entrepreneurs. Although youth entrepreneurship is important from the point of view of entrepreneurship theory and policy, it is a phenomenon which is under-investigated and deserves a lot more attention from researchers. Westhead et al. (2005), for example defined novice entrepreneurs as individuals with no prior business ownership experience. In their work they investigated the difference between inexperienced novice entrepreneurs and experienced serial and portfolio entrepreneurs. Their findings suggested that the main differences lay in the cognitive dimension, in the use of information sources and in the process of opportunity exploitation, which affects most aspects of any entrepreneurial process.

## 3. Research objectives and methodology

Most research in the field of entrepreneurial finance has concentrated on whether a classical pecking order exists, starting first with internal finance, then

moving on to external debt and finally external equity. The literature has recently introduced a revised version of the pecking order regarding innovative firms. These firms resort to bank financing only after having approached BAs and VCs, who are both skilled investors that may experience less information opacity and may also more easily finance NTBFs (Sau, 2007). Our first goal is to try to ascertain which of these two pecking orders best describes the financial behavior of NTBFs. In line with Cosh et al. (2009) and Robb and Robinson (2009) we analyze descriptive statistics on sources targeted and amounts obtained in order to allow a hierarchy to emerge in the sample from the frequency with which different sources are resorted to.

Because of the importance of human capital for NTBFs from a social capital perspective (Burt, 1992) and because of the relevance of the entrepreneurial learning process in this type of firm, as a second research objective we investigate what factors are associated with financial choices by NTBFs, and distinguish between young novice NTBFs and more mature experienced NTBFs. Firstly, we aim to identify the correlates of financial structures of young novice NTBFs (at the same time increasing our knowledge of such firms by analyzing their characteristics), and secondly, we aim to show which correlates significantly differentiate the two types of NTBFs. We use binary regression to determine which factors that extant literature suggests as relevant, do influence the probability of access to different sources, and regression is used again to arrive at which factors determine the amount of financing acquired.

Both research objectives contribute to a deeper understanding of POT and are not meant to challenge it; by investigating whether there is a difference between subsets of entrepreneurs in preference for debt or equity, and by determining whether any differences are due to greater information asymmetries – in turn leading to higher costs, our study may in fact offer more evidence supporting the pecking order approach.

Although understanding entrepreneurship is crucial to economies, little information is available about businesses in their first years of operation. Obtaining accurate information on the dynamics of new firm is difficult and surveys of new businesses have had to face difficulties such as obtaining the cooperation of new business owners, or indeed defining what actually constitutes a new business and when a firm can be considered to have started operating.

The aim of the KFS is “to address the informational gaps related to the study of entrepreneurship” (Robb

et al., 2010). It is designed to learn about the development of high-technology businesses, and their financial characteristics.

The sample for the present study is obtained from the restricted-access version of the KFS, which contains information on nearly 5,000 firms which it has been tracking with annual surveys since 2004. The KFS was set up on the following conceptual framework: (1) the data collected would be relevant to a ‘pure’ cohort of businesses that started in a single targeted year; (2) the business – not any individual owner or founder – would be the focus of the information collected; (3) financial information related to business formation would be the main analytic objective; and (4) a longitudinal survey design would be needed to inform an understanding of business development dynamics and sustainability. Detailed information on dataset creation can be found in Robb et al. (2010).

#### 4. Data analysis

Our analysis is based on a subset of the whole population and we analyzed 2004 data on sample firms (from the year they were established, information in Table 1) and then data from 2007 data, with a view to gaining insights from a comparison of the same subset after three years of business operations. One third of the whole sample is made up of sole proprietorships and half of all firms are home-based, which holds true for both cohorts. This can be attributed to the young age of the firms, which is reflected by a low level of corporate maturity and development.

Table 1. Characteristics of firms

Firm characteristics (all firms 2004)	
Legal form	
Sole proprietorship	36.0%
Partnership	5.7%
Corporation	27.3%
Limited liability corporation	31.0%
Firm characteristics	
Home-based	49.7%
Employer firm	40.4%
Employees (employment > 0)	4.5
Percentage of firms with intellectual property	
Patents	2.2%
Copyrights	8.6%
Trademarks	13.3%
Average number (for firms that had item > 0)	
Patents (patents > 0)	6.2
Copyrights (copyrights > 0)	10.1
Trademarks (trademarks > 0)	2.1
N	4,022

Table 1 (cont.). Characteristics of firms

Distribution of revenues and expenses (all firms 2004)	
Revenues	
Zero	46.5%
\$5,000 or less	9.2%
\$5,001-\$10,000	5.1%
\$10,001-\$25,000	8.3%
\$25,001-\$100,000	15.6%
\$100,001 or more	15.3%
Expenses	
Zero	22.3%
\$5,000 or less	19.8%
\$5,001-\$10,000	9.0%
\$10,001-\$25,000	13.5%
\$25,001-\$100,000	21.4%
\$100,001 or more	14.1%
N	4,022

Source: Kauffman firm survey microdata.

Although the yearly mortality rate is about 14%, on average firms have grown: 40.4% of firms were employing staff in 2004 compared with 55.6% in 2007; the number of zero-revenue firms went down by about a third in the same period (from 46.5% to 30.2 Hadlock et al. %) while the number of firms with a turnover above \$100,000 doubled (from 15.3% to 36.1%).

**4.1. Descriptive statistics.** Table 2 sets out descriptive statistics of firms from the sample for both 2004 and 2007, segmented into four subsets. We defined a firm as young-run if the majority of shares was owned by people aged below 40 with no previous entrepreneurial experience. Only high-tech samples are considered as NTBFs; non-high-tech samples are included to enable us to address our first research goal. We used the definition of high tech in (1991) which takes into account the industry's percentage of R&D employment and classifies businesses into technology groups based on their Standard Industrialization Classification (SIC) codes.

Table 2. Descriptive statistics for the KFS dataset

Variable	2004				2007			
	1 – high-tech, young, novice	2 – high-tech, more mature	3 – non-high-tech, young, novice	4 – non-high-tech, more mature	1 – high-tech, young, novice	2 – high-tech, more mature	3 – non-high-tech, young, novice	4 – non-high-tech, more mature
Number of active businesses	72	633	760	3463	66	591	658	3178
Home based	35	230	462	1756	21	124	198	1071
%	48.61%	36.33%	60.79%	50.71%	31.82%	20.98%	30.09%	33.70%
Average number of employees if > 0	1.571	3.665	1.470	2.356	3.229	9.546	3.115	4.679
Owning a patent	9	81	12	85	5	67	5	62
%	12.50%	12.80%	1.58%	2.45%	7.58%	11.34%	0.76%	1.95%
Owning a trademark	14	142	84	481	7	95	39	298
%	19.44%	22.43%	11.05%	13.89%	10.61%	16.07%	5.93%	9.38%
Owning a copyright	10	72	65	338	2	46	29	242
%	14%	11%	9%	10%	3%	8%	4%	8%
Average number of patents if > 0	2.250	5.762	10.333	4.114	23.400	3.230	31.000	3.107
Average number of trademarks if > 0	2.077	2.051	2.851	1.724	2.000	2.512	1.667	2.729
Average number of copyrights if > 0	1.444	7.536	10.422	11.847	125.500	9.293	54.741	20.986
Revenue (USD)	120,920	1,646,120	168,490	243,795	381,629	2,621,254	1,253,311	866,754
Profit (USD)	67,148	1,612,628	5,8779	134,269	282,716	2,111,344	443,372	356,743
Feel a competitive advantage	54	424	470	2191	31	270	218	1273
%	75%	67%	62%	63%	47%	46%	33%	40%
Competitive advantage due to patent	--	--	--	--	7	53	10	83
Service only company	23	141	422	1780	13	77	203	1111
%	31.94%	22.27%	55.53%	51.40%	19.70%	13.03%	30.85%	34.96%
Product only company	19	207	77	408	10	134	25	223
%	26.39%	32.70%	10.13%	11.78%	15.15%	22.67%	3.80%	7.02%
Both service and product company	29	282	260	1255	18	172	108	711
%	40.28%	44.55%	34.21%	36.24%	27.27%	29.10%	16.41%	22.37%

Notes: The table shows data for a number of variables to describe the sample. When percentage values are shown, they refer to the ratio between the respective value and size of the subset. 'Home based' is a dummy variable equal to 1 if the business is based in a house owned by a shareholder; home-based firms can have employees. IP variables (patent, trademark and copyright possession) are self explanatory. 'Feel a competitive advantage' is a dummy variable equal to 1 if the business is believed by respondents to have competitive advantage over competitors. Product-oriented, service-oriented or mixed business models are included in the last three dummy variables.

The dataset allows for an check on whether a business is home based; in 2004 more mature businesses were less 'garage based', as were non-high-tech compared with high-tech firms, which lends support to the view that more mature and tech-based businesses are more experienced, developed and resource endowed. Similar differences are observable for 2007 but the number of home-based businesses decreased dramatically (down to 1.414 from 2.483) and homogeneously within each subset.

More mature high-tech businesses were not only larger in 2004 but also showed the highest growth rate of the four subsets. As to the size of the companies, it should be noted that in high-tech subsets revenues for firms with experienced owners is ten times higher than for firms with young and novice owners, a difference which does not appear in non-technology start-ups. This raises many questions and concerns about the potential of young-run businesses, but perhaps even more it suggests that there is a positive accelerating influence of mature entrepreneurs in technology-based business growth, which is even more interesting when it is added to the fact that such firms are the most risky (the statistics show that they are twice as likely to fail as firms in other subsets). It would appear that more mature firms seek breakthroughs far more which are confirmed by the data for 2007, and although young-run tech businesses show the high-

est growth rate, they still lag behind their mature counterparts in this respect.

Moving on to strategic positioning, high-tech firms reported systematically higher self-assessment of competitive advantage across the board, and this is even higher for young firms for both years. The gap decreased in each of the four categories after three years of operation, which would suggest that running a business leads to increased knowledge about competitors and helps entrepreneurs to understand the limitations of their business value perception. It does this much more for young novice high-tech firms than other businesses, suggesting that these firms may be characterized by high levels of enthusiasm and optimism and a lower level of knowledge of the market and business dynamics at the start-up point.

Companies run by more mature and experienced entrepreneurs are more focused on product compared to the young-run counterparts and this holds true for both high-tech and non-high-tech firms and for both cohorts, suggesting that experienced entrepreneurs are more ambitious and that young NTBFs adopt more of a 'soft-start' approach (Connel, 2007). This does not seem to affect the innovativeness of companies, since similar numbers of young novice and mature NTBFs have some form of intellectual property, i.e., patents, trademarks or copyright, and both groups outperform their non-NTBF counterparts.

Table 3(a). Descriptive statistics for the KFS dataset (access to finance sources)

Variable	2004				2007			
	1 – high-tech, young, novice	2 – high-tech, more mature	3 – non-high-tech, young, novice	4 – non-high-tech, more mature	1 – high-tech, young, novice	2 – high-tech, more mature	3 – non-hightech, young, novice	4 – non-hightech, more mature
Panel A: The number of firms that have targeted the various potential sources of finance								
Owner equity	56	502	593	2810	16	139	115	698
Inside equity	27	169	418	1283	41	278	487	1717
Outside equity	7	83	20	188	2	30	5	49
Owner debt	47	371	459	2046	27	255	201	1321
Inside debt	17	79	135	410	3	34	31	145
Outside debt	29	315	278	1493	16	212	141	952
Panel B: The amount of capital accessed from the various sources of finance (units of USD, mean per company)								
Owner equity	12,545	28,664	155,933	28,729	20,701	6,052	1,537	4,333
Inside equity	--	--	--	--	--	--	--	--
Outside equity	5,563	16,092	179	12,178	17,523	14,344	12	762
Owner debt	5,086	8,675	4,604	5,813	2,640	3,300	1,548	4,356
Inside debt	2,500	2,031	2,735	2,044	1,667	1,118	346	730
Outside debt	17,000	15,580	4,359	15,333	2,121	5,201	2,101	8,657
Panel C: The amount of capital accessed from the various sources of finance, calculated from figures of finance actually taken up by firms (units of USD, mean per company)								
Owner equity	17,324	38,243	206,108	36,915	85,390	28,849	9,415	21,554
Inside equity	--	--	--	--	--	--	--	--
Outside equity	65,833	125,356	6,805	232,534	--	301,735	--	52,588
Owner debt	8,826	16,621	8,645	11,182	8,361	9,494	6,359	12,601

Table 3(a) (cont.). Descriptive statistics for the KFS dataset (access to finance sources)

Variable	2004				2007			
	1 – high-tech, young, novice	2 – high-tech, more mature	3 – non-high-tech, young, novice	4 – non-high-tech, more mature	1 – high-tech, young, novice	2 – high-tech, more mature	3 – non-hightech, young, novice	4 – non-hightech, more mature
Inside debt	11,667	16,838	15,987	18,084	36,667	19,991	8,389	16,533
Outside debt	43,107	31,825	12,083	36,193	8,750	14,587	9,806	29,200

Table 3(a) summarizes the main statistics regarding access to capital by the firms in the sample, with firms broken down again into four different subsets. What is immediately evident is that the subsets show identical patterns in 2004; regardless of the maturity of entrepreneurs and technological background, firms show paramount reliance on owner capital (with equity chosen rather than debt), which

is far and away the other most used form of financing. Next in order of access comes external debt which comes ahead of equity from insiders, e.g., finance from spouses or family. Debt from insiders seems to be a form of financing that is used quite seldom but the least popular source is external equity, which includes VC, BA, corporate VC plus other sources.

Table 3(b). Descriptive statistics for the KFS dataset (capital injections)

Panel A: The percentages referring to the number of attempts at securing finance from various sources divided by the number of firms								
Internal capital	143%	138%	138%	140%	65%	67%	48%	64%
External debt	64%	62%	54%	55%	29%	42%	26%	35%
External equity	47%	40%	58%	42%	65%	52%	75%	56%
Panel B: The average amount of financing obtained from financial sources (units of USD, mean per company)								
Internal capital	17,631	37,339	160,537	34,542	23,341	9,352	3,085	8,689
External debt	19,500	17,611	7,094	17,377	3,788	6,319	2,447	9,387
External equity	5,563	16,092	179	12,178	17,523	14,344	12	762
Panel C: The average amount of financing obtained from financial resources, included only when a firm actually accessed the financing itself (units of USD, mean per company)								
Internal capital	17,324	38,243	206,108	36,915	85,390	28,849	9,415	21,554
External debt	54,774	48,663	28,070	54,277	45,417	34,578	18,195	45,733
External equity	65,833	125,356	6,805	232,534	-	301,735	-	52,588

Table 3(b) shows the main figures for new capital injections in 2004 and 2007; for these figures insider and outsider sources are put together as outsider capital in order to arrive at debt and equity (as did Robb and Robinson, 2009). Indicators for new capital injections may be higher than 100% when a firm has more than one capital injection, e.g., both debt and equity from owner's capital.

If the data is observed from a more aggregate perspective, following the approach of Robb and Robinson (2009), who conflate owner debt and equity as 'internal finance' (Table 3(b)), there is evidence that supports the existence of a pecking order. In each subset inside financing is far preferred to debt, which in turn is preferred to equity.

If we look at amounts of finance obtained, the hierarchy is unsurprisingly reversed: owners' financing is much more common but is normally of smaller amounts, especially if compared with (outside) equity investments. Young non-high-tech firms are the only exception to this pattern since they are financed with large amount of owners' capital (an average amount of 206,108 USD).

Turning to the 2007 cohort, the most important observation is that firms have accessed proportionally many fewer financing sources than firms in the 2004 cohort; as reported in Table 3(b), the percentage of financial injections is much lower for all subsets, but since fund raising activity is not a continuous activity and is expected to become diluted over time this is not a surprising figure to emerge. What is surprising, though, is the complete reversed hierarchy which is evident between external debt and equity: of the fewer capital injections, the largest amount is still internal capital, but a larger number of new capital injections is made through equity rather than debt. This is extremely interesting: while this pattern is consistent with the revised POT (see Sau, 2007; Hogan and Hutson, 2005) our evidence suggests that the stage of business maturity along its development cycle may determine whether a firm follows revised or traditional POT order. This finding would not have been possible without the KFS having been designed so well, collecting data on firms started in the same year with subsequent evidence from a 'pure' cohort.



**4.2. Empirical analysis.** In order to answer our second research question dealing with the identification of human capital variables impacting access to different financial sources, and to expand on the evidence above, we follow the approach developed by Coleman and Robb (2009). Binary regression was performed (Table 4) to pinpoint dependent variables from those factors suggested in extant literature as relevant. The sources analyzed are outside equity, outside debt, bank loans as a specific case of outside debt, and inside financing. We also use a dummy variable (Isjuvenile) to check whether a firm is run by young and novice entrepreneurs. Regression is also performed to evi-

dence determinants of the amount of financing (Table 5), so the amount of capital injection is investigated as a dependent variable. In both types of multivariate analysis, variables refer exclusively to the high-tech sample of the 2004 cohort, both to be consistent with the Coleman and Robb (2009) approach, and to emphasize the relevance of financial injection in the first year of activity, as opposed to in the following years. This results in findings which refer to the 'launch' phase of an entrepreneurial venture, which could be followed up with future analysis on different patterns emerging when start-up or expansion capital rather than seed capital is considered.

Table 4. Binary regression (dprobit) on having sources of financing (2004)

	Model A	Model B	Model C	Model D
	Outside equity	Outside debt	Bank loan	Inside funding
Isjuvenile		-0.1152* .06488	-0.0042 .03516	.05667 .06379
Work experience (years)	-0.0003 .0002	-0.0002 .0018	.0001 .0009	-0.0035** .0018
Hours worked per week	0.0002** .0001	0.0028*** .0009	.0002 .0005	-0.0012 .0009
High school education	0.9849*** .01856	-0.1896** .0894	.0426 .0615	-0.0798 .0839
Some college education	0.9475*** .0454	-0.1888** .0735	-0.0181 .0357	.0051 .0708
College education	0.8493*** .0936	-0.2231*** .0715	-0.0217 .0357	-0.0509 .0674
Graduate study	0.9899*** .0111	-0.2138** .0868	-0.0416 .0351	-0.1447* .0769
Postgraduate study	0.9236*** .0613	-0.2759*** .0710	-0.0322 .0346	-0.1401** .0662
Number of firm owners	–	0.2293 .2280	–	-0.0006 .2444
Home based	-0.0140** .0048	-0.1680*** .0414	-0.1064*** .0205	.1342*** .0407
Intellectual Property (IP)	0.0091 .0069	-0.0290 .0452	-0.0349 .0223	-0.0524 .0425
Competitive advantage	0.0113** .0050	0.0430 .0433	.0026 .0220	.0214 .0408
Service company	0.0224* .0161	-0.0205 .0551	-0.0156 .0269	-0.0006 .0526
Both service and product company	0.0043 .0085	-0.0110 .0506	-0.0263 .0248	.0503 .0480
Observations	617	617	617	617

Notes: We analyze the relationship between dependent variable and Outside equity (Model A), Outside debt (Model B), Bank loan as a specific case of Outside debt (Model C), and Inside financing (Model D). Isjuvenile is a dummy variable equal to 1 if the majority of a firm's shares is owned by young novice entrepreneurs (under 40 with no previous entrepreneurial experience). Variables from 'high school' to 'postgraduate' measure the level of education of the main business owner. Product and service dummy refer to the case base which is 'Product only company'. Standard errors are in italics: \*\*\* p < 0.01, \*\* p < 0.05, \* p < 0.1.

The dprobit<sup>1</sup> models in Table 4 point to determinants of probability of access to different sources of funding. The dummy Isjuvenile suggests that the maturity of a firm is not particularly significant and

that young firms are not biased towards a particular form of financing. However, the figures for the number of hours worked per week are in the dependent connection with access to forms of external financing. This is an interesting finding since it suggests that the weekly work hours put in by entrepreneurs may indicate the level of their commitment and motivation, which may then be perceived as a positive signal by external investors (a finding consistent with the literature). Our check for education-

<sup>1</sup> Dprobit fits maximum-likelihood probit models and is an alternative to probit. Rather than reporting the coefficients, dprobit reports the marginal effect, that is, the change in the probability for an infinitesimal change in each independent, continuous variable and, by default, reports the discrete change in the probability for dummy variables.

al background covers all levels from high school to postgraduate study (postgraduate data includes MBA and Ph.D. qualifications) and findings show education is significant in both models for external financing. It would appear that equity providers are attracted by educated entrepreneurs and interpret educational qualifications as a sign of high quality of human capital. This is not the case with debt providers and bankers; we find a significant but negative relationship between the graduate and postgraduate levels of education and inside financing, which can be interpreted as a sign that entrepreneurs in this category seek a form of external financing.

Another variable that is highly significant in all four models is whether firms are home based, with the

findings suggesting that ‘garage based’ business are extremely unlikely to access any form of outside financing (equity, debt or bank loans) and are very likely to be financed by internal capital, which is a further signal of entrepreneurial under-development and managerial immaturity. Evidence peculiar to Model A (Outside equity) suggests that companies feeling a competitive advantage over their competitors are more likely to receive outside equity, as do firms focused on products rather than services. This is unsurprising from the point of view of supply and demand: equity investors are more attracted by product companies which are normally based on scalable business models and normally inject larger amounts of capital which product-based companies may ask for.

Table 5. Regression on level of startup capital (2004)

	Model A	Model B	Model C
	Log Outside equity	Log Outside debt	Log Outside total
Isjuvenile	-0.1548 <i>.3241</i>	.15051 <i>.2735</i>	.0069 <i>.2594</i>
Age	.08121 <i>.05444</i>	.1165** <i>.0551</i>	.0801* <i>.0457</i>
Age <sup>2</sup>	-0.0008 <i>.0005</i>	-0.0012** <i>.0006</i>	-0.0008* <i>.0004</i>
Work experience (years)	.0031 <i>.0089</i>	-0.0098 <i>.0081</i>	-0.007* <i>.0073</i>
Hours worked per week	.0219*** <i>.0040</i>	.0121*** <i>.0035</i>	.0211*** <i>.0033</i>
High school education	-0.6768 <i>.4173</i>	-0.4810 <i>.3733</i>	-0.7012** <i>.3557</i>
Some college education	-0.0614 <i>.3277</i>	-0.3847 <i>.2856</i>	-0.2507 <i>.2767</i>
College education	.0780 <i>.3255</i>	-0.1831 <i>.2878</i>	-0.2832 <i>.2747</i>
Graduate study	.3206 <i>.4389</i>	-0.0524 <i>.3991</i>	.0510 <i>.3657</i>
Postgraduate study	.4925 <i>.3472</i>	.6548** <i>.3109</i>	.3806 <i>.2931</i>
Number of firm owners	2.3674 <i>1.6254</i>	-0.9004 <i>.9529</i>	-0.4997 <i>1.1159</i>
Home based	-1.0594*** <i>.1854</i>	-0.6375*** <i>.1712</i>	-0.7824*** <i>.1551</i>
Intellectual property (IP)	.1392 <i>.2118</i>	-0.3339** <i>.1860</i>	-0.1563 <i>.1728</i>
Competitive advantage	-0.0378 <i>.1991</i>	.1674 <i>.1786</i>	.1849 <i>.1641</i>
Service only company	.2090 <i>.2457</i>	.3407 <i>.2240</i>	.4312** <i>.2055</i>
Both service and product company	.1244 <i>.2139</i>	-0.1558 <i>.2024</i>	-0.0520 <i>.1826</i>
Constant	4.6494*** <i>2.1354</i>	7.8592*** <i>1.6066</i>	0.8074*** <i>1.5712</i>
Observations	281	281	281
Adjusted R <sup>2</sup>	.2293	.1642	.1902

Notes: We analyze the relationship between dependent variable and the amount of Outside equity (Model A), Outside debt (Model B) and Total outside capital (Model C). Isjuvenile is a dummy variable equal to 1 if the majority of a firm’s shares is owned by young novice entrepreneurs (under 40 with no previous entrepreneurial experience). Variables from ‘high school’ to ‘postgraduate’ measure the level of education of the main business owner. Product and service dummy refer to the case base which is ‘Product company’. Standard errors are in italics: \*\*\* p < 0.01, \*\* p < 0.05, \* p < 0.1.

When considering the results of regression performed on the level of external capital injected into a company, confirmation emerges of what was found in the dprobit models, i.e., that hours worked as a signal of commitment and the variable home based as a signal of incomplete development of a company, have a significant bearing on the amount of each source of funding (Models A and B). Model B in Table 5 (Log Outside debt) introduces further insights into the role of intellectual property, which consistently with findings in literature on entrepreneurial finance, have a negative impact on the amount of outside debt. As far as the amount of debt and the total amount of external capital injected is concerned (Models B and C), we can notice that age is in the negative relationship with the access to external capital, which is against the findings by Vos et al. (2007) and the relationship is concave, which is interesting and could be partially due to aged entrepreneurs being wealthier and, therefore, less relying on external capital.

### Conclusion

This research study was designed in order to shed light on the puzzle regarding the existence of a pecking order theory for firms – especially NTBFs – and to provide evidence for the determinants of the choice of source of capital and determinants for the amount of capital obtained. This was done with particular focus on the peculiarities and constraints which may be experienced by firms owned by young novice entrepreneurs.

The first observation is that the data confirm the existence of a pecking order (Tables 3(a) and 3(b)) and also show that firms rely heavily on external debt, contrary to most predictions of entrepreneurial finance theories (see Carpenter and Petersen, 2002). What is particularly interesting is the fact that the same hierarchy holds true for each subset, regardless of whether a company is high-tech or run by young novice entrepreneurs. Changes are apparent, however, in the first few years of a firm's life; in 2004, the inception year of the firms in the study, each subset shows a classical pecking hierarchy but this is reversed in 2007. This suggests a somewhat new perspective to be tested in future research, i.e., that heterogeneity of adoption patterns of a given pecking order should be investigated under a longitudinal rather than across-sectional approach, to enable detection of differences over the life of a firm rather than addressing contrasts and similarities in performance

### References

1. Acs, Z. and Mueller, P. (2006). Employment effects of business dynamics: Mice, Gazelles and Elephants, *Discussion Papers on Entrepreneurship, Growth and Public Policy*, №2306, Max Planck Institute of Economics: Jena, Germany.
2. Atherton, A. (2009). Rational Actors, Knowledgeable Agents: Extending Pecking Order Considerations of New Venture Financing to Incorporate Founder Experience, Knowledge and Networks, *International Small Business Journal*, 27, pp. 470-495.

and behaviors resulting from differences between types of firm and types of entrepreneur.

Further research on this topic should also disentangle supply and demand side (coherently with Cosh et al., 2009), by controlling for credit score (see Robb and Robinson, 2009) and by controlling for differences in application and outcome for a specific source of capital.

The fact that no particular constraints were discovered regarding young firms raises the question of entrepreneurship policy implications. We believe that no previous research has separated NTBFs into those run by young novice entrepreneurs and those run by more mature, experienced entrepreneurs. Although we acknowledge a weakness in our definition, since it could be considered rather subjective and could, therefore, be questioned, the fact that firms founded by young novice entrepreneurs emerge as not being particularly different to their more mature counterparts from the point of view of human capital variables is enlightening and somewhat contradicts both Westhead et al. (2005) and Vos et al. (2007). The concave relationship between age and amount of capital may partially explain this result but more research is certainly required into potential constraints for firms run by young novices; for example it might be useful to investigate the amount of capital sought by the different types of start-ups in the study to determine whether, as would be expected, this variable has a significant effect on choice of fund source and successful acquisition of funds. Finally, as far as human capital related variables are concerned, we can confirm several suggestions coming from literature, in particular how important education is as a signal facilitating access to equity with respect to debt and inside finance, and how not only does previous experience not offer an advantage in accessing finance, but how it also has the effect of limiting the amount of total external capital obtained to a lower level (consistent with Vos et al., 2007). Further variables may also be studied regarding firms or owners to enhance the explicative power of this study, such as R&D investment, the nature of the business, strategic positioning, and internationalization. This analysis could be carried out by exploiting the power of longitudinal information collection and by the introduction of interactions between determinant variables and the Isjuvenile dummy.

3. Audretsch, D.B. (1995). *Innovation and Industry Evolution*, MIT Press: Cambridge, MA.
4. De Bettignies, J.E. and Brander, J.A. (2007). Financing entrepreneurship: Bank finance versus venture capital, *Journal of Business Venturing*, 22 (6), pp. 808-832.
5. Burt, R.S. (1992). *Structural holes – The social structure of competition*. London, Harvard University Press: Cambridge, MA.
6. Carpenter, R.E. and Petersen, B.C. (2002). Capital market imperfections, high-tech investment and new equity, *The Economic Journal*, 112, pp. F34-F72.
7. Cassar, G. (2004). The financing of business start-ups, *Journal of Business Venturing*, 19, pp. 261-328.
8. Coleman, S. and Robb, A. (2009). *A comparison of new firm financing by gender: evidence from the Kauffman Firm Survey data*, KFS Working Paper: Kansas City, MO.
9. Coleman, S. and Robb, A. (2011). Financing Strategies of New Technology-based Firms, *Review of Economics & Finance*, 4, pp. 1-18.
10. Connell, D. (2006). Secrets of the world's largest seed capital fund: How the United States Government uses its SBIR programme and procurement budgets to support small technology firms, Centre for Business Research Working Paper, University of Cambridge: Cambridge, UK.
11. Cosh, A., Cumming, D. and Hughes, A. (2009). Outside Entrepreneurial Capital, *The Economic Journal*, 119, pp. 1494-1533.
12. DeAngelo, H. and Masulis, R. (1980). Optimal capital structure under corporate and personal taxation, *Journal of Financial Economics*, 8 (1), pp. 3-29.
13. Elston, J.A. and Audretsch, D.B. (2011). Financing the entrepreneurial decision: an empirical approach using experimental data on risk attitudes, *Small Business Economics*, 36 (2), pp. 209-222.
14. Fairchild, R. (2009). An entrepreneur's choice of venture capitalist or angel-financing: A behavioral game-theoretic approach, *Journal of Business Venturing*, 26 (3), pp. 359-374.
15. Hadlock, P., Hecker, D., and Gannon, J. (1991). High Technology Employment: Another View, *Monthly Labor Review*, 114 (7), pp. 26-30.
16. Harris, M. and Raviv, A. (1991). The theory of capital structure, *Journal of Finance*, 46 (1), pp. 297-355.
17. Hogan, T. and Hutson, E. (2005). Capital structure in new technology-based firms: Evidence from the Irish software sector, *Global Finance Journal*, 15, pp. 369-387.
18. Kon, Y. and Storey, D. (2003). A Theory of Discouraged Borrowers, *Small Business Economics*, 21, pp. 37-49.
19. López-Gracia, J. and Sogorb-Mira, F. (2008). Testing trade-off and pecking order theories financing SMEs, *Small Business Economics*, 31 (2), pp. 117-136
20. Manigart, S. and Struyf, C. (1997). Financing high technology start-ups in Belgium: an explorative study, *Small Business Economics*, 9, pp. 125-135.
21. Myers, S.C. (1977). Determinants of corporate borrowing, *Journal of Financial Economics*, 5 (2), pp. 147-175.
22. Myers, S.C. and Majluf, N.S. (1984). Corporate financing and investment decisions when firms have information that investors do not have, *Journal of Financial Economics*, 13 (2), pp. 187-221.
23. Robb, A.M. and Robinson, D.T. (2009). The capital Structure Decision of New firms, KFS Working Paper: Kansas City, MO.
24. Robb, A., Ballou, J., DesRoches, D., Potter, F., Zhao, Z. and Reedy, E.J. (2010). An Overview of the Kauffman Firm Survey Results from the 2004-2008 Data, KFS Working Paper: Kansas City, MO.
25. Sau, L. (2007). New Pecking Order Financing for Innovative Firms: an Overview, Working Paper №2, Department of Economics, Università di Torino: Torino, Italy.
26. Schäfer, D., Werwatz, A. and Zimmermann, W. (2004). The determinants of debt and private equity financing in young innovative SMEs: evidence from Germany, *Industry and Innovation*, 11, pp. 225-248.
27. Schoof, U. (2006). Stimulating Youth Entrepreneurship: Barriers and Incentives to Enterprise Start-Ups by Young People, SEED Working Paper International Labour Office №76.
28. Vos, E., Jia-Yuh Yeh, A., Carter, S. and Tagg, S. (2007). The happy story of small business financing, *Journal of Banking and Finance*, 31 (9), pp. 2648-2672.
29. Westhead, P., Ucbasaran, D. and Wright, M. (2005) Decisions, actions, and performance: do novice, serial, and portfolio entrepreneurs differ? *Journal of Small Business Management*, 43 (4), pp. 393-417.
30. Xheneti, M. (2007). Youth entrepreneurship in South East Europe: some policy recommendations. In: Potter, Jonathan and Proto, Alessandra, (eds.) *Promoting entrepreneurship in South East Europe: policies and tools*. Paris, France: OECD, pp. 104-126.
31. Zhang, J. (2007). A Study of Academic Entrepreneurs Using Venture Capital Data, IZA Discussion Papers 2992, Institute for the Study of Labor (IZA).
32. Zingales, L. (2000). In search of new foundations, *The Journal of Finance*, 55 (4), pp. 1623-1653.