

European venture capital

SUMMARY

Venture capital is considered to be the most appropriate form of financing for innovative firms in high-tech sectors. Venture capital has greatly developed over the last three decades in the United States, but much less so in Europe, where policy-makers are striving to help channel more funds into this form of financial intermediation. In this paper we provide the first assessment of venture capital in Europe. We document its development in the 1990s and compare it with that of American venture capital. We find the wedge between them to be large and growing. We then look at the involvement of venture capital with some of Europe's most innovative and successful companies, those listed on Europe's 'new' stock markets. Venture capital is effective in helping these firms overcome credit constraints, and thus to be born in the first place. Using a unique, hand collected data set from the listing prospectuses and annual reports of these companies, we find European venture capital to have a limited effect on their ability to raise equity capital, grow, and create jobs. We conclude that public support of the European venture capital industry should look at both its growth and at its maturation.

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Venture capital in Europe and the financing of innovative companies

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1. INTRODUCTION

The rapid pace of innovation by entrepreneurial firms in the US has substantially contributed to America's strong competitiveness and protracted economic growth. The role of US venture capitalists in fostering such innovative firms has been well documented (Hellmann, 2000), and indeed there now exists a wide consensus among economists, business leaders and policy-makers that a vibrant venture capital industry is a cornerstone of America's leadership in the commercialization of technological innovation. A related and widely held belief is that the lack of venture capital hinders European firms from competing on an equal footing (European Commission, 1994).

Several official documents of European governments and institutions suggest bolstering venture capital and revamping the regulation of stock markets as remedies to Europe's economic sluggishness and dismal unemployment. This can be seen in the title of the European Commission's 1998 report: *Risk Capital: A Key to Job Creation in the*

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European Union, or the 2001 report by the Committee of Wise Men on the Regulation of European Securities that ‘urges governments and the European institutions to pay particular attention to ensuring that there is an appropriate environment for the development of the supply of risk capital for growing small and medium sized companies, given the crucial importance of this sector for job creation’. The Committee goes on to argue that ‘[t]oday there is still an inadequate supply of risk capital in the EU with venture capital only one fifth of US per capita levels. However, if the European Union’s financial markets can integrate . . . European venture capital financing will be encouraged from the bottom up’.

These documents raise important policy issues. In particular, it is crucial to understand how policy can actually contribute to the growth of a dynamic venture capital industry in Europe. European official documents, but also industry reports like the White Paper of the European Venture Capital Association (EVCA, 1998), tend to focus on the supply of funds and on the creation of favourable structural conditions for entrepreneurship. However, it is far from evident which policy measures would be most appropriate to nurture European venture capital. Here the lack of rigorous investigation is felt most.

Our paper contributes to this by developing the first systematic, empirical analysis of venture capital in Europe. To get around the dearth of firm-level data on European venture capital, we exploit the unique opportunity offered by the opening in 1997 of Euro.nm, the alliance of Europe’s ‘new’ stock markets for innovative companies in high-growth industries – along the lines of America’s Nasdaq. Euro.nm, which allied the ‘new’ markets of Amsterdam, Brussels, Frankfurt, Paris and Milan, ceased to exist as an alliance in December 2000, but its members continue to operate independently. Over its life span, Euro.nm has allowed nearly 600 companies to list and raise over €40 billion in equity capital.

We collect a unique data set from issuing prospectuses and annual reports of more than 500 Euro.nm listed companies. These data provide an excellent opportunity to study the effects of venture capital on Europe’s innovative companies, given the wealth of information that they are required to disclose in order to go public. We focus on three key issues. First, we develop a conceptual framework for appraising the role of venture capital in the financing of innovative companies. Secondly, we document the development of venture capital in Europe, compare it to that of US venture capital, and assess the extent and determinants of venture financing to companies listed on Euro.nm. Thirdly, we study the effect of venture capital on the ability of these companies to raise capital, grow and create jobs.

The evidence leads us to challenge several common beliefs. We argue that venture-backed companies in our sample – i.e. those listed on Euro.nm – do not grow and create jobs faster than non venture-backed companies. Whether this is due to a lack of ‘stars’ among European firms or to the immaturity of European venture capital is not possible to tell apart, but several pieces of evidence make the latter possibility more likely. We also have good news. We find that venture capital does help European innovative companies by providing them with financing crucial for their creation and development.

This also means that an increasing number of (venture-backed) companies benefit from the possibility to go public, with a positive effect on the growth of Europe's 'new' stock markets. Since venture capitalists benefit, in turn, from the possibility of cashing in their investments through a listing on a stock market, this may have triggered a self-reinforcing virtuous circle which may well outlive the present market downturn.

These findings provide support for the European Commission's stated policy of promoting European venture capital. The main action of the Commission in this respect has been the transformation of the European Investment Fund (EIF) into a major investor in venture capital funds. Our findings suggest that the 'quality' of European venture capital should be as urgent a concern for the EIF as its sheer 'quantity', so as to advance both the size and the maturation of the industry.

The rest of the paper is organized as follows: Section 2 provides a primer on venture capital. Sections 3 and 4 develop a statistical portrait of the European venture capital industry at the aggregate level (Section 3) and using our hand-collected data set (Section 4). Section 5, which contains the core of our empirical analysis, evaluates the impact of European venture capital in the performance of companies it finances. Section 6 concludes. An extensive Web Appendix provides a detailed description of our data collection and of our econometric analysis, as well as additional tables, references and material (freely available on <http://www.economic-policy.org>).

2. VENTURE CAPITAL AND THE CREATION OF INNOVATIVE COMPANIES

Modern venture capital was born in 1946 when Harvard professor Georges Doriot created American Research and Development (ARD) together with Karl Compton, president of the Massachusetts Institute of Technology, Merrill Griswold, chairman of Massachusetts Investors Trusts, and Ralph Flanders, president of the Federal Reserve Bank of Boston. ARD raised funds from wealthy individuals and college endowments and invested them in entrepreneurial start-ups in technology-based manufacturing.

Half a century later venture capital has become the form of financial intermediation most closely associated with dynamic entrepreneurial start-ups, especially in high-tech industries like biotechnology, information technology (IT) and e-commerce. Many of today's most dynamic and successful corporations received venture capital at the initial stages of their lives: Amazon, Apple, Cisco, e-Bay, Genentech, Genetic Systems, Intel, Microsoft, Netscape and Sun Microsystems, to name just a few. Venture capital also worked in more traditional areas – Federal Express, Staples and Starbucks all received venture financing.

The maturation was not smooth, though (Gompers, 1994). Until the 1980s, venture capital firms were in large part publicly funded Small Business Investment Companies (SBICs). While SBICs trained many venture capitalists and helped the industry reach a critical mass by channelling large sums to start-ups, their ability to perform was limited by bureaucratic constraints, lack of professional expertise, and a faulty design of capital structure and incentives (Lerner, 1999). Their investment record was in fact

mixed, and spurred a fall in investor confidence and in committed funds around the late 1980s. Also, many venture firms, including ARD, were organized as closed-end funds, but this attracted retail investors with short-term horizons, whose needs clashed with the long-term returns of venture capital. Only in the late 1980s were SBICs and closed-end funds superseded by the limited partnership as the dominant organizational form of American venture capital firms. Another major contribution to the adoption of a more efficient organizational form was the clarification, in 1979, of the Employment Retirement Income Stabilization Act, which allowed pension funds to invest in venture capital. This resulted in a staggering increase of funds invested, and in a faster professionalization of the industry. Until the early 1990s, venture capital remained essentially an American phenomenon, but venture capital is by now a sizeable industry in Europe and Asia.

2.1. How to start a start-up

To set the stage for our empirical investigation, we look at how venture capital can help a firm. Consider a hypothetical academic engineer who has just discovered a technology to produce, say, a new type of circuit for mobile phones. Our engineer believes his technology could eventually make him rich and famous, but industrial implementation of his finding requires an investment in the order of three million euros – far in excess of his personal wealth and that of his family and friends. His bank flatly refuses him a loan on this scale since he lacks sufficient collateral, and he cannot directly access capital markets due to the embryonic form of his project. Government grants are also unsuited for such a project, since they are typically targeted at very small firms, and often require a proven track record that no high-tech start-up may provide.

Three practicable options remain: convincing a ‘business angel’ (see Box 1 on venture capital jargon) to invest, finding an established industrial company interested in the project (a ‘corporate venture capitalist’), or going for a venture capitalist. Financial companies (holding companies that invest in industrial companies) are not an option since they rarely invest in start-ups, preferring more mature firms close to their initial public offering (IPO).

Our engineer ponders these possibilities. He discards business angels since they are a good source of funds only for smaller start-ups. A corporate venture capitalist is also unattractive since, especially in Europe, they tend to be slow and a start-up that threatens to ‘cannibalize’ a revenue of the parent company may end up being delayed or even stopped. Our engineer decides to seek support from a venture capitalist. What should he expect?

2.2. A conceptual framework for venture capital

Systematic accounts of the operations of US venture capital firms show that venture capital constitutes a special form of financial intermediation, with contractual

Box 1. Venture capital jargon

Venture capital: consists of financing young, unlisted dynamic ventures through equity or equity-like instruments by limited partnerships of professional investors who raise funds from wealthy and/or institutional investors.

Business angel: wealthy individual who invests in start-ups. Sometimes groups of business angels provide legal and organizational support, but these individuals largely invest based on personal relationships. They provide expert knowledge of an industry since many of them are (or have been) executives.

Start-up: new company created by an entrepreneur in a high-tech industry.

Limited partnership: typical venture-capital firm organization. The ‘general partners’ (venture capitalists) manage the firm and assume full liability, while ‘limited partners’ (investors) provide funds and assume no liability beyond the contributed capital.

Captive: venture capital firm owned by an industrial company or a financial intermediary; common in Europe. In the US, ‘independent’ firms are the norm.

Convertible securities: equity-like financial instruments offering to investors protection in case of liquidation, while ensuring participation in the upside should the project succeed.

Vesting: legal term for the granting of corporate stock to a person. Usually applies to entrepreneurs or employees whose stocks ownership is contractually deferred until a certain date or until certain targets are met.

Initial public offering (IPO): ‘going public’, i.e. offering of corporate stock to the public by a company which gets listed on a public stock exchange. Venture capitalists’ preferred mode of cashing in their investment.

Trade sale: sale of a start-up to another company, typically a large competitor.

Write-off: the disaster scenario – a funded company fails and the venture capital writes off the investment. Most venture investments end up as write-offs.

‘Exit’: venture capitalists typically exit their investee companies through an IPO, a trade sale, or by writing-off (liquidating) a non-performing company.

arrangements substantially different from debt contracts. The nature and complexity of these arrangements suggest that a non-financial ‘soft’ side consisting of mentoring and monitoring complements the financial ‘hard’ side of the capital contribution.

2.2.1. The soft side of venture capital. Venture capitalists are often thought of as providing firms with expert advice together with stringent incentives to perform (Barry *et al.*, 1990; Sahlman, 1990; Kaplan and Strömberg, 2000). Venture capitalists’ expertise and network of contacts with potential suppliers and customers allow entrepreneurs to focus on what they are best at – technical development. Their industry

knowledge is precious for honing strategies. They concentrate on start-up firms located nearby, and use their knowledge of industries and markets to evaluate and mentor entrepreneurs. Indeed, most venture capitalists have higher degrees, and a technical, not economic or financial, background. Venture capitalists also provide 'reputation capital' by allowing firms to boast being venture-backed so as to lure top-fly executives or to obtain new contracts. But venture capitalists are also demanding investors, who retain the right to remove the entrepreneur from his post of chief executive officer should she fail to meet any agreed-upon milestone. The combination of these 'soft' sticks and carrots is widely seen to provide venture-backed start-ups with an advantage over others firms, since it should increase the chances of survival, and help start-ups attract further funding as they expand.

The narrative literature on venture capital documents extensively these 'soft' aspects of venture capital, finding that the lack of business experience of many entrepreneurs makes mentoring from expert venture capitalists crucial to their chances of success (Gorman and Sahlman, 1989). More formal studies of US venture capital corroborate these anecdotal findings. For instance, venture capitalists do not provide full financing upfront, but disburse money in instalments at different stages of a firm's development, contingent on the achievement of milestones such as the construction of a prototype, a certain amount of sales, or the hiring of key management figures. Financing at different stages is found to take different roles (see Box 2) and to allow venture capitalists to gather information over time, thus keeping the option of abandoning firms whose hopes of success have dwindled (Gompers, 1995). Venture capitalists are also found to closely oversee investee firms, and to be active board members who step in and take control when times get difficult (Lerner, 1995).

Some recent analyses of the influence of venture capital on corporate strategy and performance provide even tighter evidence that non-financial aspects are crucial to define the activity of venture capital. Venture-backed firms are found to be faster in developing their products and in bringing them to the market (Hellmann and Puri, 2000) – an important advantage in technology markets, where timing is essential to achieve market leadership. This implies that venture capitalists provide dynamic companies with money but also with support and monitoring of their management. Venture-backed companies are in fact found to pursue more radical and ambitious product or process innovations than other companies (Hellmann and Puri, 2000). Venture capitalists also play an important role in the professionalization of the firms they invest in, for example by helping them hire experienced financial and marketing executives and by firing under-performing chief executive officers (Hellmann and Puri, 2002). Very importantly, venture-backed companies produce more, and more valuable, patents than non venture-backed firms (Kortum and Lerner, 2000). Venture capitalists also play an important role in the process of going public. Their experience helps companies choose the most favourable time for their IPOs (Lerner, 1994a) and experience lower under-pricing (Megginson and Weiss, 1991). Venture-backed companies that went public in the US in the 1970s and 1980s are also found to perform

Box 2. The stages and roles of venture capital financing

Seed finance: small investment (in the order of a few hundred thousand euros) that allows an entrepreneur to verify whether his project is feasible and economically attractive. At this stage venture capitalists help to explore the viability of a project.

Start-up finance: investment to operationalize a firm (attracting employees and executives, developing a prototype and/or implementing marketing tests, etc.). Venture capitalists may at this stage help with the company organization and corporate strategy.

Expansion finance: investment to reach industrial-scale production, upgrade the production facilities and attract further employees. At this stage venture capitalists may help find additional financing, clients and suppliers. As the company grows and needs revenue, they may also help recruit marketing and other non-technical executives.

Later stage finance: investment to help the firm become a market leader and unleash its earning potential, preparing it for trade sale or IPO. At this stage venture capitalists may help set the stage for trade sale or IPO.

better than non venture-backed companies over five-year spells (Brav and Gompers, 1997). Venture capitalists also shield companies from the need to rush to markets, thus prematurely disclosing strategic information to competitors.

2.2.2. Venture capital as a package of services. Why should the ‘hard’ and ‘soft’ sides of venture capital coexist under the same roof? In standard economic conditions straight debt contracts provide the optimal form of financing (Gale and Hellwig, 1985), so one might think that the separation of financing and mentoring would also be optimal. Start-ups, however, are not standard borrowers.

A start-up relies on the talent and skills of its founder, who knows more about its technical aspects than anybody else. This makes it particularly difficult to evaluate performance, and requires of the financier a technical and not purely financial expertise. Moreover, running a laboratory requires more freedom than operating a factory, so that an entrepreneur can more easily appropriate funds than a manager in an established firm. Finally, entrepreneurs can use privy information, like the status of technical tests, to pursue strategies which conflict with the interest of investors – like rushing to market to gain a reputation of first-comer at the cost of long-term profitability. Moreover, the very nature of entrepreneurship prevents start-ups and financiers from writing complete contracts, i.e., ones that specify obligations in all conceivable future contingencies (Hart and Moore, 1998). The right to control future strategic decisions is in fact even more important in determining success for start-ups

than for mature firms. These characteristics of start-ups provide good economic reasons for the coexistence of the ‘hard’ and ‘soft’ sides of venture capital.

Financial economists have produced several justifications for why the optimal contract between entrepreneur and venture capitalist should be different from debt (Admati and Pfleiderer, 1994; Bergemann and Hege, 1998). Financing of start-ups should also take the form of convertible securities in order to induce the entrepreneur to behave efficiently (Cornelli and Yosha, 1998; Repullo and Suarez, 2000), and to allow financiers to take control of the venture if the entrepreneurs underperforms (Berglöf, 1994). A key aspect of these models is that, unlike in standard financial contracting, *both* the entrepreneur’s effort *and* the venture capitalist’s mentoring and monitoring are not verifiable by a court, and therefore cannot be contracted upon. A start-up therefore creates a situation where *both* sides have special skills to contribute for which they experience a problem of moral hazard. This situation is fundamentally different from that of a bank loan, and in the context of start-up finance a standard debt contract simply does not work. A formalization of these results can be found in Casamatta (2000), who focuses on the complementary role of the hard and soft sides of venture capital, and in Hellmann (1998), who shows that the expertise of a venture capitalist in replacing an underperforming entrepreneur as CEO of his company is a necessary ingredient for convertible securities to entail an optimal allocation of control rights.

With this in hand, we turn to the state of Europe’s venture capital industry.

3. VENTURE CAPITAL IN EUROPE VERSUS THE US: THE AGGREGATE DATA

The first step in assessing the contribution of European venture capital to the creation of innovative companies requires a quantitative look at the state and structure of the European venture capital industry and at its evolution over time. Since the US venture capital industry is the most mature and developed, we use it as the term of comparison for European venture capital.

We base our analysis on the aggregate statistics published by the European Private Equity and Venture Capital Association (EVCA) for Europe and by the National Venture Capital Association (NVCA). These data come from extensive surveys of venture capital firms in both economies. For Europe, EVCA distributes each year a survey to venture capital firms irrespective of their EVCA membership status. For 2000, the last available year, the number of respondents was 949, corresponding to a 70% response rate. The yearly statistics published by NVCA are based on the commercial database ‘VentureXpert’ by Venture Economics, a division of Thomson Financial Securities, which contains data on over 5,000 American venture capital firms. Tables 1–6 report our elaborations on these aggregate data for 1991–2000.

3.1. Evolution of venture capital in Europe and the US: A comparison

The explosion in venture capital activity during the 1990s is apparent, but has been uneven, as the first two columns in Table 1 show. In the US, the amount of funds

Table 1. Venture capital funds raised and invested, Europe versus US, 1991–2000

	Funds raised		Funds invested	
	Europe	US	Europe	US
1991	1 748	4 743	3 028	2 257
1992	5 016	5 696	2 832	3 795
1993	4 523	3 930	2 435	4 560
1994	7 624	8 040	3 039	3 723
1995	9 927	5 845	2 974	4 810
1996	11 776	9 891	3 744	9 676
1997	17 096	22 360	4 820	14 931
1998	29 410	22 031	7 051	19 190
1999	59 940	25 919	11 586	54 111
2000	92 924	45 540	19 516	100 622

Notes: Data in millions of current dollars. The funds raised and invested each year may diverge, since venture capital firms invest the money they raise over a three- to five-year time span, accumulating resources when good investment opportunities are scarce.

Source: Authors' calculations on EVCA and NVCA data.

raised increased by a factor of 80, while in Europe, only by a factor of 12. What is intriguing is that the level of funding in Europe increased mostly after the opening of Euro.nm in 1997, which paved the way for the listing of high-tech start-ups. Whether this coincidence conceals a causal link or reflects broader changes cannot be determined from simple inspection of these figures, but it suggests a challenging research topic. The data also show a widening gap in the amount of funds raised in the two economies, and that growth has been smoother in the US.

Taken at face value, the aggregate funding data shown in the second column in Table 1 would suggest that in the second half of the decade Europe has seen an impressive growth in the amount of funds raised, which increased nearly twelve-fold between 1995 and 2000 after remaining stagnant in the first half of the decade. Unfortunately, this is not the case. The problem is that aggregate data for funding comprise two very different types of data. They include funds raised for venture capital, but also funds raised by firms which specialize in management buy-outs (MBOs). These are financing operations that enable management to buy out an existing business from its original owners. MBOs typically involve established companies in mature industries, and are therefore quite distinct to venture capital, which is directed to new ventures. That the resulting bias is serious is shown by the last two columns in Table 1. Aggregate data on investments separate between funds that go into venture capital proper and into MBOs. Once we compare the amount of funds raised with that of funds invested into venture capital proper, we see that the performance of Europe is less thrilling than suggested by column 2. The growth of funds invested in venture capital between 1995 and 2000 has been near six-fold, a mere fourth of that experienced in the US. A similar result holds if we look at the whole decade, since its early years saw sluggish growth in both economies. Despite the rise

Table 2. Venture capital: sources of finance in percentage terms

	Institutional investors		Corporations		Financial		Government		Other	
	Europe	US	Europe	US	Europe	US	Europe	US	Europe	US
1991	15	76	5	5	48	6	2	–	30	13
1992	13	67	6	4	45	17	9	–	27	12
1993	16	73	5	8	40	12	6	–	33	7
1994	20	69	9	9	41	10	3	–	27	12
1995	29	59	5	5	36	20	3	–	27	16
1996	34	70	3	20	35	3	2	–	26	7
1997	26	56	11	25	42	6	2	–	19	13
1998	24	66	10	12	37	10	5	–	24	12
1999	23	61	10	14	43	16	5	–	19	9
2000	31	61	10	4	32	23	5	–	22	12

Notes: Institutional investors include endowments and pension funds, corporations include investments by corporations (also through dedicated corporate venture funds), financial institutions include banks, insurance companies, and funds raised from capital markets, other includes individuals and realized capital gains. The drop in the share of corporate funding in the US in 2000 is partly due to the shift from corporate funds to ‘in-house’ corporate investing, which does not get recorded in NVCA statistics.

Source: Authors’ calculations on EVCA and NVCA data.

of venture capital activity, the gap between Europe and the US has actually widened, and at an increasing pace.

Venture capitalists finance their activity by raising ‘funds’ from institutional investors like pension funds, insurance companies or endowments. Each ‘fund’ is invested in a number of firms with a five- to ten-year horizon. Once a ‘fund’ is ended, its cash proceedings, which come from IPOs and trade sales, are distributed to investors together with any remaining equity holdings. Table 2 uncovers a substantial difference in the structure of venture capital funding across the Atlantic. Institutional investors (mainly pension funds) are by far the largest contributor in the US, accounting for nearly two-thirds of all funds, as compared to less than one-third in Europe. The stability of the share of institutional investing in the US is also worth pointing out as a sign of maturity of that market. European venture capital is instead dominated by funding from financial institutions (mainly banks), which still remain the largest source of funding. Funds controlled by a financial or corporate entity (‘captive’ funds) are in fact more common this side of the Atlantic, where the share of corporate investment has doubled in the second half of the 1990s.

The table also highlights the lower reliance of American venture firms on ‘other’ sources (individual investors and realized capital gains), another sign of the maturity of that market. Government funding is virtually non-existent in the US, where publicly funded Small Business Investment Companies are not considered venture firms, and it is low in Europe. These profound differences in funding patterns largely reflect the different structure of capital markets in the two economies. Europe is still dominated by banks, which control a large part of the mutual funds industry. Since also the

Table 3. Venture capital investments, by stage

	Total		Of which in VC:		(Early stage)		(Expansion stage)		(Later stage)	
	Europe	US	Europe	US	Europe	US	Europe	US	Europe	US
1991	6 381	2 464	3 429	2 257	10	32	80	47	10	21
1992	6 354	5 059	3 828	3 759	10	25	76	43	14	32
1993	4 639	4 919	2 794	4 560	8	40	78	36	14	24
1994	6 635	5 263	3 707	3 723	10	35	75	32	14	33
1995	7 370	5 471	3 952	4 810	11	40	77	38	12	22
1996	8 389	11 211	4 652	9 676	12	38	71	37	18	25
1997	8 992	17 213	5 388	14 931	15	26	70	47	15	27
1998	15 662	21 981	7 636	19 190	23	30	62	46	15	24
1999	25 628	59 372	12 623	54 111	27	24	64	53	9	23
2000	33 177	103 494	19 516	100 622	32	24	63	56	5	20

Notes: Data are in millions of current dollars. Early stage includes seed and start-up financing. See Box 2 for stage definitions. Early stage comprises seed and start-up financing.

Source: Authors' calculations on EVCA and NVCA data.

nascent pension fund industry is likely to be controlled by banks, we should expect these differences to persist, and to influence the behaviour of venture capital firms.

Table 3 reveals that European venture capital invests an increasing share of its funds at 'early stage', which is where its contribution is expected to be most significant, though the monetary amount invested in early stage in Europe is about one-fifth of what is invested in the US. In Europe, the share of early stage financing has more than doubled between 1997 and 2000, and since 1999 it has been greater than in the US. Again, though one is intrigued by the coincidence of the opening of Euro.nm and the increase in this riskier type of investments, only causal conjecture is possible at this stage. In both countries the majority of funds goes to expansion investments. These go to companies that have survived the perilous early years and have shown good success prospects. As for funding, the higher variability of investment patterns in Europe can be taken as a sign of immaturity of the industry, which still has to find a stable structure.

The gap between Europe and the US is also evident from Table 4, which compares the amount invested in venture capital as a percentage of GDP in the US, in Europe and in some of its national economies. Two facts stand out. First, Europe invests a smaller share of its GDP into venture capital than the US, a difference that widened in 2000, reflecting the boom in venture capital investment on the western side of the Atlantic. The second striking fact is the large and persistent variability of venture capital intensity across European countries. One also notices that higher venture capital intensity does not necessarily correspond to more stock market listings, as the experiences of Sweden, Belgium or the Netherlands show. One likely explanation is that many venture-backed companies from these countries list in the US on Nasdaq, or in their national 'traditional' stock markets. For instance, 25 Dutch companies are

Table 4. Venture capital investments as a percentage of GDP

	US	Europe	UK	Germany	France	Sweden	Italy	Belgium	Nether.	Spain
1990	5	1	11	4	6	2	2	4	7	2
1991	4	1	9	4	7	1	4	3	7	4
1992	6	1	8	3	6	1	4	8	6	3
1993	7	1	7	3	6	1	2	5	6	3
1994	5	4	9	3	6	5	2	5	9	2
1995	6	4	9	3	4	2	3	5	12	3
1996	12	5	9	3	6	11	4	5	13	4
1997	18	6	11	5	10	4	4	8	19	5
1998	21	9	16	7	7	6	6	10	24	5
1999	58	14	21	13	13	20	6	27	34	10
2000	78	17	38	30	10	21	7	10	80	8

Sources: Authors' calculations on EVCA and NVCA data; GDP from *International Financial Statistics* of the IMF, GDP for Europe (EU-15) and US from the *Monthly Bulletin* of the OECD.

Table 5. Venture capital investment destination, percent by sector

	Telecom		Computer		Manufacturing		Biomed		Electronics		Other	
	Europe	US	Europe	US	Europe	US	Europe	US	Europe	US	Europe	US
1991	2	12	6	19	56	13	6	25	3	17	27	14
1992	4	21	4	12	58	8	5	22	3	10	26	27
1993	1	21	6	30	59	8	6	21	4	7	24	13
1994	2	17	4	18	61	9	5	23	4	10	24	23
1995	5	18	7	21	56	12	8	22	4	12	20	15
1996	4	15	5	27	52	9	6	20	4	7	29	22
1997	6	16	7	30	51	8	7	27	5	8	24	11
1998	9	16	9	36	46	8	7	17	3	11	26	12
1999	12	17	11	56	50	6	7	7	2	6	18	8
2000	14	17	13	58	43	7	10	6	4	8	16	4

Notes: Underlying data in euros for Europe, in dollars for US. Biomed includes biotechnologies, medical technology and healthcare; Computer includes online and Internet start-ups; Manufacturing includes industrial products, consumer products, energy; Electronics includes computer hardware and semiconductors. Other includes agriculture and financial services. Unfortunately Europe's data include investments in MBOs, since a sectoral breakdown for venture investments is not published by EVCA. This may explain the predominance of investment in traditional sectors in Europe.

Source: Authors' calculations on EVCA and NVCA data.

listed on Nasdaq, 9 of which did so since 1997. One intriguing fact is that the opening of Euro.nm seems to have also spurred venture capital intensity at national level, albeit with some delay. Indeed, intensity increased more than sixfold in Germany since 1997, and nearly doubled in France since 1996, the year the Nouveau Marché opened. Not all countries experienced such an upsurge, though. Venture intensity in Italy and Belgium, for instance, has languished.

Table 5 provides data on the sectoral distribution of venture capital investments. While differences in sector classifications make it difficult to closely compare EU and US patterns, some facts stand out. Most notably, manufacturing – which includes

Table 6. Venture capital backed companies

	US companies	EU investments	EU companies
1991	1 088	5 615	n.a.
1992	1 294	5 088	n.a.
1993	1 150	4 422	n.a.
1994	1 191	4 459	n.a.
1995	1 325	3 891	n.a.
1996	2 002	4 081	n.a.
1997	2 697	5 044	3 967
1998	3 149	6 062	5 083
1999	3 969	9 470	7 335
2000	5 412	12 958	9 574

Notes: Data are counts of exits.

Source: Authors' calculations on EVCA and NVCA data.

consumer and industrial products – plays a major role in Europe, but only a marginal role in the US. While this is partly due to the inclusion of MBOs in the European data, its lower propensity to high-tech investments is confirmed by the relevance of investments in agriculture and finance ('other' in the table). The evolution of investment patterns is also telling. Europe is much less dynamic, and the relevance of investment in more advanced sectors has only begun in 1999. The US, instead, shows a more flexible investment attitude. For instance, the share of money put into biomedical companies has shrunk in the last few years, while computer investments in Internet-related companies have boomed.

Table 6 shows another interesting difference between the structures of venture capital investments in the two economies. While Europe invests much less in venture capital than the US, it supports a much larger number of companies, nearly twice as many. This means that the average amount invested per company is much smaller in Europe, where money is spread very thinly across companies.

An interesting way of looking at the evolution of the venture capital industry is also to consider the number of venture capital firms. A problem in this respect is that no standard definition or registry of venture capital exists. Therefore – unlike banks or brokers – one must resort to a subjective criterion to identify venture capitalists. What we did was to consider a venture capital firm as such if it belongs to EVCA, whose directories since 1990 are available (despite our best efforts, we could not obtain pre-1999 directories from national venture capital associations). Based on this definition, Table 7 provides some interesting insights into the dynamics of the venture capital industry. The vast number of venture firms confirms that Europe still has some way to go before boasting a venture capital industry as large as in the US.

The number of venture capital firms in Europe remains nearly half that of the US. Also, the high growth of the American industry started as early as 1995, together with the growth wave in funding and investment. In Europe, on the other hand, the number of venture capital firms almost doubled over just three years, raising again

Table 7. Venture capital firms, EU and US

	US	EU	UK	Germany	France	Sweden	Italy	Belgium	Spain	Nether.
1991	389	163	42	11	30	1	10	12	5	21
1992	397	161	38	15	29	2	12	11	6	20
1993	401	159	40	13	29	3	11	12	7	19
1994	400	162	42	15	27	5	11	14	8	17
1995	425	169	40	18	32	5	11	13	8	16
1996	460	176	42	20	31	4	13	13	8	18
1997	507	184	52	27	32	5	12	16	8	19
1998	547	210	61	36	33	7	12	17	10	25
1999	620	331	79	51	48	11	16	23	14	32
2000	693	424	90	75	59	22	19	30	17	33

Notes: Venture capital firms members of EVCA and NVCA.

Source: Authors' calculations on EVCA and NVCA data.

the question of what role the opening of Euro.nm might have played in this. Indeed, the five countries where a 'new' stock market opened accounted for almost half of the total growth in the number of EVCA members since 1997.

The number of venture capital firms is much greater in those countries with an active stock market for innovative firms. Italy is the only exception, with a small and less dynamic venture capital industry. Taken together with the difference in organizational structure (Jeng and Wells, 2000), funding sources and investment behaviour, these numbers draw a picture of wide differences in the venture capital industries of the US and Europe. What might that mean for the financing of innovative companies is the object of the rest of this article.

4. VENTURE CAPITAL IN THE WINNER'S CIRCLE: VENTURE-BACKED COMPANIES ON EUROPE'S 'NEW' STOCK MARKETS

Aggregate data leaves one with the impression that European venture capital has substantially developed over the last decade, but has lost ground to the US in its ability to fund innovative start-ups. Aggregate data, however, cannot answer the key policy-relevant questions. How effective is European venture capital in nurturing fast-growing companies? Has the growth in the size of the industry corresponded to a growth in its ability to support the creation of innovative companies, or not? The only way to obtain a convincing answer is to turn to firm-level data. Since systematic, commercial data collection in Europe has begun only very recently, we had to gather our own data set. In this section we first describe the data and then display several of its key features.

4.1. The data set

Our hand-collected data set is based on listing prospectuses and annual reports of companies that went public on Euro.nm from its inception to December 2000. Listing

prospectuses contain detailed information on the financial and business situation of the company. Such information is not confined to the IPO year, but extends back in time, up to the three previous years. We use prospectuses and annual reports also to derive quantitative information on several financial and business variables. For each company we collect all the available data for pre-IPO years from the issuing prospectus, which usually contains data for the preceding three years. We also collect data for all the available post-IPO years from annual reports. Each company in the data set is assigned to a sector through a procedure we describe in the Web Appendix, which also contains a detailed description of the data collection process and of the variables we use in this study. Our final data set, which does not include sixteen companies in financial services, consists of 511 companies – more than 90% of the total.¹

Additionally, we collected data about financing from venture capitalists and their involvement with these companies. We took particular care in extracting relevant information from our sources. This turned out to be an extremely time-consuming task that required a careful search of each single prospectus and crosschecks with several other sources.² The process of identification of venture capitalist was made particularly difficult by the fact that, unlike for banks, no standard identification criterion is available. We were able to collect data on the extent of ownership and on the timing of venture capital financing, while the exact amount of funding generally remains undisclosed. Again details are in the Web Appendix.

4.1.1. Pros and cons of looking at Euro.nm-listed companies. An advantage of looking at Euro.nm listed companies is that they belong to a small number of high-tech industries, are of fairly similar age, and come from a small number of countries. This makes them a relatively homogeneous group of ‘venturable’ companies where we naturally find a reliable control sample, avoiding sample design problems. Focusing on Euro.nm listed companies also gives the advantage of obtaining detailed information thanks to the tight disclosure requirements of Euro.nm, which makes companies disclose information not only for the years starting with the IPO, but also for the three pre-IPO years. Such breadth and depth of information cannot be attained for private firms.

Looking only at companies that make it to the stock market has the obvious limitation of disregarding what happens to those that are still private, were sold in a trade sale, or failed. In our case, however, this limitation should not be too much of a concern. Start-ups that go public are arguably among the most successful ones, since the pecuniary and reputation rewards for founders and financiers are highest in this case. Founders can get a much higher valuation with a flotation than with an

¹ Companies in the financial services sector are not considered because their financial structure, funding requirements and strategic behaviour differ substantially from those of industrial and (non-financial) services companies.

² We are grateful to our research assistants for the enthusiasm they put in this demanding and tedious job.

acquisition or a private placement. The ability to bring companies public is one of the key abilities venture capitalists boast about with institutional investors, since IPOs are the most lucrative exit from a venture investment, on average four or five times more profitable than acquisitions (Gompers and Lerner, 1997). Since venture capitalists are profit-seeking organizations we would expect them to bring as many of their portfolio companies public as possible, and since they crucially rely on reputation for their business, we would also expect them to select the most promising firms as investees. Therefore we might *over*-estimate the impact of venture capital on corporate growth by looking only at listed companies, a possibility we will return to in the interpretation of the data.

4.2. Euro.nm: Europe's 'new' stock markets

Euro.nm was created in the spring of 1997 as an alliance of the newly born 'new stock markets' of the stock exchanges of Amsterdam (Nieuwe Markt), Brussels (Euro.nm Brussels), Frankfurt (Neuer Markt), and Paris (Nouveau Marché, which had opened in March 1996). In June 1999, Milan's Nuovo Mercato completed the ranks of the alliance. Euro.nm's purpose was to attract dynamic, innovative companies with high growth potential by offering them suitable admission and trading rules, along the lines of what Nasdaq does in the US. Euro.nm offered admission criteria and listing requirements appropriate for young companies with bright prospects but no established track record, willing to accept tight disclosure rules in order to attract investors (see Box 3).

The listing rules of Euro.nm were less restrictive than those in use for 'traditional' exchanges, and thus more appropriate for dynamic new ventures. However, listing

Box 3. Euro.nm admission and listing criteria

- Shareholder equity (pre-IPO): at least €1.5 million
- Age: at least three years (waiveable)
- IPO volume: at least €5 million and 100,000 shares
- IPO prospectus: according to international standards
- Lock-up: existing shareholders must lock-up their holdings for at least 12 months after the IPO (6 months on the Neuer Markt)
- Free float: at least 20% of the nominal capital must be floated. Also, at least half of the IPO volume must come from a capital increase
- Only ordinary shares with no restrictions to negotiability can be floated
- At least one sponsor (an investment bank regulated by the stock exchange) must be designated by the firm to co-ordinate the listing process
- Timely release of annual and quarterly reports and of price sensitive information.

Table 8. IPOs on Euro.nm and capital raised

	<i>Euro.nm</i>	Nouveau Marché	Neuer Markt	Nieuwe Markt	Euro.nm Brussels	Nuovo Mercato
1996	18	18	—	—	—	
1997	44	20	17	5	2	
1998	103	43	46	8	6	
1999	182	32	138	1	5	6
2000	220	52	132	1	2	33
Total	567	165	333	15	15	39
(of which in the data set)	(511)	(157)	(306)	(6)	(6)	(36)
Total capital raised	41 618	7 986	26 673	470	225	4 633
Capital raised at IPO	29.4	10.1	38.2	5.7	8.1	44.0

Notes: The number of IPOs includes 16 financial companies that are excluded from our data set. Capital raised is in millions of euros. Capital raised at IPO: median values. The large amount of capital raised on the Nuovo Mercato is due to a small number of very large telecom companies.

Source: Authors' calculations.

on Euro.nm was more demanding than listing on a traditional exchange in terms of disclosure requirements. The Neuer Markt, which adopted the strictest rules, required prospectuses and annual reports to be published also in English, acceptance of the German Takeover Code, and compliance with international accounting standards (IAS or US-GAAP). Euro.nm closed in December 2000 after the merger of the Paris, Amsterdam and Brussels stock exchanges into Euronext, but its constituent markets have continued their activity independently. In Bottazzi and Da Rin (2001) we analyse the evolution of Euro.nm and provide an assessment of its contribution to the financing of European innovative firms.

Table 8 summarizes the evolution of IPOs on Euro.nm. It is worth noticing that IPOs on the Belgian and Dutch markets has tapered off with time, and that the Neuer Markt shows a robust and uninterrupted growth pattern, unlike the uneven growth of the Nouveau Marché. More than half of the IPOs occurred on the Neuer Markt, almost a third on the Nouveau Marché, while the Nuovo Mercato attracted almost as many companies as the Neuer Markt in its first eighteen months. Our sample closely replicates the market composition of the population, apart for the two smaller markets, which are under-represented. Notice that the Neuer Markt accounts for a larger share of capital raised than that of listed companies. Therefore, the (median) amount of capital raised at IPO is far larger on the Neuer Markt than elsewhere.

4.3. A first look at the data

Our data show that venture-backed companies constitute a substantial part of Europe's new public companies: The first two rows of Table 9 show that nearly 40% of the listed companies were backed by at least one venture capitalist. This proportion is higher for companies listed on the Nouveau Marché than for those listed elsewhere.

Table 9. Involvement of venture capitalist with Euro.nm-listed companies

	Venture capital and Euro.nm listed companies					
	<i>Euro.nm</i>	Nouveau Marché	Neuer Markt	Nieuwe Markt	Euro.nm Brussels	Nuovo Mercato
<i>Listed companies:</i>						
Without VC	292	68	186	6	6	26
With VC	219	89	120	0	0	10
<i>of which, firms receiving:</i>						
VC before Euro.nm	67	27	34	0	0	6
VC after Euro.nm	130	41	86	0	0	3
Date unknown	22	21	0	0	0	1
Equity holdings by venture capital firm (% of equity)						
	Pre-IPO			Post-IPO		
	Mean	Min	Max	Mean	Min	Max
Neuer Markt	10 (17)	0	100	6 (9)	0	43
Nouveau Marché	14 (18)	0	85	8 (12)	0	53
Nuovo Mercato	7 (14)	0	46	4 (9)	0	32

Notes: ‘With VC’ identifies companies that received venture capital financing, and ‘without VC’ those that did not. ‘VC before Euro.nm’ identifies companies which received venture capital financing before the opening of the ‘new market’ they list on and ‘VC after Euro.nm’ those that received it after the opening. ‘Date unknown’ indicates those for who we could not ascertain the date of venture capital financing. Numbers in parentheses in the ‘Mean’ columns are the standard errors.

Source: Authors’ calculations.

The proportion of listed companies that receive venture finance has doubled since the opening of Euro.nm, a trend that is most noticeable in Germany, a fact we will return to. Notice also that no company listed in Amsterdam or Brussels was backed by a venture capitalist.

This is at odds with the numbers in Table 4, where these two countries were shown to have relatively high venture capital intensity. One possible explanation is the long tradition of listing on Nasdaq of Dutch companies (Blass and Yafeh, 2000), which might be helped by venture capitalists to go through a more expensive listing in the more established American market. Ease of access to Nasdaq could also explain the overall dismal performance of the Nieuwe Markt. More difficult to explain is instead the lack of venture-backed companies on Euro.nm Belgium, and a Parisian dominance cannot be invoked; only one Belgian company is found on the Nouveau Marché. Our data also reveals that the sectoral composition of venture capital investments is very close to the sectoral structure of Euro.nm, except for a slightly lower involvement with Media and Entertainment and a higher involvement with Biomed (Table A-2 in the Web Appendix).

Another way to look at the involvement of venture capitalists with listed companies is to look at their equity holdings, which we examine in the last three rows of Table 9.

While fairly volatile, holdings are far from negligible. Moreover, these numbers are likely to underestimate the involvement of venture capital, since in many cases ‘bridge financing’ from specialized intermediaries is used in the wake of the IPO to increase the equity base. Venture capitalists often sell part of their stakes at this stage, but we are not able to see these transactions. The table also shows that at the time of going public, venture capitalists sell only about 40% of their holdings, and remain involved with the company after it has gone public. As a comparison, Barry *et al.* (1990) find that US venture capital firms had a higher average pre-IPO equity stake (32%) and sold about one-third of it. European venture capital thus seems to have lower shareholdings.

We then want to know the extent to which European venture capital has been involved with listed companies. Our data show that the involvement of European venture capitalists with Euro.nm has been substantial, with nearly one-third of the ‘core’ group of European venture capital firms being involved with companies that listed on Euro.nm. This represents a substantial involvement, given that about 70% of Europe’s venture capital firms have been members of EVCA for less than three years and therefore may not have had enough time to take investee companies to the stock market.

Another reflection of the fact that many European venture capital firms are still very young is that most have not had the time to get many companies public. In our sample, 122 venture capitalists had investments in only one listed firm, 46 had 2–4 investments, 16 had 5–9, and only 8 had investments in 10 or more listed firms. Table A-1 in the Web Appendix shows that larger venture capitalists with an international presence tend to support the largest number of listed companies. Looking at the other side of the coin, namely the number of venture-capital investors by company, shows that syndication of venture investments is not very common in Europe, unlike in the US (Lerner, 1994b); more than half of the 219 venture-backed companies in our sample only had one venture capitalist.

Our last piece of information is given in Table 10, which lists the nationality of venture capital firms and investee companies. Reported numbers are counts of investments by venture capital firms (row) in a certain country (column). One would expect venture capitalists to invest in firms geographically close to them, given their need for constant interaction with their investees. Several studies based on US data document the fact that venture capitalists tend to invest in the proximity of their headquarters (Lerner, 1995). The table confirms that this is the case for our sample, as the vast majority of investments are made within a venture capitalist’s own national borders, as one can see by looking at the diagonal in the table. The only exceptions are venture capital firms with an international reach, and American venture capitalists that invest in Europe; it is worth noting that these possess local offices in several countries.

4.3.1. Which companies are venture-backed? Before proceeding to the analysis of the effects of venture capital we want to know which characteristics of a firm are

Table 10. Venture capital and investee companies, by nationality

Venture capitalists	Investee companies:					
	Germany	France	Italy	Israel	US	Others
Germany	134	3	0	0	2	1
France	2	139	1	0	1	0
Italy	0	0	10	0	0	0
Israel	2	4	0	5	0	0
US	11	9	1	0	2	1
International	44	32	2	0	1	1
UK	5	9	2	0	0	0
Others	5	1	0	1	0	5

Notes: Others includes venture capitalists from Austria (5 investments), Denmark (1), Ireland (1), Netherlands (8), South Korea (1), Switzerland (5).

Source: Authors' calculations.

associated with receiving venture capital financing. Using probit analysis (details of the formal statistic methods can be found in the Web Appendix) we find that the level of sales prior to receiving VC backing *reduces* the probability of obtaining venture capital financing, while leverage has a positive effect, although it is not statistically significant. These findings are consistent with a view of venture capital getting involved with firms that are still at a very initial stage of development and are therefore not yet able to sell. The positive effect of leverage is consistent with a view of venture capital as an important source of financing. In other words, the 'hard' side of venture capital goes well along its 'soft' side.

4.3.2. The impact of Euro.nm on venture capital. We conclude our statistical portrait of venture capital in Europe by taking a dynamic view of its involvement with the 'new' stock markets. A close inspection of the listing data reveals in fact that something is changing in the involvement of venture capital with listed companies. We have seen that venture firms are growing fast in Europe. This is good news, for at least two reasons. One is that a large number is a sign of maturity. The second is that a large part of Europe's venture capitalists are what the jargon defines as 'captives', i.e. subsidiaries of industrial companies or financial institutions (typically banks). Captives are not the most aggressive among venture capitalists (Hellmann, Lindsey and Puri, 1999). An important change seems to be taking place, however, with a new breed of US-style, independent, venture capital firms entering the market and possibly changing the way venture capital operates in Europe.

Table 9 above shows a suggestive piece of information in this respect. Of the 197 venture-backed firms in our sample for which we could identify the entry date of a venture capitalist, two-thirds received venture financing *after* the opening of Euro.nm. Interestingly, this proportion is higher in Germany, whose Neuer Markt is considered the most dynamic of the 'new' markets. Our data provides further evidence that Euro.nm may really be having an effect on the European venture capital industry.

Defining a start-up as venture-backed if it receives venture finances within six months from its foundation, we have 50 VC-backed start-ups, which we divide into those that were born before the opening of Euro.nm (20 companies) and those that were born after it (30 companies). The number of VC-backed start-ups clearly increases *after* the opening of Euro.nm. We take this evidence as a suggestive indication of the positive effect of Euro.nm on venture capital. We also notice differences across markets, as the positive effect seems to be much stronger in France than in Germany or Italy. No venture-backed companies are listed in Amsterdam and Brussels.

Taking our data further, we see evidence of increasing involvement of European venture capitalists in companies that have the potential to list, and an increasing importance of venture capitalists in the creation of innovative start-ups. Specifically, we partition all the VC-backed firms by year of Euro.nm listing and by whether they were born with or without VC backing. The number of both types of VC-backed start-ups increases over time, with the number of VC-born start-ups more than doubling each year. Indeed, 2000 saw a doubling of the *proportion* of all VC-backed companies that are born in this way. Our data set also shows that six of the 28 companies that were born venture-backed in 2000 had a 'young' venture capitalist, i.e. one that had become a member of EVCA at most two years earlier. Between 1996 and 1999 only two such cases had occurred.

There are good reasons to greet this evidence with optimism and hope. Several recent studies emphasize the complementary role of stock exchanges and venture capital (Black and Gilson, 1998; Michelacci and Suarez, 2000). In this view, venture capital and stock exchanges are more than simple sources of finance. Venture capital contributes effective oversight of new ventures, selecting and supporting valiant entrepreneurs and promising new ventures. Such support facilitates the growth of these ventures and accelerates their arrival to equity markets. In turn, active and liquid stock markets make IPOs affordable for companies and attractive for investors, creating a complementarity similar to that modelled by Pagano (1993). The American experience with the Nasdaq, which was created in 1971 to provide an equity market for high-tech companies, is certainly suggestive in this respect. Over the 1990s about 6,500 companies listed on the Nasdaq – the American stock exchange focused on high-technology industries that in December 2000 listed over 6,000 companies with a capitalization above \$5 billion. Many of these companies had been backed by venture capital, among them successful ones such as Amazon, Cisco Systems, Dell Computers, Intel, Microsoft and Yahoo! The evidence we provide in this paper will show that for Europe this road is still very long, but we are probably moving in the right direction.

5. VENTURE CAPITAL AND THE PERFORMANCE OF INNOVATIVE EUROPEAN COMPANIES

Studies conducted for venture capital industry associations, portray venture capital as conducive to job creation and to the growth of technologically oriented firms. For

instance, between 1993 and 1997, British venture-backed companies annually increased employment by 24%, and sales by 40%. By comparison, employment at the hundred largest British listed companies grew by 7%, and sales by 15% (BVCA, 1999). On a European scale, between 1991 and 1995, employment at venture-backed companies grew by a yearly 15% and sales by 35%, as compared to 2% and 14% for the 500 largest European listed firms (EVCA, 1996).³

Suggestive as they are, the jobs and sales growth figures suffer from two important biases that make venture capital's role bigger than it might actually be. First, these studies suffer from 'survivorship bias', i.e. they only look at successful start-ups, ignoring sales and job figures for the much larger number of failed firms. A correct comparison should look at both winners and losers, taking into account that small and medium enterprises (SMEs) suffer from a high mortality rate. The contribution of SMEs to economic growth or *net* job creation is in fact far from obviously positive, and has been recently challenged in a series of studies such as Audretsch and Thurik (1999). The second bias involves size. These studies compare venture-backed firms with large firms, which are, by their nature, less dynamic (Davis *et al.*, 1996). A correct comparison should instead pit venture-backed against non-venture-backed start-ups.

In short, the spectacular jobs and sales growth experienced by VC-backed firms could, in principle, reflect a spurious correlation between being a start-up and receiving venture capital; the vitality of European VC-backed firms could be due to factors other than venture capital. The design of studies like those undertaken by the British and European Venture Capital Associations prevents them from being able to separate the effects of venture capital financing from those of being a (naturally fast-growing) start-up. A deeper analysis is therefore warranted, and our paper provides a first attempt in this direction.

5.1. Our empirical findings

We now turn to the core of our analysis, namely a rigorous statistical assessment of whether European venture capital helps select and nurture the most dynamic innovative companies. Venture capital is expected to provide valuable support to investee companies, and it is indeed found to do so in the US. Does European venture capital also provide the companies it finances with 'hard' and 'soft' support able to make them the 'superstars' among innovators?

We focus on four indicators, namely the timing of the IPO (listing on a stock market, or 'going public'), the amount of capital raised at the IPO, and post-IPO corporate growth measured by sales and employees.

³ Also see the case studies on the difficult gestation of European venture capital in the 1980s and 1990s provided by Becker and Hellmann (2000) and Freeman (1998).

5.2. Evidence on the timing of the IPO

The timing of the listing is a crucial one in the life of an innovative company. Going public helps future growth and financially rewards financiers and founders. Our primary hypothesis is that venture capital neither speeds up nor slows down the IPO process. By contrast, venture capitalists might speed up the IPO if they are pushing for a quick IPO to cash in and turn to new ventures, or if they enabled companies to mature faster. NVCA (1988) indeed claims that, between 1992 and 1996, US venture-backed companies were 70% more likely to become listed than other start-ups. Alternatively, venture capitalists might postpone listing because they invest in younger firms and wait for them to mature.

To explore this issue we compute what we call the time-to-listing (TTL), defined as the time between a company's foundation and its IPO. For companies born before the creation of Euro.nm, which represent 80% of our sample, the TTL is the difference between the creation of the relevant 'new' market and the firm's IPO.

5.2.1. 'Hazard ratios'. By the very nature of TTL, pinning down the impact of venture capital backing requires an uncommon (but standard) statistical approach. For any given firm going public is a one-time event and many things which influence its precise timing include pure chance. One way of capturing this empirically is to suppose that each firm that has not yet gone public faces a particular probability of going public in the current year. The axis of investigation is then to look at the determinants of this probability, which is also known as a hazard rate (see Kiefer, 1988). To improve the interpretability, we look at the determinants of the ratio of the probability that a firm goes public to the probability that it has not already done so – the hazard ratio. We are especially interested in seeing whether financing by a venture capitalist tends to increase or decrease the ratio.

The top part of Table 11 reports the hazard ratio estimates (an estimate over one implies the variable *increases* the probability of going public, i.e. of speeding up the IPO). In studying the impact of VC-backing, we control for the return on asset (ROA) and for leverage, both measured at IPO, for sectors of activity and for countries. As in the other regressions, we also try a different specification that uses the venture capitalists' shareholdings size as a measure of their influence. Since in all cases we find no significant difference in the results obtained, we report the simpler dummy specification. Finally, we control for age at IPO since this variable might introduce a bias as firms differ in their stage of maturity at the time of the creation of Euro.nm. In other words, older firms may be readier for going public than newborns. We take care of this possibility by controlling for the age of the firms at the creation of the 'new markets' through a variable which interacts the company's age with the calendar year of its listing.

Venture capital turns out to have little effect on TTL. The hazard ratio is 1.05, so venture capital does tend to decrease TTL, but the effect is not statistically different

Table 11. The impact of venture capital backing IPOs timing and size**The impact of venture capital on time-to-listing (TTL)**

	Venture capital	Leverage	ROA	France	Age*97	Age*98	Age*99	Age*00
Hazard ratio	1.05	0.89	1	0.36***	1.00***	1.01***	1.00*	0.99***
<i>t</i> -statistic	0.61	-0.48	0.18	-8.71	7.32	8.24	1.6	-6.37

Notes: All variables measured at IPO; age multiplied by year is the age of the company interacted with a dummy for year of listing. Significance levels are indicated by * (10%), ** (5%), and *** (1%). Huber-White corrected standard errors are used to obtain robust estimates. We use a Cox proportional hazard model (Kiefer, 1988), i.e. $h(t) = h_0(t)\exp\{\beta'X\}$, where $h(t)$ is the hazard rate that depends on independent variables X_i and $h_0(t)$ is the baseline rate; no restrictions on $h_0(t)$ are imposed in estimating β . The hazard ratio for X_i is $\exp\{\beta X_i\} / [\sum_j \beta X_j]$, where $j \neq i$. In this regression, the number of observation is 488, the log likelihood is -2,460.57, the Wald chi-square (7) is 233.67 and the *p*-value is 0.00.

The impact of venture capital on funds raised over assets

	Venture capital	Sales/assets	Leverage (at IPO)	ROA (at IPO)	Age	France	Constant	France
Coefficient	0.633***	0.096***	1.399*	1.627***	-0.004***	-1.799	2.984***	-1.799***
<i>t</i> -statistic	2.411	3.465	1.787	32.389	-3.650	-6.104	3.714	-6.104

Notes: All variables measured at IPO. Significance levels are indicated by * (10%), ** (5%), and *** (1%). Huber-White corrected standard errors are used to obtain robust estimates. Ordinary least squares is the estimation procedure. Given the high variability of our data we choose an estimation method that performs an initial screening and eliminates gross outliers and performs the regression iteratively, weighting the observations by absolute residuals; the method is based on Cook's D.

from one. Also ROA and leverage do not significantly affect TTL. The age of the company at the creation of the 'new markets' is, by contrast, always statistically significant, but it leaves the hazard ratio virtually unchanged. Companies listed on the Nouveau Marché have a TTL that is about 60% longer than elsewhere. Finally, companies in all sectors of activity, except the traditional one, have a hazard ratio that is close to 0.3 and highly significant.

When we control for R&D expenditure (to focus on the most innovative companies in our sample), we confirm these results, except that now venture financing increases TTL, albeit still without statistical significance (see the Web Appendix for details).

5.3. Evidence on the amount of funds raised

Another IPO-related indicator of the impact of venture capital is the amount of capital raised at the IPO. This variable is important since it affects the resources that a growth-oriented company can rely on. Our primary hypothesis here is that venture capital does not affect the amount raised at IPO. Again, there are alternative hypotheses. First, 'certification' from a venture capitalist may reassure investors even when financial results do not still reflect the full potential of the company, so VC backing would increase the amount raised; this would also be the case if VC-backed firms were systematically more patient than non-VC-backed firms in waiting for a 'hot'

IPO market. Alternatively, if venture capitalists ‘push’ firms to the market, their eagerness to exit could be detrimental for the amount raised, both because investors would be suspicious of venture-backed companies and because the IPO might take place during a ‘cold’ market.

To check which hypothesis is correct, we use standard statistical techniques to see how the amount of funds raised is affected by the firm’s sales (divided by assets) along with the presence of a venture capitalist, the return on asset (ROA), leverage, age (all measured at the IPO), and we control for country and sectoral effects. Given the high variation in firm size, which arguably influences how much capital a company can raise, we normalize the amount of funds raised by dividing by assets (measured at IPO).⁴

The bottom part of Table 11 reports some of our results. Companies that have higher sales (over assets), and therefore are probably more mature, are able to raise a higher amount at IPO: an increase of 10% of sales (over assets) brings an additional 1% increase in the amount raised (over assets). A similar result holds for companies whose ROA and leverage are higher: a 10% increase in either of these ratios carries an increase of 16% and 14%, respectively, in the amount of funds raised (over assets). Companies listed on the Nouveau Marché are characterized by a markedly lower ability to raise funds – they raise about 180% less than other companies. Older companies also raise less capital, but only marginally so. Venture capital has a positive and significant role: venture-backed companies raise on average 60% more than the others, a result we will come back to. Sectors of activity are found to play no role.

When we control for the R&D intensity some of the above results change (see the Web Appendix for details). Sales (over assets) become only marginally significant and lose much of their economic impact. Venture capital also becomes statistically insignificant, while the negative effect of age and of France persists. Overall, these results refute our null hypotheses that venture capital has no influence on the dimension of the IPO, a result that is consistent with the idea that the ‘hard’ side of venture capital is very important.

5.4. Evidence on corporate growth

Our third and fourth indicators of the impact of venture capital focus on corporate growth. Here the hypothesis we wish to test is that the post-IPO growth of a listed company is ‘venture capital neutral’, i.e. there is no relation between the post-IPO growth and the presence of a venture capitalist. Venture capitalists might indeed be attracted by the innovativeness of a firm, which could be unrelated to employment or sales. We take the IPO as a turning point in the life of these companies, because it provides them with the financial resources necessary to fully unfold their business

⁴ We use assets and not sales because the latter would be a poor measure of the size of these innovative companies, which still need time and money to invest to fully express their commercial potential. Sales, instead, may be a good measure of the extent to which an innovative company has matured.

Table 12. Venture capital and corporate growth

Indicator of corporate growth:	Venture capital involvement	Pre-IPO	Post-IPO
Assets	Non-VC-backed	7.1*	59.3##*
	VC-backed	6.2*	42.8##*
Debt	Non-VC-backed	4.7*	18.1##*
	VC-backed	3.5*	11.5##*
Equity	Non-VC-backed	1.2*	35.6##*
	VC-backed	0.9*	24.5##*
EBITDA	Non-VC-backed	0.8##*	3.2##*
	VC-backed	0.2##	0.4##
Leverage	Non-VC-backed	0.8*	0.3*
	VC-backed	0.8*	0.3*
ROA	Non-VC-backed	0.11*##	0.07*##
	VC-backed	0.05##	0.01##
Sales	Non-VC-backed	9.3##*	36.4##*
	VC-backed	5.6##*	22.9##*
Employees	Non-VC-backed	77*	210*
	VC-backed	54*	170*
Capital expenditure	Non-VC-backed	0.6*	7.0*
	VC-backed	0.4*	4.9*
Foreign sales (%)	Non-VC-backed	0.01##	0.00##
	VC-backed	0.03##	0.01##
Intangible assets	Non-VC-backed	0.2*	8.0##*
	VC-backed	0.2*	4.0##*
R&D	Non-VC-backed	0.8*	3.3*
	VC-backed	0.8*	3.4*
R&D intensity	Non-VC-backed	0.1##*	0.05*
	VC-backed	0.2##*	0.06*

Notes: EBITDA is an accounting measure of profitability (earnings before interest, taxes, depreciation and amortization). * indicates a statistically significant (at 5% confidence level) difference of medians *across time* (a Wilcoxon test is used); a # indicates statistically significant (at 5% confidence level) differences between *VC-backed* and *non-VC-backed* companies (Kruskal-Wallis sign-rank test is used). For each variable we report the average of its median values for the (up to) three years before (*Pre-IPO*) or after (*Post-IPO*) the IPO. In the upper row we report the medians for non venture-backed companies (no VC), in the lower row those for venture-backed companies (VC). See the Web Appendix for descriptive statistics for all reported variables, so as to facilitate comparisons of 'pre' and 'post' values.

potential. Again we have some plausible alternative hypotheses. The first alternative hypothesis is that venture capital favours sales and employment growth through its ability to connect the firm with potential clients and suppliers and to attract additional funding. NVCA (1998) claims that US venture-backed companies created jobs at a 55% faster pace than other start-ups between 1992 and 1996, and Brav and Gompers (1997) find them to yield higher stock returns in the five years after listing. If that were indeed the case we would have a very nice piece of evidence to support the presumption of a positive macroeconomic effect of venture capital. An opposite alternative would see venture capital as detrimental to growth if its main goal is to realize a 'quick and dirty' capital gain at IPO and then leave the company to its own fate.

To examine how venture capital affects corporate growth, we compare how venture-backed and non venture-backed companies behaved. Table 12 reports the results of two tests.

The first test looks at the difference in the medians of several variables pre- and post-IPO, where pre- and post-IPO are defined as the periods of (up to) three years before and after the IPO year. We run this test for both venture-backed and non-venture-backed companies. A second test looks at whether the medians of several variables differ in a statistically significant manner between venture-backed and non-venture-backed companies, *within* the pre- and the post-IPO periods. The figures in the table are medians and those marked with a ‘*’ differ significantly *across time* and within the VC-backed and non-VC-backed groups of companies. Medians marked with a # are statistically significantly different between the two types of company (VC-backed and non-VC-backed) *within* a pre- or post-IPO period.

We shall concentrate first on how variables differ across time. Here we find that virtually all variables vary significantly, with the notable exception of profitability for venture-backed companies. This result confirms that listed companies do invest and grow substantially after the IPO, and that this does represent a turning point of their evolution.

Things become more varied when we look at differences between venture-backed and non-venture-backed companies. Before the IPO, VC-backed and non-VC-backed companies do not differ systematically. We find statistically significant differences in three variables: profitability and sales, both of which are lower for venture-backed companies, and R&D intensity, which is higher. After the IPO, non-venture capital firms become significantly bigger in terms of assets, debt and equity, although both types of companies show the same level of leverage. We also find a systematic difference between venture-backed and non-venture-backed companies in terms of sales (which we interpret as a sign of maturity), employees, capital expenditure, and intangible assets – venture capital being linked to lower values.

5.4.1. Controlling for other factors with regression analysis. Although the analysis of Table 12 is suggestive, it cannot be considered conclusive. We need to control for other characteristics of the firms in order to ascertain the true impact of venture capital financing on corporate growth. We thus turn to a more formal regression analysis of the effect of venture backing on the growth of employment and sales after the IPO. The model we have in mind is very simple; the capacity of an innovative firm to grow depends on its ability to invest, which can be financed either from revenues or from external finance (debt or equity). Age, an indicator of the stage of corporate development, is also relevant since we expect younger companies to grow faster. We also believe the willingness to export to be a characteristic of more dynamic companies – since expanding beyond one’s natural realm requires the ability to sell truly innovative products and services – so we include a variable whose value is one when a company declares in the IPO prospectus its willingness to expand the market for its products outside of the domestic domain.

The top part of Table 13 reports our results for employment growth. The precise variable we are explaining is the growth of employment in the period of (up to) three

Table 13. Impact of VC-backing on job and sales growth**VC-backing's impact on employment growth**

	Venture capital	ROA	Leverage	Foreign sales	Age	France	Constant
Coefficient	-8.93	16.56***	121.48***	10.58	0.10*	-51.47***	50.37
<i>t</i> -statistic	-0.548	2.375	2.623	0.695	1.836	-2.602	1.055

Notes: All independent variables measured at the time of the IPO. Significance levels are indicated by * (10%), ** (5%), and *** (1%). Huber–White corrected standard errors are used to obtain robust estimates. In alternative, unreported, specifications we control for capital expenditure, the level of debt (relative to asset) and its maturity, but this worsens the statistical significance of individual variables and of the regression.

VC-backing's impact on sales growth

	Venture capital	ROA	Leverage	Foreign sales	Age	France	Constant
Coefficient	-4.68	7.73***	13.19	6.80**	0.03***	-10.05***	7.69
<i>t</i> -statistic	-1.542	5.603	1.508	2.302	2.676	2.768	0.87

Notes: All independent variables measured at the time of the IPO. Significance levels are indicated by * (10%), ** (5%), and *** (1%). Huber–White corrected standard errors are used to obtain robust estimates. We have also included country and sector of activity dummies. We adopt an estimation method that eliminates gross outliers and employs robust standard errors. Number of observations is 316, the $F(11,304)$ is 6.63 and the p -value is 0.000. Note that the dimension of our data set decreases both because not all companies report employment data and because we cannot compute post-IPO employment growth for companies which went public in 2000. We are then left with 270 observations.

years after the IPO. The results confirm our intuition. Relatively older companies and those whose return on asset (ROA) and leverage are higher, increase their employment most. Leverage, in particular, is not only statistically but also economically significant; a 1% increase in leverage means a company creates 121 jobs in the post-IPO period. Companies listed on the Nouveau Marché experience a decrease of 51 units in employment, while the foreign sales dummy has a statistically insignificant effect. Venture capital plays no role, as it implies a slight decrease in employment, which is, however, statistically insignificant. Sectors of activity are also not significant.

In the Web Appendix, we report results when we control for R&D expenditure at IPO (due to a lack of data, this reduces our sample of firms by almost half). To avoid an issue of simultaneity and of reverse causality we control for R&D at IPO, not after it. Since R&D expenditure includes expenditure for labour in R&D it is highly plausible that the latter variable is significant in explaining employment growth. In fact this turns out to be the case; €1 million of additional R&D expenditure creates an additional eleven jobs. Leverage and the France dummy remain significant and retain (even increase) their size and sign, while ROA becomes insignificant. Interestingly, the foreign sales dummy now becomes statistically significant, and negative. For companies with high R&D expenditure the willingness to expand abroad is detrimental for employment growth. Again, venture capital does not seem to be relevant and retains its negative effect on job creation.

Next, we turn to the post-IPO sales growth. The bottom part of Table 13 reports our estimates. The results do not differ much from those for employment growth. Older companies with a high ROA and leverage experience a higher increase in sales; a 1% increase in ROA results in almost 8 million of additional post-IPO sales, and a similar increase in leverage creates €13 million of sales, albeit with scant statistical significance. The new result is that the intention to expand their product market in foreign countries does contribute to sales; export-oriented companies enjoy almost €7 million more of revenue than purely domestic players. French companies significantly grow less also in terms of sales; their post-IPO turnover is almost €10 million lower than elsewhere. Venture capital financing remains ineffective; venture-backed companies sell almost €5 million less than others, but the result is marginally statistically significant. Sectors of activity continue to hold no effect.

Controlling for R&D expenditure undertaken at IPO reduces the sample to 143 companies and here R&D expenditure turns out to be relevant again. R&D performing companies enjoy €2 million of sales more than non-performing ones. Age and leverage retain their positive effect on sales, while ROA and France become insignificant. The intriguing result is that venture capital does finally play a role; venture-backed companies experience an after-IPO increase in sales which is lower by almost €8 million than for non-venture-backed companies (see the Web Appendix for details).

5.4.2. Addressing possible statistical problems. Before turning to an overall interpretation of these results and of their meaning for the role of European venture capital, we note some limitations of our analysis. Our results could indeed suffer from two possible selection biases, on both observable and unobservable variables. In the Web Appendix we discuss this possibility and present the results of two different methodologies that help correct for this. One approach is known as the ‘matching’ method, and mainly addresses the issue of bias due to incorrect control for observable variables. The second approach is known as the ‘difference in differences’ method, and it is particularly useful in removing unobservable individual effects and common macro effects. Overall, we conclude that the inference from the analysis above may not be robust to possible specification biases with respect to observable variables in the case of TTL and amount of capital raised. In the case of sales and employment growth, however, we find reasons to remain confident on the robustness of our findings.

5.5. Venture capital in Europe: an assessment

We are now able to provide an initial assessment of the role of venture capital in Europe, and of its ability to contribute to economic growth and job creation. We shall consider several elements in turn.

First, we have seen that European venture capital has grown substantially over the last few years. The amount of money invested in innovative companies and the

number of venture capital firms have increased rapidly. Wide differences remain across national economies, and the gap with the US is far from closing, but the European venture capital industry is certainly expanding fast. This is hardly surprising, since the industry appears to be highly profitable: the internal rate of return for three-year-old investments was a hefty 29.2% in 2000; for ten-year-old investments it was a remarkable 15.6%, according to the European Venture Capital Association (EVCA, 2001).

Secondly, we have documented that the involvement of venture capital in firms listed on Europe's 'new' stock markets has become substantial, and might have started a virtuous circle whereby easier exit through an IPO encourages venture investments, which in turn nurture companies which can soon list and support the growth of stock markets. Intriguingly, we have seen that the number of venture-backed listed companies that were born with the financing of a venture capitalist increases year after year, as does its proportion over all venture-backed firms.

Thirdly, we have focused on the effect of venture capital on some of Europe's most successful innovative firms, those that made it onto one of the 'new' markets. Here we can apply a more formal statistical analysis and sharpen our arguments. On the basis of the theoretical literature, and of empirical studies of US venture-backed firms, we have explored the effect of venture capital on the timing of the listing of investee companies, and on their ability to raise funds at IPO, to generate revenue, and to create jobs. Venture capital appears to yield uncertain influence on the timing of IPOs. We also find that it helps companies raise more capital at IPO, but this result does not seem robust to possible biases in the analysis. From this we conclude that the ability of venture capital to ease credit constraints in Europe is very important but still confined to the earlier stages of a firm's life, when financing may be crucial for its very coming into existence. In fact, the number of venture-backed companies has more than doubled after the opening of Euro.nm, reaching almost 10,000. It is suggestive to compare this result with what Hellmann and Puri (2000) find for a sample of Silicon Valley firms. They argue that the role of venture capital in front of less radically innovative companies is precisely the provision of funds at early stages, rather than speeding up their maturation.

We also find that venture-backed companies do not generate more sales or create more new jobs than others. On the contrary, when we restrict our sample to the more innovative companies, those that perform R&D, the venture-backed ones appear to increase their sales less than the others. Robustness checks to detect possible biases in our analysis confirm that these findings are indeed robust, and that venture-backed companies are not the 'superstars' among those listed on Europe's 'new' stock markets – at least in terms of sales and employment growth. While we cannot eliminate all reasonable doubts on the possibility of selection biases, the empirical evidence we uncover does support the idea that venture-backed listed companies are not systematically different from non-venture-backed companies, and that they do not grow faster, either before or after the IPO.

We interpret this finding as suggesting that the role of venture capital in Europe is somewhat different than in the US. The provision of early stage financing, which has grown very fast in the past three years, seems to be crucial to allow innovative start-ups to overcome credit constraints, which are arguably tighter in the old continent. Whether the lack of a systematic association with the most successful innovative companies is due to the immaturity of European venture capital or to a lack of 'superstars' among European firms we cannot say at this stage.⁵

A sensible objection to our interpretation is that the unselective high valuation of companies listed on Euro.nm might have masked the true value of being venture-backed. This is a fortunate time to look at this possibility, since stock valuations on Europe's 'new' stock markets have fallen sharply since mid 2000. One may conjecture that the true value of venture-backed companies would only show up once the market becomes more selective. While a thorough analysis of the determinants of valuation goes well beyond the scope of this paper, we can provide some telling information.

Figure 1 plots a simple (unweighted) stock price index of all the companies in our sample, which we divide into venture-backed and non-venture-backed ones. One can readily see that there has been no systematic under-valuation of venture-backed companies, and that the behaviour of the two indices is quite similar.⁶ Since our data go through June 2001, we consider it unlikely that extremely high valuations of high-tech companies in the late 1990s may have obscured the true value of being venture financed. On the contrary, this pattern appears at first sight in contrast to the results of Brav and Gompers (1997), who find that in the five years after going public the growth of venture-backed companies outperforms similar non-venture-backed companies.

Another possible objection to our interpretation is that the main role of venture capital is to bring companies up to the levels required for listing, thus helping those that would not be able to qualify for an IPO without external help. In this case, the value of venture capital would result in high growth of investee companies *before* the IPO. Unfortunately, the nature of our data set prevents us from testing directly for this possibility, since for the companies in our sample the time between the arrival of the venture capitalist and the IPO is too short to allow any statistical analysis (the median time between VC backing and IPO is only 16 months). However, indirect evidence suggests that this conjecture may not hold to closer scrutiny. First, the listing requirements of Euro.nm do not constitute a tight barrier, and are in fact far from binding for most of the companies that go public on Euro.nm. Secondly, the financial structure of listed companies varies widely, so that not even 'de facto' minimum standards seem to characterize these IPOs (Bottazzi and Da Rin, 2001). Finally, we find that

⁵ One should also consider that venture capital firms are (successful, it seems) profit-driven organizations, not public bodies. Hence, one may expect them to contribute to corporate growth and job creation only inasmuch as this makes them richer.

⁶ Moreover, the standard deviation of the index of venture-backed companies is about one and a half times that of non-venture-backed companies, i.e. the former are more volatile, suggesting more uncertainty on the part of investors. A rank-sign test accepts the hypothesis of equality of the medians of the two series, but not of the variances.

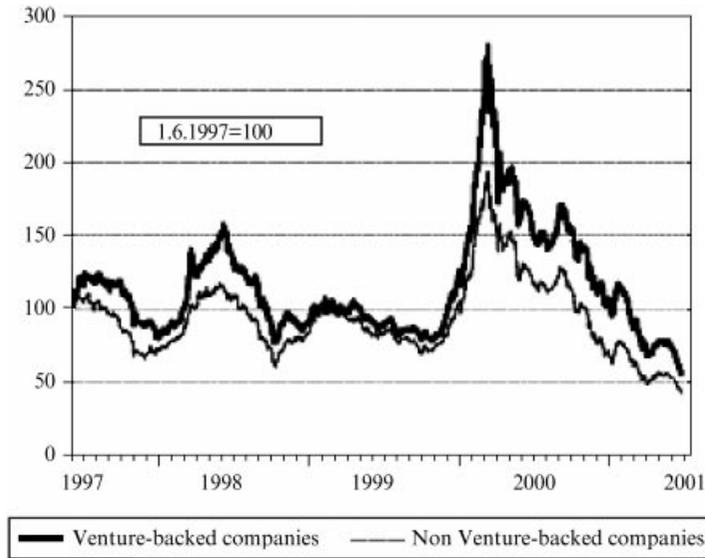


Figure 1. Stock market prices of VC-backed versus non-VC-backed firms, 1997–2001

Source: Authors' calculations based on Datastream daily price data (1/6/97 to 30/6/01).

firms that receive venture capital are characterized by a low level of sales, but also that the sales and earnings of venture-backed companies remain lower than those of non-venture-backed firms in the three years before IPO. This would not be the case if the main task of venture capital were to bring investee companies to pass a hurdle or to reach the same performance of more aggressive competitors.

While the nature of our data clearly makes it difficult to distil truly conclusive results, ours is clearly a pioneering attempt and we have to make do with available data. For instance, we cannot observe the intrinsic quality of investee companies, nor the actual behaviour of venture capitalists to assess if some of them may be more effective than others in nurturing innovative businesses. Still, we believe that we have constructed a solid interpretation of what venture capital is presently doing in Europe, and that this hard evidence may contribute to more informed policy decisions.

6. CONCLUSION

Venture capital is growing fast in Europe, and its influence on European entrepreneurial firms is increasingly important. Without financing from venture capital many of today's most dynamic start-ups could have never come into existence, and a non-negligible number of the companies which list on Europe's 'new' stock markets would probably never have made it. Venture capital is therefore understandably high on the policy agenda, both at EU and national levels. The presumption is that venture-backed firms are particularly dynamic, and able to create jobs and wealth. An effort to create suitable conditions for the development of this form of financial intermediation then seems warranted.

We provide the first attempt at a rigorous assessment of this policy stance. We ask ourselves what role does venture capital really play in Europe. We find that the industry is expanding fast, but that the sums invested are growing less than in the US. Since venture capital plays a crucial role for the creation of innovative start-ups in a continent where capital markets are particularly unsupportive of non-established businesses, the public concern for fostering the supply of funds to industry appears justified. However, studies for the US also suggest that it is probably the demand, rather than the supply of venture-funds that is constraining the rise of the industry (see Gompers and Lerner, 1998). We then look beyond the supply side to the ability of European venture capital to deliver more than pure financing.

Our results show that in Europe venture capital is not systematically associated with particularly dynamic companies, whether we look at sales growth, at new employment, or at stock market performance. The limitations of our data make us stop short of a final answer, but they resonate well with an increasing body of evidence that European venture capital lacks more human than financial resources. For instance, recent case studies show that in the 1990s German venture capital suffered from a lack of qualified experienced professionals (see Becker and Hellmann, 2000). In an insightful survey study, Freeman (1998) finds that lack of human resources is cited by respondents – insiders to the industry – as a major problem for the maturation of the German venture capital industry. We mentioned the relative stock market under-performance of venture-backed companies in Europe, as compared to the US, which might be another indication of an immature industry.

This interpretation, while still tentative, would also be consistent with the need of still young industry to learn the ropes. After all, American venture capital matured over a much longer period, which was not always a bed of roses. Other facts point to this direction. For instance, in 2000 the number of investee companies per venture firm in Europe was three times as large in Europe as in the US (23 as opposed to 8). Since effective nurturing requires an intense and close relationship with investee companies, beyond a certain threshold the quality of the ‘soft’ side of venture capital might well fall. To us, these facts and the evidence we uncovered suggest that creating the conditions for a more mature venture capital industry should be a high priority for European and national policy-makers.

Discussion

Jan C. van Ours

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The paper on venture capital in Europe by Laura Bottazzi and Marco Da Rin is interesting in many ways. It is informative because it is entering an area where not much empirical research has been done. The data collection is impressive and the

data collected give clear and insightful details about European venture capital. The authors focus on three issues related to venture capital: developing a conceptual framework, documenting developments in Europe and studying the effects on fund raising, growth and job creation. Not being burdened by a lot of prior knowledge about venture capital both the conceptual framework and the documentation of the developments were very informative for me. I think these parts of the paper are very readable, clear and interesting. In my comments I will focus on the third issue, the empirical analyses.

Being a labour economist, when I read the introduction I was a bit worried about the relevance of my own field of research. The paper starts with the notion that there is a growing perception that Europe's growth problems may be caused not as much by rigidities in labour markets, as by weaknesses in capital markets, and in particular in the access to risk capital. However, the paper ends with the notion that European venture capital lacks more human rather than financial resources. This conclusion is based on the empirical analyses that lead to the conclusion that European venture capital is not systematically associated with particularly dynamic companies, whether we look at sales growth, at new employment, or at stock market performance. Conditional on observed characteristics of the firm, the activities of the venture capitalist don't seem to matter. Hence, venture capitalists have no specific skills whatsoever. The main argument in my comments is that although the authors have collected a lot of information the possibilities of a thorough analysis are limited and therefore it is not possible to draw strong conclusions about the relevance of venture capital and venture capitalists. I will first discuss the data collection and then the specific empirical analyses.

It is not an easy task to collect data about venture capitalists, as there is no standard definition of venture capital. The authors indicate that there is a wide consensus that venture capital corresponds to the professional financing of young, unlisted dynamic private ventures through equity or equity-like instruments like convertible securities. There are several stages in venture capital financing. In the stage of seed finance the venture capitalist helps explore the viability of a project. In the stage of start-up finance the venture capitalist may become involved in the organization of the company. In the expansion finance phase the venture capitalist may help find additional financing and help the company contact clients and suppliers and in the last stage the venture capitalists may help in a trade sale or an initial public offering (IPO). So, the role of the venture capitalist is complex. The data are collected from the listing prospectuses and annual reports of companies that went public on Euro.nm since its inception to December 2000. One has to keep this in mind when evaluating the empirical analysis. Only in the last stage are data collected. Hence, the data set is not informative about the early stages in venture capital financing. Furthermore, venture capitalists are identified by name. Both the data collection and the identification of venture capitalist may introduce selectivity in the sample. In the data collection only part of the firms in which venture capitalists are involved are selected. The identification

of venture capitalists may introduce selectivity because it is based on origin and not on destination.

It could be that the main contribution of venture capitalists is to bring firms alive, not necessarily bring them to an IPO. The authors indicate that not many venture capital companies are sold before an IPO, but that is conditional on being listed at Euro.nm. So, it could be that there are firms that never come to an IPO *because* there is venture capital invested. In the same way it could be that venture capitalists pick potentially low growth firms and by investing stimulate growth. Think of the following analogy. Is flying in a plane with a venture capitalist as a passenger more dangerous than if there is no venture capitalist present? If the presence of a venture capitalist does not affect the flying any result would be circumstantial. However it could be that a venture capitalist picks more risky (cheaper) planes and improves the performance. If the venture capitalist succeeds in doing this, in the empirical analysis this is not shown since the researcher compares planes that are *ex ante* different but *ex post* the same. No difference between the two is found *because* and *not despite* of the presence of the venture capitalist.

The main results from the empirical analyses are that the presence of venture capital does not affect the timing of the IPO nor does it affect sales or employment growth. The time-to-listing is defined as the time between the start of a particular market and the IPO. It is not clear why this duration is relevant. If we think of new activities starting all the time this duration does not mean anything. Shorter durations could imply that activities matured sooner, or it could mean that it took more time to set up the market. That is, the duration may depend on an exogenous event outside the influence of the firm. No wonder that venture capital does not affect the time-to-listing.

With respect to the analysis of employment (or sales) growth I have similar problems. Venture capital firms may differ in unobserved characteristics from other firms. These unobserved characteristics might affect employment growth. It could be that venture capitalists pick firms that initially underperform. Because of the investment they are put back on track indistinguishable from other firms. The measure of the relevance of venture capital on employment growth is not whether venture capital firms have a different pattern of employment growth. The relevant question is whether non-venture capital firms would benefit from an investment by a venture capitalist. The authors try to correct for evaluation biases by using a difference in differences method. However, this method assumes that a 'natural experiment' drives the investment by the venture capitalist. Since this investment is not likely to be truly experimental the conclusions for this evaluation method do not hold. All in all, it could be that venture capital is more important than one is likely to conclude from the analyses presented in the paper.

I finish where I started. The study by Laura Bottazzi and Marco Da Rin is very interesting. They put European venture capital in perspective by collecting an enormous amount of relevant information. However, their empirical analyses are only a

first step in assessing the contribution of venture capital to economic growth and development.

Erik Berglöf

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There is a view that the growth problems in Europe are not primarily due to rigidities in labour markets but rather to weaknesses in capital markets, in particular in the institutions supporting entrepreneurial finance. This article is an interesting, while somewhat embryonic, survey of venture capital investment in firms listed on five European exchanges in the Euro.nm alliance. It provides an introduction to venture capital finance, a rather comprehensive inventory of the listed firms, and some information on the venture capitalists themselves. The authors draw on the data and the institutional description to analyse the effects of venture capital finance on corporate strategy and performance.

The topic is clearly one of broad interest and strong policy relevance. As the authors rightly point out, there is a dearth of systematic data, let alone analysis of venture capital activity in Europe (unlike the US where a sizeable body has developed over the last decade). This paper does a considerable service by compiling a valuable data set and important institutional information. The analysis also contains several interesting observations and promises more. The presentation is clear and logical.

The presentation, however, is now on the descriptive side, and there is not much of a conceptual framework to deepen the analysis. Let me give some suggestions for how these weaknesses could be addressed. Venture capital is essentially a form of financial intermediation with institutional investors providing funds to the venture capitalist who allocates them across ventures and provides corporate governance and other services to the entrepreneur. The paper deals ostensibly with one side of the relationship, that between the venture capitalist and the entrepreneur. In order to understand the problem of nurturing venture capital in Europe we probably need to look at both sides of venture capital. Is there demand among the institutional investors in Europe for venture capital-type intermediation activities? If not, why? Will this change with ongoing pension reforms in much of Europe?

In the US venture capital finances certain types of investments with specific risk-return characteristics and capital requirements. These investments may also require various services in the implementation phase. From a conceptual point of view, a discussion of the underlying issue in this paper should start with a description of how such investments are financed in Europe, if at all. In other words: what is the financing problem? Using such a 'functional' approach, the properties of these institutional arrangements would then be compared to those of venture capital in its various guises in the US to try to identify the institutional gap. Why is it that universal banks, investment companies and 'venture capital'-type activities of large firms in Europe do

not fulfil the same function? I realize that this a very different, and more ambitious, approach than that chosen by the authors, but at least the biases of their analysis should be acknowledged. It may well be that in the end the policy implications are not much different.

In general, I miss a discussion of why venture capital is less developed in Europe. If the emergence of Euro.nm or the five member markets were so important for venture capital to develop, why did this not happen earlier? Why now? The paper shows an increase in venture capital activity in Europe in recent years and interprets this as a breakthrough, but the US experienced a much more dramatic increase in volumes, at least in absolute terms, during this period. Possibly these booms have similar causes quite independent from any institutional changes in Europe.

Panel discussion

Oliver Jeanne raised the issue of specification bias and pointed out that there are several variables for which the specification does not control. Some entrepreneurs have financial wealth while others do not and if the latter go to venture capitalists, one would expect to observe the findings reported in the paper, but this would not mean that venture capital would not matter. He also pointed out that it is was not clear why venture capital in Europe is claimed to be different than in the US.

Pontus Braunerhjelm pointed out that venture capital in Europe is described by a much wider definition than in the US, for instance including management buy-outs and management buy-ins. He felt that the definition was indeed wider than described in the paper. He remarked that studies from Sweden contradict the present paper by showing that firms that have received venture capital grow much faster in terms of employment even though they do grow as fast as firms from the same industry in the US. Benny Moldovanu found it questionable, furthermore, that public policy could create a place that would enhance the usage of public policy. Hylke Vandenbussche felt that a venture capitalist provides more than just the capital as it also provides advice to the firms.

Hans-Werner Sinn suggested that in the paper there was not enough on the policy aspect. He felt that this is really a revolutionary development in Continental Europe, where the stock market used to be unimportant. He argued that there is a new phase since about 1996 and 1997, where new markets were created and there was a move away from bank finance to risk finance. He felt that it should be seen in the future that there is an effect on risk taking and also on economic growth. He pointed out that some people argue that the new economy could never have developed in Europe because it was lacking risk markets. Now there are risk markets and presumably there should be an effect on growth in the near future.

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