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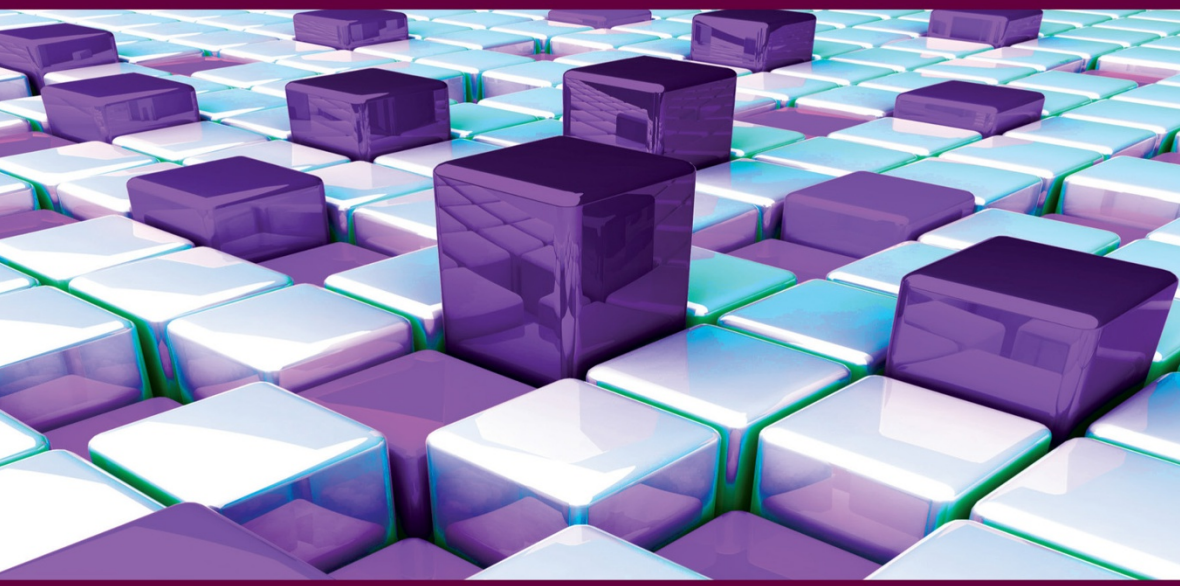

Volume 6

# Venture Capital and the Financing of Innovation

Bernard Guilhon

ISTE

WILEY

Venture Capital and the Financing of Innovation

**Innovation between Risk and Reward Set**

coordinated by
Bernard Guilhon and Sandra Montchaud

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# Contents

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For Elizabeth. This book is dedicated to her, though it may have turned out to be the opposite of what her concerns were. She is all the more deserving of this dedication for having read and reread it, and in having suggested changes and improvements, in the form of simpler sentences and less sophisticated turns of phrase. The material does not exactly make for a page turner and is perhaps a bit arid, which is yet another reason for segments that sounded strange and possibly in need of a bit of fine tuning. A special thank you goes to her.

For Alice, always quick to make space for my insatiable urge to write and to provide me with all the means to achieve it. And once more, through SKEMA, she provided the logistical infrastructure and opened its doors wide to give me the warmest welcome.

For Stéphane, whose taste for reading does not go so far as to include economics, and who prefers real economic games to reflections on economic issues.

For Matilde, whose future choices remain to be seen, in hopes that this book will serve as an inspiration to her to reflect and research.

For Arseniy, who always seems to be out of balance, in hopes that he will put his very real abilities to use.

# Introduction

"Really, what is analyzing, if not choosing and deferring?"

[ALA 10, p. 174]

The works carried out on the subject of venture capital analyze this financing mechanism in terms of the stages of intervention, the players involved, the actions and innovative practices they implement. They also focus on the institutional arrangements that govern them, as well as on the performance of innovation and growth of the company, the sector in which it operates, and the economy as a whole.

What economists refer to as innovation implies novelty, but it is not novelty in itself that constitutes innovation. A new product, service, or process concept may be filed away and never brought into use. What matters is how this concept is implemented in economic practice so that the new feature introduced changes previously established practices and, in turn, the ways in which certain types of problems are addressed. The idea of innovation therefore implicitly refers to methods of producing, consuming or financing, that is to an existing routine that is an accepted way of dealing with a recurring problem. We will use the definition proposed by Vanberg [VAN 92]: "An innovation can be considered as a routine that purports to be new and potentially superior with regard to the accepted way of dealing with a given problem".

The phasing out of existing routines is a concept that comes directly from Schumpeterian analysis. In his book *Capitalism, Socialism and Democracy* [SCH 51], Schumpeter points out that capitalism is infinitely malleable,

whose capability is not to manage existing structures but, by applying "disjointed pushes", to create new ones and then destroy them [SCH 51, pp. 122–123]. He refutes the thesis of the exhaustion of technological progress, because capitalism is inherently subjected to an evolutionary process whose fundamental impulse is innovation. The creative destruction process takes place over the long term and transforms the economic structure from within "by eliminating outdated elements and continually creating new ones" [SCH 51, p. 122]. This is the essential source of productivity gains. The appearance of a new product, more modern equipment, or a new type of organization is, above all else, an *internal* phenomenon *within* a company that has the effect of modifying the forms of competition on the market *through* the effect it has on quality and costs. This process should not be reduced to a simple phenomenon of competition through pricing, since creative destruction calls into question "the very foundations and existence... of existing firms" [SCH 51, p. 124].

However, the Schumpeterian dynamic can only be understood if both the real and financial dimensions of the act of innovation are taken into account. Entrepreneurs who create innovations are faced with the need to finance their projects in order to achieve new discoveries, which means giving a primary role to financing mechanisms in the desired level of economic activity. In his own historic period, Schumpeter favored financing through banks, which over time, came to be seen as very limited in its ability to support innovative projects.

## I.1. Venture capital: an original mechanism for financing innovative projects

Over the past 40 years, the relationship between industrial structures and financing structures has changed profoundly. The forms of competition, including all institutions and organizations involved with competition in the markets, are the dominant institutional structure. Some institutional structures (deregulated labor markets, the mobility of skilled labor, more open and diversified financing, intellectual property rights, etc.) encourage the emergence of new companies capable of creating marketable technological knowledge. The emergence of venture capital is a by-product of the need to develop forms of innovation in financing, allowing new technological paths that have proliferated in many activities, particularly high-tech ones, to be explored. At the same time, the deregulation of

financial systems favors marked-based systems and threatens the stability of bank-based systems. This has profound implications for how financing is provided to companies, as well as for the opportunities made available from private savings. Venture capital funds are multiplying: as professionally managed organizations, they constitute venture capital (VC) firms, they gather financing resources and they invest in companies that pass through a formative period for a limited period of time (5 to 8 years).

## I.2. Analysis of the financing chain

In an earlier paper [GUI 08], we defined venture capital as a financing mechanism for the early stages of a company's life, and proposed to analyze it as a two-tiered structure of intermediation.

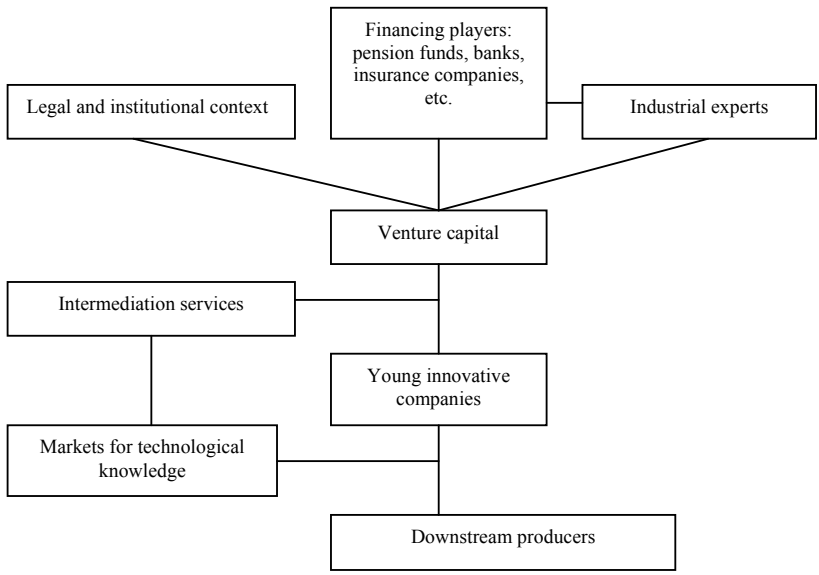


**Figure I.1.** *The simplified intermediation structure (source: [GUI 08, p. 9])*

A venture capital fund is first and foremost an innovative project management structure, firmly rooted in a legal and institutional context that expresses the incentives and constraints defined by public authorities (taxation, legal rules, control mechanisms, etc.). Using this as a basis, the financing players, constituted mainly in Europe by banks and in the United States by pension funds, insurance companies, retirement funds, etc.,

become involved. In addition to these players, scientific, technological and industrial experts also take part, whose participation is often required to assess the market prospects of the projects that are presented.

The second level of intermediation involves projects that are more specifically technology-intensive. In recent years, institutions specializing in technological intermediation have emerged as agents acting as interfaces between venture capital and new technological developments. Particularly in the United States, many of these intermediaries have taken the form of Internet service providers that provide information on the quality of technology projects and growth opportunities. In addition, many technology companies in the start-up phase, initially financed on an individual basis, are knowledge producers seeking complementary financing from venture capital funds and targeted information on downstream opportunities (licensing). In this perspective, technological intermediation supports the development of technological knowledge markets in many activities: software, biotechnology, artificial intelligence, 3D, etc.

This intermediation mechanism creates specific constraints from the point of view of information [RIN 16]:

– the existence of an agency relationship between the principal (venture capital) and the agent (entrepreneur), which is absent in bank financing;

– the limited duration of these vehicles requires VC firms to disclose the real value of their investments to be recovered at the closing date of the venture capital fund;

– "At this point, institutional investors will be able to know the 'true' return to their investment, and can make an informed decision whether to participate in the VC's future funds or not. This structure, based on sequential fund-raising through closed-end fund vehicles that allow revelation of information about true investment returns, is central to the VC industry" [RIN 16, pp. 3–4].

Today, the financing chain for innovative projects has been extended, and the number of stages of the intermediation has increased [EKE 16, p. 2]:

*Step 1. Incubation*

In the first stage of development, when the company does not yet exist and its business model is not established, financing is

mainly based on *love money* (*Family, Friends and Fools*), public assistance (competitions, loans of honor), or assistance provided by incubators or accelerators.

*Step 2. Seed*

This is the first capital contribution made to the company. Funds can come from *business angels*, public authorities (grants), private savings mechanisms such as *crowd-funding* or specialized funds (priming funds).

*Step 3. Start-up*

Generally, it is at this stage that venture capital in the strict sense of the term becomes involved, mainly through the activity of specialized funds, but also *through* public aid at this point as well.

*Step 4. Growth*

During the growth phase, growth capital funds are also involved, which allow the company to expand its business volume and enter new markets.

*Step 5. Exit*

The last potential step is the exit: the resale of the company (usually to large companies wishing to take ownership of its assets, ideas, and/or the technologies it developed) or an initial public offering.

These five stages follow the path of a logistic curve from incubation to exit, with venture capital considered by these authors to include the start-up and growth phases.

Another slightly different definition has been proposed by the OECD [OEC 18a, p. 102] which is based on the definition proposed by EVCA:

> "*Venture capital* is a subset of private equity (i.e. equity capital provided to enterprises not quoted on a stock market) and refers to equity investments made to support the pre-launch, launch,

> and early stage development phases of a business. *Venture capital-backed companies* [...] are new created or young enterprises that are (partially or totally) financed by venture capital".

The seed phase is included as part of venture capital. The same is true in a more recent publication [OEC 18b] in which the OECD includes the following four steps in its definition of venture capital: seed/start-up/early stage/late stage venture.

In our opinion, these different definitions refer to constraints on the information available to work on long series. They are also explained by the confusion that often occurs between the company's development stages and the investment stages:

| Development of the company | Concept/ Start-up | Development | Growth | Maturity |
|---|---|---|---|---|
| Investment stages | Seed Angels | Early stage VC | Late stage VC | Exit |

**Table I.1.** *Progression of development and investment of companies (source: [NVC 18, p. 7])*

The start-up and early stage phase includes the production of the concept, the business model, and the operational deployment. These three stages are situations in which the cash flow is negative. The so-called late stage phase corresponds to the company's growth phase. During this phase, the viability of the product is made certain, the company begins to grow, and its marketing and sales operations play an increasingly important role. In most cases, and based on the data available to us, venture capital will be identified in our work during the start-up, early stage, and late stage phases[1].

1 Very often, venture capitalists are involved at the seed stage, which is the responsibility of business angels. The question arises as to whether venture capitalists and business angels are complementary or may be substituted [HEL 17]. In fact, venture capitalists invest money from third parties while *business angels* invest their own money. This distinction is far from insignificant: if they are complementary, the financial ecosystem is integrated; if they are able to be substituted, the financial ecosystems are disjointed. The authors suggest that there are two separate paths in the start-up ecosystem and that this can be explained by the diverse range of companies' needs.

Thus, the company's development is based on types of interventions made by the players by means of a technical, social, and cultural process that leads to the emergence of a technological variety, in other words, an innovation.

## I.3. Analysis of the intermediation structure

This structure can be identified by three elements:

– as an incentive structure that defines division of powers and compensation schemes: venture capital receives two forms of compensation: an annual percentage on the amount invested plus 20 to 25% of the earnings at the exit time. The compensation of entrepreneurs varies, depending in part on balance each of them strike between an entrepreneurial career and the status of employee in a large company, and on the amount of assets they personally own (see Chapter 1);

– as an allegiance structure. Financing with venture capital makes it possible to modify the distribution of rights between the contracting parties. These are voting rights, the rights to sit on the board of directors, settlement rights and cash flow rights. In addition, the most critical resource of a company is its organizational capital [ZIN 00], which is a property that emerges from its employees' specific investments. Contributions in equity only become legitimate because the structure of specific investments can be considered consolidated enough to grant power to investors:

> "In this context, venture capitalists will tend to professionalize the firm's management so as not to make it too dependent on the entrepreneur or a specific professional manager. The financing of innovation, driven by venture capital, tends to erase the role of the entrepreneur in some cases *once* the *firm is incorporated*, which facilitates the external financing of the firm during various 'rounds of financing'" [GUI 08, pp. 71–72].

However, this allegiance structure remains flexible. There are situations regarding which the level of performance strengthens the power of venture capitalists, and there are situations of conflict in which decision-making power and control rights will be exercised by the entrepreneur;

– as a structure of interrelated rules: those defined by national laws and which form the legal, fiscal, and operational environment (a situation of

heteronomy) and those defined by the elements of the contracts negotiated by the participants (a situation of autonomy).

## I.4. Justification of venture capital

In addition to representing an original mechanism for financing innovative projects, many studies have highlighted certain unique features of venture capital. Here are some of the most important aspects:

First, it appears that venture capital (public programs and the private financial sector) has enabled dynamic entrepreneurs to create companies whose emergence and growth have revolutionized high-tech industries such as IT, digital technology, biotechnology, medicine, etc., as well as services such as insurance, e-commerce, etc.

Second, venture capital represents only a small fraction of total R&D expenditures. Venture capital-backed firms accounted for about 3% of R&D spending in the United States between 1983 and 1992, while accounting for 8% of total patents filed during this period [KOR 00]. It was during the 1970s that venture capital became an important component of the new innovation system in the United States [KEN 11][2]. In total, venture capital investment has accounted for about 10.2% of innovation flows in 15 European countries since the early 1990s.

2 "The first and most important of the new economic areas might be termed the networked, distributed computing model that was made possible by the advances in semiconductors. This includes both the personal computer (Apple, and then in the 1980s, Osbourne, Compaq, and others) and work stations (Apollo Computers, to be followed in the early 1980s by Sun Microsystems, Silicon Graphics, and many more), components for small computers (Seagate, Shugart Associates, Tandon Corporation, Zilog and many more), software (Microsoft to be followed in the early 1980s by Ashton-Tate, Borland, Lotus, to name a few) and even computer retailers such as Computerland. The computer data networking sector also began its explosive growth with companies such as Rolm (founded in 1969), Ungermann-Bass, 3Com, and in the 1980s many more. Additionally, there were continuing opportunities in classes of larger computers leading to firms, such as Amdahl, and providing components and software for them, e.g. Oracle. One change for the most successful ICT start-ups of the 1970s and into the 1980s is that the government market was significant, but no longer critical" [KEN 11, p. 1708]. (pp. 14–15).

Third, venture capital rarely funds fundamental research, with start-ups devoting a large part of their R&D expenditures to product development and marketing.

Fourth, venture capitalists are currently facing a new concept, one that they have looked on with uncertainty, regarding the entrepreneurial skills of the management team, markets, and technology. Betting on enlightened investors and decision-makers is not a sustainable proposition in this area. With regard to markets and technology, there is little or no data, making the future difficult to predict from existing benchmarks – though not impossible to imagine. From this point of view, venture capital works as a mechanism for selection and screening, that must involve experts, people with scientific, economic, and marketing knowledge, in order to define the scope of the new concept by carrying out testing and experimentation phases to establish highly uncertain ideas on solid foundations, particularly in high-tech sectors. In addition, venture capital funds accumulate knowledge and experience that support and assist entrepreneurs. In this way, the barriers to entry into entrepreneurship are not simply financial or informational, but social and psychological, and their extent also depends on the acceptability of innovation. Indeed, the start-ups invested in are not primarily producers of goods or services, they permeate the field of science and innovation and offer new methods for producing, consuming, knowing, and communicating. From this perspective, venture capital is an *essential facility*, by its nature, that is, it is an essential service infrastructure from which innovative ideas can be carried out and move forward to business start-ups[3].

Finally, venture capital does not produce developments in isolation, rather, this type of financing is influenced by macroeconomic (GDP, interest rates, etc.), institutional, and organizational developments, without one single reading being applicable. For example, the relationship between venture capital investment and growth can be interpreted as directly one-to-one: venture capital is a growth factor and, in turn, growth has a positive and significant impact on the development of this industry in countries where it has reached a certain degree of maturity. Moreover, institutional changes are

3 This makes it possible to give context to the approach, defining a venture capital fund solely as a portfolio of start-ups whose risk frontier is to be adjusted by distributing it using strictly financial techniques.

inextricably linked to the development of this industry[4]. Finally, the very significant role played by new players such as *business angels* has made it possible to have a more detailed division within the organization of the financing chain and to encourage the implementation of supervision and selection processes that have reduced the uncertainty surrounding the new concepts. Not to mention *serial entrepreneurs* and investors who are able to invest large sums in start-ups, either directly or through fund structures, and who have built a reputation for skills, qualifications, and integration into effective networks.

## I.5. Problem addressed by the book

The fundamental issue addressed in this work is organized around the following four proposals:

1) the players involved take decisions by mobilizing different knowledge sets in relation to the innovative project. More specifically, venture capital activities use two types of knowledge:

> "*Instrumental* knowledge represents the means of production used within a process of activity. They include scientific and technological knowledge, knowledge relating to management or organizational principles, etc. The second type refers to *interpretative* knowledge that helps to define situations, to develop representations of reality, and to give meaning to a productive activity. Interpretative knowledge is developed during a filtering phase that seeks to identify the contributions

4 In the United States, if we look exclusively at companies created after 1974, "the idea here is to see what portion of the companies that could have received VC financing, choose to use VC financing. To get at the companies who could have used VC financing, we limit our sample to those companies that came of age after the Prudent Man Rule. By excluding firms like Ford Motor Company and General Electric, we can better estimate the importance of VC to young companies. Approximately 1,339 currently public US companies were founded after 1974. Of those, 556 (42%) are VC-backed. Focusing on these companies dramatically increases our measures of VC impact. VC-backed companies comprise 63% of the market cap of these "new" public companies, versus 21% for the full sample. Employment share increases similarly, from 11% to 38%. The most impressive figure is arguably R&D spending, with VC-backed firms making up an overwhelming 85% of the total R&D of the post-1974 public companies. Given that the VC industry has been in large part spurred by the relaxation of the Prudent Man Rule, these results provide an illustration of the importance of government regulation" [GOR 15, p. 5].

> of new knowledge in relation to existing solutions and to evaluate technological projects in terms of their effectiveness and utility...” [GUI 08, p. 63].

Instrumental knowledge is held by entrepreneurs, and its purpose is to delimit all possible activities. The purpose of interpretative knowledge is to delimit all conceivable activities, they are held by venture capitalists (assisted by experts). Of course, there are overlaps: entrepreneurs also develop representations that are supposed to correspond to productive and market opportunities, venture capitalists hold instrumental knowledge they have obtained from areas such as their previous experience as entrepreneurs. The intersection between these two sets of knowledge represents the achievable activities;

2) the attention span of the players is limited [SIM 83]. No single player can control all the elements included in an innovative project. It is recognized that cognitive limitations depend on the distance of the players from the content of the project [FLE 01]. If instrumental knowledge is close to the knowledge bases held by entrepreneurs (for example, the project consists of the recombination of a known set of components), the behavior adopted is described as exploitation. In contrast, while interpretative knowledge is knowledge that is distant from what is normally found in the field of venture capital intervention, it is exploratory in nature and needs to be supported and expanded on by the use of scientific and industrial experts. In this context, the “attention network” must operate in such a way that links are created between the entrepreneur who directs attention to salient points of the project, and the network members who receive this attention [LAZ 11]. This allows for the exchange of information;

3) from these two proposals, it follows that the financing of innovative projects with venture capital is fundamentally ambiguous. Points of ambiguity may be generated by the difficulty of distinguishing between more and less worthwhile projects. Similarly, technological knowledge can lead to divergent assessments of the contribution of a technology. In this case, the productive and commercial aspects of the project must be rethought and reassessed;

4) ambiguity can be reduced by mechanisms for consolidation and valuation, known as syndication, staged financing, improvement of intangible assets, assistance provided by the entrepreneurial support

network, the increased presence of informal investors, increased testing and experimentation phases, etc.

## I.6. Overview of the book

The purpose of this book is to analyze the operating mechanisms and interpretation structures of this type of innovation financing, using a dual approach based on analytical considerations and applied economics. The scope of the investigation includes the United States, Europe and particularly France. We have paid less attention to the Asia/Pacific region due to the difficulty of obtaining significant samples of venture capital-backed companies. and series long enough to establish robust results and considerations. The levels of analysis that are the motivation for the three axes of our reflection are based on three types of logic.

Chapter 1 identifies the rationale of the main players who make use of this following financing mechanism: the project leader (the entrepreneur) and the person(s) responsible for the fund (venture capital). The logic of control and sanction is at the basis of the contractual model. The cooperative logic serves as a pillar for the scheme which postulates mutual dependence between the two players, with neither of them able to exert a unilateral and asymmetric influence on the behavior of innovative start-ups. In addition, facing how difficult it can be to select the right projects, venture capital works at the limits of uncertainty through syndication and staged financing, which partially reduces failures and disappointing investments (exits at zero value). The difficulty of selecting the right projects is therefore real. For his part, the entrepreneur must deal with a type of risk that cannot be diversified, and in all too many cases, when the ambiguity is removed it reveals only a negative outlook. In addition, some European countries, such as Italy, have distinguished themselves from the United States by promoting less permissive cultural behaviors in terms of innovation, resulting in a strong resilience of family capital and a strong attachment to traditional ownership values. This is what we have called the refusal attitude towards this type of funding.

Chapter 2 highlights the different forms of sectoral logic. Since the goal is to study a mechanism for financing innovative projects, it was natural to focus on the most promising sectors in terms of innovation, that is high-tech sectors. The sectoral orientation of venture capital makes it possible to

highlight the specific features of Europe and the United States, as well as the consolidation mechanisms that distinguish the industrialization trajectory in the United States: R&D spending, manpower qualifications, testing and experimentation phases, etc. These innovative practices that seek to reduce ambiguity are not used with the same intensity in Europe. For example, R&D does not seem to be considered by private players as a crucial variable capable of transforming a small enterprise into a high-growth firm, which it feeds into both through filing patents and through its attractiveness to qualified productive resources. To complete this analysis, we have sought to highlight the determining factor of high-tech investment in Europe in order to assess the quality of the environment.

Chapter 3 focuses on macroeconomic and macro-social variables whose coherence is highlighted by the model presented. This leads us to favor the analysis of the institutions we have compared using structures typically employed for interpreting this activity: on the one hand, the market, and on the other hand, industry. Markets and industries are embedded in institutional mechanisms that we highlight in several ways: the construction of a European venture capital megafund, public authorities' interventions *through* tax exemption mechanisms or, as a counterpoint, the insufficient mobilization of certain players in France faced with the need to create a real entrepreneurial ecosystem. The ambiguity on display here involves the attitude of public authorities, namely with regard to managing venture capital as a niche or to making it an instrument of industrial policy. A more specific analysis of the institutional variables is thus carried out to highlight the idea that orienting institutions so that they are complementary is stronger for market-based systems and that it favors the expansion of this industry.

# 1

# Venture Capital, Behavior and Performance of Stakeholders

The venture capital industry is structured on the management of assets carried out by third parties. This chapter will focus on the logic guiding the actions of the various different stakeholders to make venture capital an effective mechanism for financing innovation. The social practices that take place are done within three-way relationships between the following players.

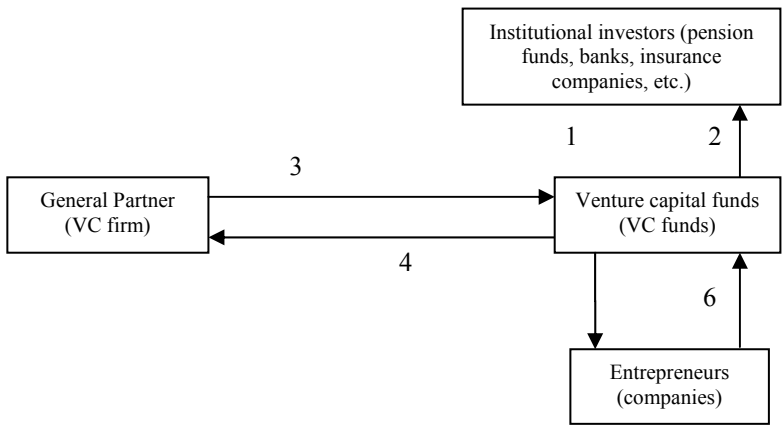


**Figure 1.1.** *Simplified diagram of venture capital activity: (1) collection of funds; (2) distribution of returns obtained; (3) low level of contribution; (4) management fees and payments; (5) investments; (6) end of the investment relationships (source: [RIN 11])*

We have identified three main areas of investigation: interactions between financed firms and venture capital (selection, investments,

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strategies, exits), interactions between venture capital funds and institutional investors (collection of finances, distribution of returns), and finally the organization of venture capital firms and their relationships, including syndication. We adopt the point of view of the works of literature which considers the "General Partner" as a firm and the company as a start-up that receives funding. When we consider the financing chain for innovative start-ups, we may note two characteristics unique to France: first, the relative weakness of long-term funds, and second, the significant participation of the public sector [EKE 16]. For regulatory reasons (prudential ratios), investments by banks and insurance companies in long-term, high risk projects are necessarily limited. The influence of public intervention is given in Table 1.1.

| | Germany (1) | United Kingdom (2) | Scandinavian countries (3) | France (4) |
|---|---|---|---|---|
| Public institutions | 22.3 | 2.9 | 13.4 | 22.3 |
| Family offices and individuals | 18.8 | 6.5 | 6.9 | 19.1 |
| Insurance companies | 8.4 | 9.6 | 4.3 | 16.6 |
| Funds of funds | 15.5 | 18.6 | 22.1 | 14.7 |
| Pension funds | 21.5 | 36.3 | 27.4 | 11.0 |
| Banks | 6.1 | 2.2 | 5.6 | 7.2 |
| Private companies | 3.6 | 1.8 | 1.5 | 5.0 |
| Sovereign wealth funds | 0.7 | 15.4 | 10.5 | 2.7 |
| Capital markets | 0.2 | 1.6 | 1.5 | 0.8 |
| Academic institutions, donations, and foundations | 3.1 | 5.1 | 6.6 | 0.8 |
| Total | 100 | 100 | 100 | 100 |

**Table 1.1.** *Distribution of private equity funds raised, by type of investor (in %), 2012–2015: (1) = Germany + Switzerland and Austria; (2) = United Kingdom + Ireland; (3) = Denmark, Finland, Norway, and Sweden; (4) = France + Belgium and Luxembourg (source: [EKE 16, p. 5] from EVCA)*

Table 1.1 shows the funds raised by private equity. Despite the similarity of these statistics, venture capital must be considered as distinct from private

equity, even if these two financing mechanisms are of a comparable nature (illiquid and medium- to long-term investments). The two do not take the same approach to the problem of fundraising. In particular, with regard to venture capital in Europe, the difficulty of finding the right options for departure explains why this industry consistently underperforms. This would explain why the funds raised on the European venture capital market do not reach the levels of those raised on the private equity market.

With regard to venture capital, a recent article states that:

> "France is characterized... by the importance of venture capital financing through public funds, which represent more than a quarter of the amounts raised. This is partly due to the lack of pension funds and university foundations. In fact, the time scale of these investors, which spans a greater period than that of other institutional players (banks, generalist funds, etc.) and their greater capacity to take risks (compared to insurers, for example), makes them important players in other countries. France is also characterized by its smaller specialized funds. As an example, the largest French funds are about 10 times smaller than the largest American funds. This fragmentation poses a particular problem for the most important fundraising events, beyond the start-up phase, which are essential for supporting the growth of successful start-ups and keeping them within the territory" [FRA 17, p. 2].

It should be noted that the target company and the entrepreneur do not occupy the same position in these two configurations. In private equity- and particularly in buyouts – the company already exists, it is established, is often mature, and generally functions as part of the "old economy". Investors acquire existing companies, improve their business model (the targets are very often underperforming business units) by transferring modern managerial tools and financial techniques to them to increase their value. Poorly managed companies become attractive targets that can be transformed into profitable companies [MEY 06].

By contrast, in venture capital, the company does not exist at the beginning of the process. It is only a concept of a product, process, or service, which will be developed in the "new economy". The trade-off between seizing on an entrepreneurial opportunity and being employed in a

large company, given the entrepreneur's aversion to risks, often leads to the conclusion that entrepreneurial choice is not very profitable because of the specific risks faced by the start-up that is to be created. The risk of exposure to corporate volatility is much lower in later stages (development or transmission). On the other hand, managers of venture capital and development capital funds are exposed to the same difficulty of diversifying their portfolios.

Moreover, the financial flows do not have the same purpose. Venture capital represents an institutional and organizational innovation that makes it possible to organize young innovative companies and professionalize their management, so that – in the case of the most efficient among them – they can make it into the technology stock market (going public). Following the logic of private equity, opportunities for profit can be found when the funds become owners of mature companies in which operators identify opportunities to create value, by optimizing their business portfolio and restructuring the scope of these companies. To this end, companies are often removed from the stock market, their shares become the property of one (or more) funds and, since they are no longer listed, they cannot be bought on the stock exchange by the public: they "go private", hence the term *private equity*. A new model known as the "not publicly traded" model has emerged and developed rapidly in recent years, which contradicts the underlying logic of capitalism.

We will focus on three aspects. First, we will specify the framework for analyzing the relationships between venture capitalists and entrepreneurs. Then, we will analyze the real behavior of these two categories of actors. Finally, we will highlight the contributions made by venture capitalists to the performance of innovative companies.

## 1.1. The analytical framework

Academic literature essentially uses two approaches: the agency theory and the resource dependency approach.

### 1.1.1. *The contractual model and agency problems*

Over the lifespan of the company, a financing gap is created when potentially profitable investment opportunities cannot be taken advantage of

due to a lack of internal financing. Additional external capital might then be provided by shareholders, banks, venture capitalists, companies, etc. In the first stage of development, when the company does not yet exist and its business model is not defined, funds may be provided by the entrepreneurs themselves, their families, and/or their friends. In addition to this, they may receive public support (competitions, honorary loans) or support provided by incubators (see Box 1.1) or accelerators[1] [EKE 16]. The authors of the cited work distinguish the incubation phase from the seed phase (with funds usually provided by business angels, but also from public authorities or specialized funds) and the start-up phase, in which venture capitalists are very active[2].

"EuraTechnologies [is] an ecosystem where major digital firms and start-ups coexist... The path to creating a company is filled with challenges: deciphering the administrative process, convincing investors, building an address book of potential clients... To address these challenges, the incubator gives guidance and advising. It brings in lawyers, accountants, tax experts, managers... An army of experienced professionals, whose job it is to show newcomers the ropes before letting them take the wheel. Alongside the multitude of small businesses, digital giants such as IBM and Capgemini have created their own operations to 'directly access project leaders', says Massimo Magnifico [Chief Operating Officer of EuraTechnologies]. The presence of large laboratories, such as those of the *Institut national de la recherche consacré au numérique* (Inria) or the *Commissariat à l'énergie atomique* (CEA), continue to contribute to the richness of the site... The owners of a technology talk to companies who will 'potentally [find it] a practical application...'"

**Box 1.1.** *The EuraTechnologies incubator (source: [NUN 17, p. 18])*

1 Accelerators differ from incubators in the limited duration of their schedules, the provision of tutoring and training, and the payment of salaries. In addition, these programs are organized into cohorts, that is companies enter and exit these programs in groups [COH 14].

2 This does not prevent them from participating in the previous seed step as well. New methods have emerged in the start-up phase: "*crowdfunding*" (a call for private savings contributions: funds are raised from a large number of participants, each providing a very limited amount) or *crowd equity*, which allows large investors (banks, large companies, etc.) to select start-ups seeking external financing. More often than not, the start-up is acquired in this case.

The literature has often focused on the opacity of the information involving start-ups, particularly those that are technology-intensive [CAR 02]. In addition to the fact that coverage by the media only very rarely works in favor of young companies (except at international trade fairs), an innovative idea that can lead to a new product, process, or service is a strategic asset that the company must protect in order to receive future returns. In this sense, restricting information is a rational strategy for controlling intangible assets. Moreover, since these are innovation-based companies whose concept is based on R&D expenditures, their situation can be compared to what has become known as the "lemons market" and modeled by Akerlof in 1970. When projects involve long-term R&D investments, funders have more difficulty distinguishing between worthy projects and ones that are less so. The existence of such problems of information imbalances gives rise to three types of difficulties: adverse selection, moral hazards, and opportunism.

In its extreme version, adverse selection means that the market for R&D projects can disappear if the information imbalance is too severe. Indeed, if the cost of disclosing information to the market is very high, the quality of the signal surrounding the potential project is reduced [HAL 10]. The ambiguity is very strong in this case. According to Hall, this mechanism can be attenuated in two ways. First, if R&D expenditure is an observable signal that can be audited externally, and second, if the innovator is a *serial entrepreneur* whose reputation has been built through previously founded and successful start-ups.

Moral hazards occur when the entrepreneur – and venture capitalist do not share the same objective, with the former preferring to invest in activities that are rewarding for themselves, but not necessarily for the company. Regardless of this difference, the entrepreneur may have excessive confidence in a project and overestimate it, while the probability of success will only gradually become apparent over time. In this context, the entrepreneurs and the venture capitalists will disagree on the time commitment and the number of rounds of funding required. Venture capitalists face the dilemma of either having to wait too long to cancel a project or having to cancel it too quickly. However, it is possible to accelerate or slow down the project's financing rate, depending on the progress that has been made and the expectations formed at each stage. There is also nothing from preventing the venture capitalists from including a termination rule in the contract (based on certain criteria), thus eliminating

the possibility for opportunistic behavior by a contractor seeking to extend the duration of the project.

These considerations show that providing equity capital from external sources will be more difficult to achieve for innovative projects than for ordinary investments, and this difficulty is still greater for innovative start-ups. In this context, how can we mitigate agency problems?

Venture capitalists have several possibilities for doing so. In addition to a qualitative evaluation of the project to be carried out on the basis of the business model provided by the entrepreneur, investors pay the most attention to the composition of the management team during the evaluation phase. In addition, external cognitive resources can be mobilized within the "entrepreneurial support network" that has been formed [KEN 04], including those of experts whose intervention is necessary to assess the commercial potential of projects, and those of institutions specializing in work as technological intermediaries (legal advisors, intellectual property specialists) who act as interfaces between investors and technological start-ups. Finally, the practice of syndication multiplies the skills required to review a project, while spreading the financial risks over time during the investment phase:

> "This refers more generally to work on the advantages of a system called hierarchy, in which a project is accepted on the basis of the observations of several people in relation to the polyarchy characterized by independent decision-makers" [GUI 08, p. 103].

Indeed, the authors (Sah, Stiglitz, etc.) stress the difficulty for individuals to gather, absorb, and make use of large masses of information in a limited period of time, which gives rise to the idea that a deliberation within an information ecosystem is able to do better, which is to say, lead to better decisions, than a single individual whose capacity for attention is necessarily limited.

Guilhon and Montchaud also point out that the contract is necessarily the result of negotiations between the venture capitalists and the company's managers, seeking financing. The most notable aspects are regarding the financial package (amount of funds injected, types of securities used: convertible preference shares, contractual protection mechanisms, etc.) and the drafting of the shareholders' agreement (inclusion of the venture

capitalist(s) on the Board of Directors, granting of decision-making rights, financing in stages, incentive mechanisms, etc.). In particular, the allocation of decision-making rights and the exercise of these rights depend on observable measures of the financial and non-financial performance of companies.

In this way, the discretionary allocation of rights and the possibility of using performance incentive systems create the equivalent of a hierarchy in the sense described by Williamson: the ability to give orders and carry out the administrative management of the project. However, the intensity of the hierarchical relationship varies, and is exercised on a structure that is not very thoroughly integrated when considering the different *rounds of* funding. The hierarchical relationship varies in intensity and this expresses that:

> "The venture capital contract is a hybrid, a complex combination of equity and debt (and one that in fact frequently contains convertible priority securities or other similar investment vehicles) that more closely resembles debt when the company has poor performance (control is given to the investor) and more closely resembles equity when the company demonstrates good performance (control is transferred to the entrepreneur, which is consistent with the logic of incentive)" [HAL 02, p. 47].

As enticing, as it may be, contractual analysis through the agency relationship has several limitations. Despite the presence of mechanisms for flexibility that allow the relationships between these actors to change over time based on the company's performance and the information received, some elements are inevitably left out of contracts, which by definition are always incomplete. In addition, once the decision has been made to invest, agency costs can be mitigated through a cumulative learning process. Over time, as a result of investments already made in many areas and the experiences gained, venture capitalists learn to better interpret the observed performance of funded start-ups [DIM 08]. Dimov and Murray point out that the cumulative learning process allows the VC firm to form a group of experienced managers, that is "intangible and tacit human capital that represents a secure and inimitable source of advice for the less experienced managers of the companies in the portfolio" [DIM 08, p. 130]. The accumulation of expertise skills, the product of learning through practice, makes it possible to extract higher returns on investment and to engage in

projects with higher added value, in particular, the most innovative start-ups. In addition, more effective monitoring (advising, etc.) and governance processes are being adopted in the start-up (and possibly seed) activities, which are becoming more specialized.

Finally, despite the flexibility of the contract and the effects of learning, the oversight mechanisms present a negative image of the relationship between venture capital and the entrepreneur. In particular, the transfer of rights is punitive in nature. Moreover, this image is incomplete. By considering venture capital as the principal and the entrepreneur as the agent, we are ignoring the fact that venture capitalists, in addition to their oversight activities, are often very involved in the management of funded start-ups and that the company's manager(s) are not simply agents expected to perform tasks that the principal imposes on them. These two players have interdependent roles, and because of the relative imbalance of knowledge between them, "their relationship should be considered as one of mutual dependence based on the relationships of power" [PAR 16, p. 15].

### 1.1.2. *The resource-dependent approach*

An analysis of the different types of knowledge, and their placement within a scheme for the distribution of roles between venture capitalists and entrepreneurs, makes it possible to specify the way in which a resource dependency approach complements the logic of the contract.

As mentioned above, the business of venture capital involves two types of knowledge. The intangible means of production used within an activity process are qualified as *instrumental* knowledge. They are explicit (i.e. scientific and technological knowledge) and/or tacit in nature. In this case, they are procedural in nature (knowing how to do it). The second type refers to *interpretative* knowledge that helps to define situations, imagine representations of reality, and give meaning to a productive activity by integrating it into a value chain. This kind of knowledge works to reduce the ambiguity associated with certain real-world conditions, particularly in high-tech activities. The respective roles of these two categories of agents are not set in stone. When entrepreneurs develop representations of interpretative knowledge that are supposed to correspond to production opportunities and market opportunities, they are not always able to evaluate the information created by their innovation. That is how new certain ways of acting, consuming, or communicating may be. Therefore, it is important for

cognitive attention of financial decision-makers and experts to be focused, through producing a model that can present salient points. Indeed, since cognitive attention is limited, the different aspects of the project are sequenced.

The possible and conceivable activities that an innovative project may take cannot be superimposed on each other; there must be an intersection between these two sets of knowledge. The literature notes that venture capitalists and experts gain new knowledge and, as a result, develop capacities of expertise that improve their ability to evaluate projects, to appreciate intangible assets (patents, R&D expenditures), the viability of a business model, etc. Entrepreneurs actively participate in this legitimization process by using their technical skills to find a place in a market that fits the product, and by seeking to define a distinct space and identity so that the company and the market become synonymous.

Identity can be constructed from several mechanisms, such as by reproducing cognitive models that are easy to identify and have been implemented elsewhere, particularly by investors. In particular, in services related to the Internet, a cognitive model can be built around the notion of secure transactions, or the notion of trust. Similarly, patenting allows innovators to give investors an indication of their R&D spending, the capacity of their expertise, and technological lead in a given field. The actions taken jointly between these two groups of players are intended to reduce the ambiguity of the situation created by the innovative project. This ambiguity exists because players may assign different functionalities to a new technology. They have their own "cultural resources" (skills, theoretical diagrams, etc.) that focus the attention on certain aspects that become more salient to them than others [LEO 11]. According to Leonardi, technologies are "interpretatively flexible" [LEO 11, p. 349], thus venture capitalists and entrepreneurs may have different interpretations of the problems that a technology is supposed to solve. In this context, *innovation is not so much a process for solving problems, which are supposed to exist somewhere until they are solved, but rather a process for constructing problems*. When the problem is shared by the actors, ambiguity is reduced.

By contrast with the logic of a contract, the forms of involvement and the type of coordination between the actors are different. Relationships of mutual dependency produce a cooperative form of governance based on the implementation of reciprocal and complementary knowledge that, far from

demonstrating the preeminence of venture capital, generates strong interactions between themselves and the company's management. Their involvement depends on both the attitudes they share about the projects and the resources they control. Because of their innovations, start-ups face specific risks that depend on the newness of the innovation. While adhering to the same project, both actors may have a preference for risk, more so in the "early stage" phase, but that is different or changes over time when the company reaches a more advanced stage (a "late-stage venture". The start-up begins to grow, the viability of the product is proven, and the business activity focuses on marketing and sales). The interdependence or reciprocal influence exercised by each actor depends on the extent of the resource held by one player, on the performance of the other, and the extent of control that each player exercises over the resource or a replacement for that resource [PAR 16]. The knowledge and skills possessed create a situation of mutual dependence, since it is rare for either player to fully master all the elements required to perform an action or achieve the desired result.

## 1.2. From the theoretical framework to the empirical findings: observed behaviors

Kaplan and Stromberg argue that transitioning from theoretical modeling to practice does not pose any major difficulties: "Venture capitalists are real-world entities whose behavior is very similar to that of theoretical investors" [KAP 03]. These players are supposed to be able to solve what Gilson calls "the problem of simultaneity", that is bringing together entrepreneurs, investors and financial intermediaries at the same time. In fact, the behaviors observed through the empirical estimates run up against methodological difficulties. Taking note of these difficulties allows us to take a more cautious approach to theoretical predictions. Moreover, the relationships between these players vary based on the trade-offs they make, they change along the stages of the company's life, they are part of a social and economic context, and finally, for the venture capitalists, they represent an aversion to risk that can be reduced by syndication.

### 1.2.1. *Methodological problems*

The behaviors observed depend on the information contained in the databases that face sample selection problems [INR 11]. For these authors, it

is conceptually impossible to precisely define a company's date of birth. Should we favor the first stage of financing, or admit that entrepreneurs can make their projects mature well before they are taken over by a funder? Indeed, personal or family financing may have enabled them to pay research and development (R&D) expenses, develop a business model, or develop a new concept while working as an employee at a large company.

In addition, empirical estimates face the difficulty of isolating the effects of selection from the effects of treatment, also known as "coaching" effects. Selection effects appear from the moment when the empirical data only include firms that have obtained financing, neglecting those that have been refused financing or those that have refused an equity contribution. In the first case, the screening process excludes "the worst entrepreneurs" from receiving any financing. Assuming that the transaction is completed, it depends not only on the quality of the project, but also on the entrepreneurs' personality and their ability to anticipate demand – variables that are difficult to enter into any database, and yet raise a problem of endogeneity. Venture capitalist finances a project because the entrepreneur has chosen wisely regarding the field and year of creation of the start-up (market timing skill) [GOM 08][3].

Reverse causality means that expectations of future events can influence the behavior of agents. In particular, Da Rin *et al.* [RIN 11] point out that a quality project can quickly lead to an initial public offering (IPO) and motivate venture capital investment. Such investments hold convertible preference shares, while entrepreneurs hold ordinary shares. In the case of an IPO, the preference shares are converted into ordinary shares, which allows the funder to retain an interest in a successful company. The opposite causality can also play a role: the investment made can strengthen the quality of the entrepreneurial project and encourage an initial public offering at an early stage in the lifespan of the start-up.

If this now results in moving forward in terms of performance, (see section 1.3), a strong growth in the revenue of the start-ups that are financed can be attributed to selecting the right projects, or to the financial and non-financial support provided to the portfolio companies (treatment effect) [BER 11, VIC 11]. It should also be remembered that the selection effect is

3 Heckman-style models reduce problems of selection on variables that cannot be observed.

sometimes difficult to interpret when the reputation effects of the most experienced venture capitalists attract higher quality projects.

### 1.2.2. *The arbitrations made: the entrepreneurial risk*

Arbitrations are not always financially explicit. If we analyze the behavior of the three stakeholders shown in Figure 1.1 (investors, entrepreneur-founders, and venture capitalists), we find that the financial assessment mainly concerns investors, entrepreneurs, and venture capitalists who implement only small amounts of financial capital, but a great deal of human capital [HAL 07]. The authors consider that the "venture company" represents an option that can be expressed as follows: provide financial capital or allow the company disappear due to a lack of liquidity.

The data used by these authors are taken from the United States, over the period between 1987–2003. The database lists 54,699 rounds of financing and 13,049 exits for 19,434 companies. The 13,049 exits can be subdivided into 1,936 IPOs, 4,802 acquisitions, and 6,281 exits at zero value. The investors earn higher than market returns (payments are made 32 months after the investment). The 3% annual amount represents the return that exceeds the risk-adjusted cost of capital.

As far as the entrepreneurs are concerned, they are extremely exposed to the specific volatility of the company and the return obtained is that of the human capital they provide. If the exit is done through an IPO, the average value received by contractors is $22 million (in 2006 dollars), but the distribution of the values received is very skewed. It should be noted that 68% of start-ups provide no value, and only 0.2% of them have IPOs valued at $1 billion or more. In this model, entrepreneurs are confronted with the possible trade-off between the probability of obtaining the best result and a return that is much lower, but is guaranteed. Calculating this probability indicates that the expectation of receiving $21 million in earnings generates only $1 million in *effective wealth*. In other words, when a venture capitalist agrees to invest in the company, the entrepreneur would like to sell it for $1 million. These evaluations make it possible to estimate the entrepreneurial risk over the period: the effective gain represents only 4.7% of the gain expected by the entrepreneur. Nevertheless, the entrepreneur accepts this risk because the venture capital firm uses the value of the best exits, in order for the entrepreneur-founders to accomplish their tasks.

Venture capitalists receive two forms of compensation: 3% annual of the amount invested, plus 20% to 25% of the earnings at the time of the exit. Over the period under review, their average remuneration was $8.3 million [HAL 07].

There are several important conclusions to be drawn. First, venture capitalists are unable to control the efforts of entrepreneurs to commercialize their projects. This justifies the analysis in terms of moral hazards and explains the use of the exit value to motivate entrepreneurs, who face a "non-diversifiable entrepreneurial risk" [HAL 10b]. Second, venture capitalists establish a mechanism for self-selection among entrepreneurs, which explains why only those who are highly motivated and confident in the quality of their project apply for funding, knowing that the amount they receive in compensation may be negative. Finally, the workings of this mechanism also explain why entrepreneurs receive salaries lower than market rates during the early stages of the financing.

More recent data have made it possible to give updated results [HAL 10b]. These involve 22,004 start-ups financed over the period of 1987–2008. Included in this total are 2015 IPOs, 5,625 acquisitions, 3,352 exits at zero value, 4,220 exits over five years at zero value and 6,792 start-ups that have not yet attained their exit value. The estimates are based on a sample of companies that have been listed on the stock exchange. Just under 25% of entrepreneurs receive the full exit value ($91 million) and one-sixth of them receive less than 20% of this value. Those who own 20% of the shares receive less than one-fifth of $48 million, or about $9.2 million. All these calculations are made at constant 2006 dollars. In the sample selected by Hall and Woodward, if we exclude the 6,792 start-ups that have not yet completed their exit process, we see that the exits at zero value make up 49.8% (7,572/15,212) of the companies, or nearly half.

In total, the probability of earning millions of dollars is low, and "the economic advantage of entrepreneurship over an alternative career is not significant" [HAL 10b, p. 1177]. The gap between salaried employment and entrepreneurial employment is even greater, since the latter comes with few assets in the beginning. It is this economic agent who bears much of the burden of the risk specific to the company. By using a standard risk aversion coefficient of two, the authors observe that the advantage of entrepreneurial opportunity is generally low or negative. In other words, the higher the wages in salaried employment (in the case of highly qualified senior

executives in large companies), the more the advantage of entrepreneurial opportunity is lost, except in the case of entrepreneurs with significant assets.

In fact, significant fundraising events occurred in France in 2016 (investment in start-ups increased by 24% to €2.25 billion) despite a below-average performance in Europe (see Box 1.2). Worldwide, investments have trended downward. Several elements played a role in this trend. The difficulties in exiting investments did not allow for capital gains to be generated that could be reinvested in other projects:

> "At the same time, many start-ups have been negatively affected by the excessively high evaluations they obtained in 2014 or 2015. These young companies, most often unprofitable ones, had to accept very strict clauses that guaranteed that their investors to recover their investment share, or even double or triple it, in the event of a sale or IPO at a discount. In this context, the priority for start-ups then became to control costs. This resulted in cutbacks in areas ranging from benefits in kind to social plans" [CAS 17, p. 3].

Moreover, even if entrepreneurship is on the rise, particularly in Europe and France (when costs increase faster than earnings and taxes become heavier, new forms of activity replace a salaried work relationship [GUI 16a]), the skills of entrepreneurs should not be underestimated (see Box 1.3). This explains the high failure rate of start-ups, whose survival rate remains low. In a US study of data from 10 start-up accelerators, it appears that out of every 100 start-ups in ICT, 92 fail:

> "In the American entrepreneurial world, more than 25% of start-ups end up in liquidation, and the percentage of those that do not repay their full investment share is much higher still; in short, a few brilliant successes compensate for a large majority of failures" [EKE 16, p. 8].

In France, estimates place failure rates between 60 and 75%. On the other hand, it's worth noting that entrepreneurial activities are generating increasing returns. A successful exit provides significant gains and/or assets, which makes entrepreneurship more attractive than paid employment and "reduces the specific risk burden of a second start-up" [HAL 10b, p. 1184].

According to the *Association française des investisseurs pour la croissance* (AFIC), the average net internal rate of return (IRR) on venture capital over 10 years was -0.2% at the end of 2013, with the average of the top 25% at 11.8%. In Europe, the average net IRR was 1.68% in the same year, with the top 25% obtaining 15.5%. This difference in performance may also contribute to the low level of interest of foreign private capital in French venture capital. However, further studies should be carried out, given the fact that a 2015 report by the *fonds communs de placement dans l'innovation* (FCPI) and *fonds d'investissement de proximité* (FIP) shows an average net IRR of the sampled tax funds of -5.1% for 2014, well below the AFIC average, which would drive the average down. It would be useful to establish the net performance of French venture capital funds subscribed by institutional investors, without including tax funds such as FCPI/FIP, so that it can be assessed in comparison with other European funds. These low profitability figures in themselves suggest that there is no significant shortage of capital dedicated to start-ups in France.

**Box 1.2.** *Performances in France are below the European average (source: [EKE 16, p. 4])*

"It thus became obvious that these flexible, quick-moving 'start-ups', adept at new ways of thinking, would create jobs and bring down established companies – perhaps we should call them 'end-ups' – ... Why does it feel so good to sing the praises of start-ups while on the other hand signing death warrants for large companies? Because start-ups position themselves as a winning combination between three different areas: they are instilled with the creative drive of the liberal economy, they exalt the values of dynamism and entrepreneurial intensity, and they promote themselves based on the belief that 'small is beautiful'...

"However, not everyone is cut out to be an entrepreneur. An army of pseudo-Start-ups has sprung up, made up of small, twisted and malignant companies that 'hack' large companies. But how many hares are really racing against the tortoises [large companies, slow by definition], how many start-ups are offering true alternative and cheaper models? Very few. Blablacar perhaps, or Criteo, to give the most recent example. In reality, most start-ups do not compete with large corporations, they simply work their way into their own micro-markets... But, when all is said and done, how many jobs do they really create?

"The point here is not to discourage entrepreneurs, but to dim the spotlight that has been shined on them a bit so they don't get blinded".

**Box 1.3.** *Start-ups and large companies (source: [DUE 17, p. 7])*

### 1.2.3. *The change of the relationships over time*

Venture capital investment does not have the same effects at different stages in the company's life. The relationship of mutual dependence between venture capitalists and entrepreneurs changes. The former encourages the latter to take risks at the early stages of the company's life "as a means of increasing the market value of the company being funded" and discourages it from adopting risky behavior in later stages, in order to preserve the value of the innovations that have been achieved [PAR 16, p. 2]. In other words, the valuation of early stage companies depends on the newness of the innovation, while their valuation at the end of the period depends on the commercial viability of the innovations achieved.

As these authors find, it can be assumed that the initial period is one of high potential yields and a high probability of failure. However, both of these players have reasons to keep going. Entrepreneurs who benefit from equity contributions are often very confident and motivated. Venture capitalists, on the other hand, are able to withstand potential losses when the start-up begins, due to the low level of the sunk costs of the investments, particularly through adopting step-by-step financing and reducing risks through a moderate diversification of their portfolio.

In later stages, the company begins to develop, the product is marketed, and value is extracted, either from the existence of a tangible product or from intellectual property revenues. At this stage, venture capitalists are much more averse to risks. The failure of an R&D program is a much greater burden and adjustment costs have to be paid due to increased competition, partly as a result of the inevitable dissemination of knowledge. At the same time, R&D is an asset that is difficult to redeploy, and whose sunk costs increase with cumulative capital expenditures and are "higher than those of ordinary investments" [HAL 10a, p. 20].

Park and Tzabbar also find that that placing too much focus on innovation may come at the expense of other activities that bring value to the start-up, such as improving sales and marketing along a clearly defined technological line and, it would appear one that is recognized by the market. The aversion to capital risk increases as the start-up develops; the investment they make reinforces the creation of novelty in the "early stages" and slows it down later, especially when compared to companies that are not backed by

venture capital. In fact, in the context of mutual dependence, the attitudes of venture capitalists are mediated by the nature of the power of the company's management.

The management of the company (personal/collective) exercises two forms of power: structural power and technical power. Structural power is entrusted to the organizational structure and hierarchical authority: the stronger this power is[4], the more likely it is to reinforce positive attitudes towards innovation and risk-taking at the beginning of the lifespan of the start-up. The confidence managers have in their own judgments, the possibility to earn gains, and the reduction of potential threats, lead venture capitalists to believe that the knowledge held by the people bringing the project forward represents a highly feasible productive and commercial opportunity. Conversely, interests are opposed in the "late stage". For venture capitalists, the priority is no longer to strengthen innovation, but to promote sales and manage intellectual property. At the same time, they are encouraged to achieve their gains in order to redeploy their financing to other start-ups. The outlook of the entrepreneurs extends over the long term, confident that future gains will be greater than current gains. They can influence the more short-term prospects of venture capitalists and reduce the amount of spending on innovation.

The technical expertise of the entrepreneur-manager[5] is complementary to the knowledge provided by venture capitalists. The latter are influenced by entrepreneurs, the knowledge they hold tends to reduce the information imbalances that are an obstacle to their decision-making process. The entrepreneurs' technical expertise provides a balanced approach to innovation within an existing technological trajectory. Based on a realistic outlook, they weigh the opportunities and costs associated with taking risks and moderate the potential enthusiasm of venture capitalists in the early stages of the process. Conversely, they use their implicit knowledge to persuade venture capitalists of the importance of the calculated risks and, in the late stage, moderates their inclination towards commercialization and licensing at the expense of innovation.

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4 Structural power is measured by the centralization of decision-making processes at the top of the organization.

5 Technical expertise is measured by the number of patents whose inventors are also directors of the start-up, and the impact they have.

The sample selected by Park and Tzabbar consists of 482 independent biotechnology start-ups, excluding subsidiaries and joint ventures, over a period of 30 years (1973–2003). The empirical results confirm their assumptions: venture capital financing has a positive effect on innovation in the early stages, while having the opposite effect on companies over 12 years old. In fact, the behavior of the venture capitalists changes as the company ages:

– the structural power of entrepreneur-managers reinforces the positive impact of venture capital on innovation and the level of novelty in the early stages, and reduces its negative effect in the late stage;

– technical expertise has the effect of reducing the enthusiasm of venture capitalists for innovation and moderating the negative impact of this type of financing on innovation during the late stage, by avoiding an excessive focus on marketing and commercialization.

In this model, the mutual dependence within a generally positive effect on innovation has the effect of smoothing out the innovation behavior of start-ups, avoiding both periods of uncontrolled growth and periods of abrupt contraction. Mutual dependence makes it possible to grasp more complex relationships between these two players, by rebalancing the power of venture capital with that exercised by company management, whether it has an organizational and formal origin or is produced by instrumental knowledge. In fact, this model forms part of an interplay between instrumental and interpretative knowledge. Structural power is more oriented towards the project of the start-up, it reinforces its quality by giving it meaning and legitimacy. Technical expertise is more focused on the element of time, smoothing out the jerkiness that may be caused by the venture capital financing and ensuring the survival of start-ups over the longer term, whose value tends to erode as they grow older and have to balance innovation and the protection of intellectual property.

### 1.2.4. *Behaviors of refusal*

First, let's consider the case of venture capitalists. Intellectual property is a source of income. Often, companies – especially larger ones – combine operations marketing a product with licensing operations, the sale of patents, or engineering services. Producers of knowledge are at the same time industrial producers, and specialization is said to be relative. Smaller

companies, especially start-ups, can specialize entirely in the production and sale of knowledge: this is known as absolute specialization [GUI 04].

In recent years, the development of commercial exchanges of knowledge has seen the emergence of companies that have specialized in the purchase/sale of knowledge and in challenging patents filed by other companies. The threat of a long and costly trial often leads small companies to compromise to avoid the potentially high costs of preparing a case and legal fees. Indeed, entities that challenge patents are not engaged in R&D or product manufacturing activities:

> "As a result, not only can they not be taken to court for infringing third parties' patents, but, in relation to the opposing party, they also pay charges that are generally less high due to legal proceedings that, for reasons of technological expertise, may involve exhaustive discovery requests." [LAL 17, p. 103].

It is tempting to see venture capitalists as having been caught up in this whirlwind of intellectual asset commodification [FEL 14]. In particular, venture capitalists would be attracted by the possibility of monetizing the patents of the start-up they are considering financing, in the case that the entrepreneurial project fails. This financial opportunity could motivate some venture capitalists to make the investment. In fact, studies done in the field based on surveys and interviews indicate that the vast majority of them do not consider the potential revenues that could come from the sale of patents to "patent trolls", whose main activity (if not their only activity) is licensing and patent litigation.

However, legal challenges can have the effect of damaging the image of a company that may potentially receive funding. In addition, they represent specific costs for the start-up, and management and engineers are mobilized to defend their intellectual property. "When companies incur expenses to defend their position, they do not develop, and when companies spend time and effort responding to these challenges, they do not invent" [FEL 14, p. 11]. This process may convince venture capitalists not to invest in a company whose patents are in dispute.

For the entrepreneurs, is it conceivable to refuse a venture capital transaction? These entrepreneurs' attitudes depend on the quality of the projects submitted, the way they make their judgements, and how confident

they are in their own judgments. In the literature, two attitudes have been identified to justify attitudes favoring refusal. On the one hand, the difficulty of appropriating the knowledge produced may lead entrepreneurs to seek other forms of external financing [CRO 16]. On the other hand, some venture capitalists practice active and restrictive monitoring, and "this managerial activism can be considered as an excessive intrusion into the management of their company" [CRO 16, p. 6]. Beyond these aspects, three socio-economic factors seem to explain attitudes of refusal: human capital, the size of the company, and the type of ownership.

The human capital of entrepreneurs represents the first potential area for friction. Will the technical knowledge and managerial skills they possess encourage them to conclude the transaction or encourage them to be cautious? This perspective is a clear departure from the idea of a complementary cognitive relationship between the technological knowledge held by entrepreneurs, and the strategic and entrepreneurial skills held by venture capitalists. The second element is the size of the firm. Is there a relationship between the size of the firm and the likelihood that they would refuse such financing? The authors hypothesize that the larger the size of the firm, the more likely it is that the firm would refuse this funding. The third element concerns the ownership structure and type of control. If family capital is used extensively, this can be an obstacle to the participation of venture capital.

The sample studied is extracted from the RITA database on Italian firms for the years 2002, 2004, 2007, and 2009. Financial and accounting data are available for the period from 1994 to 2009. The companies interviewed were asked whether they had received an offer to receive venture capital financing during their lifespan, whether they had refused and, if so, what was the basis for their refusal. The search of the database indicates that 120 companies received an offer to receive venture capital over the first years of their existence, 40 of them refused, and 80 accepted. The refusals were broken down into three categories: the lack of financial needs, the need to maintain ownership and control of the company, and the dissatisfaction with the valuation price and the terms of the contract.

Next, the authors obtained information on 103 of the 120 companies in the survey. Their preferred indicator is sales growth, and their estimates are intended to answer the question of whether the refusal to receive venture capital funds has influenced the route the company took to achieve growth.

There are several elements that would appear significant in the decision to refuse this funding, and the consequences of that decision:

– the type of ownership strongly motivates the decision to refuse. In this context, family ownership, which is highly developed in Italy (and in some other European countries), is an obstacle to the expansion of the venture capital industry, including for companies that have reached a certain size;

– the second reason concerns the characteristics of the human capital of the founding entrepreneurs. Those who have received advanced technical education and have managerial experience are often motivated to turn down this funding. By contrast, those with extensive economic training are better able to assess the benefits of venture capital financing and the costs and risks it involves;

– the companies that declined the offer for financing obtained a much slower growth rate than those that accepted it. The fear of potentially losing control of the company limits the development of the company and "entrepreneurs have a stronger attachment to the private benefits of control (including non-monetary benefits, such as a sentimental attachment to the company) than to growth rates that would be higher, but would be shared with a venture capital firm" [CRO 16, p. 9]. Opting for a growth rate that is less than optimal, but allows the entrepreneur greater control is a characteristic feature of the sample under study, which cannot be extended to other societal contexts without careful consideration.

All these elements represent obstacles to expanding this method of financing. Perhaps singling out high-tech companies from within this sample would have made for more interesting results, but this proved impossible. In any case, these results complement those obtained in the previous section to a certain extent. The power and technical experience of the entrepreneurs works not only to moderate the tendency of venture capitalists toward increased or decreased innovation, but also to reject their intrusion in order to promote a long-term vision of the company that is developing less rapidly, but that they fully assume.

### 1.2.5. *Risk aversion of venture capitalists*

There are several different mechanisms that can be implemented to reduce risk aversion among venture capitalists. The most frequently referenced are investment and syndication.

#### 1.2.5.1. *Funding in stages*

In a previous paper [GUI 08], we highlighted that this method of financing is a hybrid, based on the relationship established between the venture capitalists and the entrepreneurs. The relationship between investor and innovator is based on a sufficiently flexible contractual arrangement that allows options for investment decisions to be changed and decision-making powers to be shifted. There are situations in which venture capitalists have the right to cut off funds to a project when they believe it has performed poorly. The control of the venture capitalist over the investment decision establishes a situation characterized by an investment organized in stages, in the form of a sequence of short-term investments. "Rounds" of financing are an instrument used to limit the risk assumed by venture capital, but they do so by creating potential conflicts between the entrepreneurs, initial investors ("insiders"), and potential investors ("outsiders"). On the other hand, step-by-step financing expresses the negotiating power of venture capitalists. There are other situations in which the level of performance achieved is justification for control to be held by the innovators/entrepreneurs. In this case, venture capital acts more like a shareholder, who is far from being passive, given the instruments at its disposal (convertible preference shares, etc.).

From an analytical standpoint, step-by-step financing is an incomplete contract [RIN 11, p. 40] and an initial contract could very well specify the introduction of more sophisticated clauses when the subsequent steps are reached. Empirically, the evaluation of investments made in stages only measures *ex-post* achievements, whose relationship to the company's performance is not clear. For example, shorter intervals between each stage could very well result from a deliberate intention of the venture capital firm, or they may be the result of good performance by a company that achieves its objectives faster than expected [RIN 11, p. 41].

The empirical work on this point can be approached in different ways. We have chosen the analysis proposed by Colombo *et al.* [COL 14], in which investors either finance entrepreneurial start-ups that have adopted open source software (OSS) by opening their business model, or start-ups that develop and sell proprietary software developed from internal R&D. The question is whether start-ups in the first category, which access external

knowledge through collaborations with software developers[6], benefit from a larger number of funding stages. The sample surveyed includes 524 entrepreneurial start-ups listed in the SDC Platinum database. Of these, 124 have adopted an OSS business model, while the remaining 390 used a proprietary model. The results indicate that high quality venture capitalists are associated with the financing of start-ups of the first type, while the second type benefit from a greater number of financing stages. The quality of venture capitalists is identified by their past experience (the number of contracts already completed), their specific industry experience, the number of financing rounds in start-ups exited through an IPO, the total amount already invested in entrepreneurial start-ups, and the position they occupy in syndication networks. Financing in stages reduces agency costs but also, and most importantly, it is better adapted to the higher risk and increased complexity of an investment in start-ups with an open business model. Indeed, an open-source system increases the difficulties of coordinating external sources of knowledge (e.g. those generated through collaborations) and modifies the mechanisms for creating value, which is often reduced due to the presence of unexpected costs (e.g. development costs).

Overall, financing in stages allows venture capitalists to monitor the company's progress while still allowing them the possibility to leave the project as a way to limit losses. For Gompers and Lerner, financing in stages has two advantages: "[it] keeps the owner/manager on a tight leash, and it reduces the potential losses inherent in making a wrong decision" [GOM 98, p. 140]. From this point of view, it helps to at least partially solve, the problems of information, reduce the ambiguity of the project, and allows the various rounds of financing to be adapted to the company's real needs.

#### 1.2.5.2. *Syndication*

Syndication can be analyzed in different ways. It requires the venture capital firm that initiated the project to show interest and profit in order to persuade another venture capitalist to commit to the same project. It is generally observed that experienced and recognized venture capital funds have a preference to form syndication agreements with each other, particularly in the early stages. More recently, it has been shown that

6 These companies operate in the software business and participate in the free circulation of the basic version of open source software, but they also sell a premium version of the software that incorporates the technological advances they have made.

syndication agreements are often concluded with privileged partners from venture capital communities, which are often complex and different in size and influence, but homogeneous in the way they take action during specific stages.

In fact, the interpretation in terms of the knowledge held by the players involved leads to the conclusion that investors and networks built through syndication represent an important form of social capital that is useful to the companies receiving the financing [TER 16]. By syndicating, venture capitalists obtain information on various fields, which they are responsible for interpreting and applying to the company's specific project. In other words, the networks that are formed offer informational advantages to support investment decisions. More specifically, the social capital that investors build through their previous syndication experience is an important asset for both venture capitalists and the company receiving the financing. The resources created through these networks provide two types of benefits [TER 16, p. 396]:

– the value of the social capital for portfolio companies depends on their access to a variety of information on the basis of which venture capitalists carry out their advising activities. These groups must have both in-depth expertise in the sector and knowledge from the various fields in which they interact. A "heterogeneous syndication" creates links through which a domain of knowledge can be useful in another context by offering a new solution or adding a new perspective to the project being analyzed;

– social capital strengthens the ability to interpret how this broad range of information applies to the company's specific field. In practice, there may be "interpretative barriers" to understanding the information and assessing its value, which may limit the ability to interpret the various different types of information to be applied to the current project. It all depends on the configuration of the networks that have been built.

The most critical aspect is the level of redundancy of the information that the players involved access from the network. The direct links that form around the main players involved are characterized by being seen to a certain extent as "closed" (the players are directly connected to each other, the information is redundant), or as "open" (the other players are not connected, there are "structural holes", to use Burt's expression, the information is said not to be redundant). As these authors have found, it is recognized that redundant information reduces the likelihood that anything will be

misrepresented, while non-redundant information flows in open networks allow players who come into contact with other previously unconnected ones to access rich, diversified, and commercially useful information for their own benefit. In this context, networks of syndication must find a balance between the advantage of having redundant information and the advantages of the diversity of non-redundant information. Closed networks may be limited by the lack of information that is not redundant, where venture capitalists have difficulty challenging the representations acquired and tested within groups in which most participants have already co-invested in the past. In open networks, only a few venture capitalists have previously made syndicated investments.

In making their analysis, the authors take into account both the structure of the syndication network (open/closed) and the properties of the knowledge held by investors (diverse/specialized). The knowledge is similar when the players have previously worked on the same knowledge fields, and diverse when they specialize in different areas. Thus, by including the properties of this knowledge, it is possible to determine how these configurations can facilitate access to information that is both diverse and easy to interpret. In this sense, there are two types of networks that have emerged: closed and diversified networks, and open and specialized networks.

Closed and diversified networks have the advantage of greater diversity, which is combined with information that is easy to interpret, produced by a closed network. In this way, venture capitalists can gain access to best practices, and identify current trends and developments in the various sectors. Some players have co-invested in the past, but in different sectors, and this gives a wider range of alternatives. The interpretation of diverse information is possible because the connections that have been firmly established between players require them to use more time and effort. In addition, the connections between two players and third parties help to build trust in their relationships. A triangulation process takes place, making it easier to make interpretations through interactions that form a distributed cognitive process [TER 16, p. 400]. This approach encourages exchanges and analysis of the business models of different companies.

Open and specialized networks among venture capitalists are only "closed" to a very limited extent. Focusing on the same knowledge areas, these are rife with "structural holes", that is areas where the information is

non-redundant. Partners in the syndication have little previous co-investment experience but strong incentives to share information, and the similarity of knowledge increases their trust. The advantage of diversity is obtained by comparing different geographical contexts, which creates non-redundant information. As for requirement of specialization, this is related to the fact that the information everyone uses comes from a familiar field. Receivers are given an "interpretive scheme" [TER 16, p. 404] to assess the significance of the information obtained regarding the information they already have. In this context, venture capitalists do not have relationships with third parties, as was the case in previous networks. Syndicated networks of this type are able to provide high quality advice to funded companies.

The empirical estimates obtained from this conceptual map assess the success of a funded start-up when it obtains a second round of funding. The scope of application is made up of information technologies and the Internet industry (hardware, network hosting, searches, various applications, etc.), which encompasses 11 established sectors and 21 new emerging sectors, or 10,266 companies receiving financing, spread out over 34,146 rounds of financing, raised from 5,032 venture capital funds.

The most significant results confirm that closed/diversified and open/specialized syndicated networks are more effective. More specifically, new companies in established sectors are more likely to succeed (obtain a second round of funding) if their networks can be categorized as closed/diversified. By contrast, those operating in emerging sectors are more successful if they are backed by open/specialized networks. In addition, some estimates indicate that the informational benefits associated with social capital can be maximized if "the redundancy and non-redundancy of information coexist" [TER 16, p. 420]. Indeed, redundancy is effective in making interpreting information easier, and non-redundancy protects diversity through the triangulation with third parties. When these players are not similar in the knowledge they have within a network, the connections they share with third parties act as an important mechanism for interpreting information. In other words, it has been found that the effects produced by the structure of a network are not sufficient to explain the success or failure of the syndication of venture capital firms. It is also necessary to take into account the nature of both the instrumental and interpretative knowledge that venture capitalists possess in closed/diversified and open/specialized configurations. It can also be seen that diverse information comes either from the position of venture capitalists in networks with many "structural

holes", or from their position in networks composed of a varied mixture of actors (with dissimilar knowledge).

The results obtained confirm the relevance of the hypotheses that were proposed. In a way, they complement those obtained by Gompers *et al.* [GOM 08], who note that the influence of experienced venture capitalists is not always decisive. In emerging sectors in particular, their influence becomes decisive when they are able to attract critical resources by building syndication networks that allow them to interpret information and apply it to the projects they analyze. In this sense, syndication, as analyzed in terms of knowledge and network structure, makes it possible to select the best projects and shorten the time between the different rounds of financing. As a result, the effectiveness of financing in stages becomes a characteristic of syndication when it brings together knowledge and skills in the most appropriate configurations.

## 1.3. The contribution of venture capital to the performance of innovative companies

It is worth recalling the methodological difficulties that were already noted at the beginning of this chapter. A distinction must be made between the pairing of venture capitalists and entrepreneurs and the involvement of the former in the companies they finance. This pairing is considered a selection effect: the most experienced venture capitalists are able to select the most talented entrepreneurs. The effect of implication is an effect of treatment: the effects considered are the incremental effects of the actions of venture capitalists, that is the processes by which they add value to the companies in their portfolio. These two effects influence the performance of companies. Also to be considered are the "forward looking" selection effects, that is the fact that certain entrepreneurs seek out certain venture capitalists because of the services of added value they are likely to provide [RIN 11, p. 37]. More generally, the question of reverse causality also arises in the case of private equity. In this context, it is necessary to assess the approaches that seek to isolate the selection effects from the treatment effects [BER 11]. Having made these clarifications, two areas of performance will be analyzed. The first includes innovation, growth, and employment performance. The second involves the survival rate of entrepreneurial firms and the effects of persistence.

### 1.3.1. *Innovation, growth and employment*

The idea that long-term growth is closely related to a country's capacity for innovation is commonly accepted in the literature [AGH 16]. Many studies have concluded that the deficit of innovation in Europe is due to its limited ability to transform scientific knowledge into marketable products and services. Indeed, a large number of these potential innovations fall into what has become known as the "Valley of Death". It is possible to link the stages of technological innovation with the forms of financing that support them. The chain from R&D to a market launch does not function unambiguously, disruptions may occur, which of course may result from the technological obstacles encountered, but also because of the existence of "financing gaps" that hinder the transition from concepts to the creation of a prototype and demonstrations. The venture capital industry can potentially play a significant role in making it past these milestones, just as access to incubators facilitates the transition from research to product development.

First, the impact of venture capital on performance will be analyzed by providing a few macroeconomic benchmarks. We will then continue this reflection at the level of individual sectors, then at the microeconomic level by highlighting its influence on companies' innovation strategies.

To assess the effects of venture capital on innovation (estimated using patents), we use the work of Popov and Rosenboom [POP 11], which covers 21 European countries over the period 1991–2005. The authors estimate the doubling of venture capital investment led to an increase of about 2.5% in new patents[7]. In fact, the results vary widely between European countries. With the exception of countries with low venture capital investment, there is a significant effect on the propensity to patent since every dollar of venture capital investment is equal to three times that of every dollar invested in

7 Other research does not confirm this result. Lahr and Mina [LAH 16] find, from and examination of a sample of 940 American and British start-ups (2004–2005), that venture capital investments do not lead to an increase in new patents. Once the investment is made, venture capitalists do not seek to increase the knowledge base of invested firms, but develop an operating strategy by reducing the time it takes to bring inventions to a market. In this way, contribution of equity capital can allow more innovations and fewer patents to coexist. The progression from idea to sale on the market therefore has a negative effect on the decision to obtain a patent.

traditional R&D [POP 11, p. 20]. By considering venture capital spending within different national contexts, the results suggest that venture capital is more effective in creating innovation in countries where the barriers to entering the market are lower. Similarly, the effect of venture capital is more significant on the number of patents filed in countries where the labor market is more flexible and less highly regulated. Finally, it can be observed that the effect of venture capital on innovation is stronger in countries with a higher level of human capital training. In total, venture capital investment has accounted for about 10.2% of innovation flows in 15 European countries since the early 1990s.

The relationship between venture capital and innovation has been analyzed at the level of individual sectors by Bertoni and Tykvovà [BER 12]. These authors examine the type of investor (public versus private) and assess the influence exerted by the structure of the transaction (syndication versus non-syndication). To perform this analysis, they used the VICO database to construct a sample set of 865 European companies (159 of which were venture capital funded) operating in biotechnology (673) and pharmaceuticals (192). The companies backed by venture capital received their first round of financing between 1994 and 2004, and were significantly younger than firms that had not received this type of financing[8] (8.86 years for the first group, and 10.94 years for the second). The innovation output was measured through the number of patents obtained.

This econometric modeling led to six significant results:

First, venture capital investment has a positive relationship with the patents held one to five years after the investment was made. This increase is much higher than for the companies in the control group.

Second, syndication relationships led by private venture capitalists show a significant increase in the number of patents held by the companies financed compared to those of the control group from t +2 to t +5.

Third, syndication increases the innovation output to a much greater extent than autonomous transactions, either by public (government) or private venture capitalists.

8 These firms form the control group.

Fourth, the analysis of the transaction structures was refined to take into account the players involved in the syndication. The model considered separates syndicated transactions into two groups: heterogeneous (private and public venture capital) and homogeneous (private or public venture capital). The coefficient of heterogeneous syndication is very significant, and its influence is very strong, while the coefficient of homogeneous syndication is never significant.

Fifth, the model estimates the influence exerted by the syndication manager. When a heterogeneous syndication is organized, the innovation output increases more significantly through the action of private venture capital than through that of government-based venture capital.

Finally, a heterogeneous syndication led by private venture capitalists is the most effective form out of all transaction structures[9] for promoting innovation in biotechnology and pharmaceuticals.

This lends credence to idea that venture capital does not have the same effectiveness when applied to different types of investors or transaction structures. Instead of pitting private and public venture capital firms against each other, the authors show that:

> "The mode of investment used by governmental venture capital investors is also a key variable in the design in effective innovation policies. Specifically, to support innovation, governmental venture capital investors should not invest alone but should syndicate with private partners. In addition, private venture capital investors should be allowed by their governmental partners to lead the syndicate" [BER 12, p. 17].

The relationship between venture capital and innovation can also be assessed qualitatively by analyzing the influence on innovation strategy. Four strategies have been distinguished [RIN 13]: "No-Make-No-Buy", "Buy-only", "Make-only", "Make-and-Buy". The latter strategy represents the empirical dimension of the concept of absorptive capacity [COH 90], which the authors extend by introducing the idea of transformation [ZAH 02] produced through the recombination of internal and external knowledge.

9 Only private, only public, homogeneous private syndication, homogeneous government syndication, heterogeneous syndication led by public venture capital.

More precisely, this strategy involves the construction of the capacity for absorption[10]. The hypothesis tested is that there is a link between venture capital and the Make-and-Buy strategy, which involves companies whose innovations can quickly be put on the market. The sample tested consists of 10,000 Dutch companies, 161 of which are backed by venture capital (data from the CIS, ThomsonOne and PATSTAT).

One-third of companies adopt this strategy, and companies backed by venture capital achieve a higher percentage of sales from innovation and are committed to building capacity for absorption. By testing a smaller sample of firms before and after receiving venture capital financing, it appears that companies change their strategies after obtaining this type of financing (the probability increases by 17%). In this context, venture capitalists play an essential role in guiding companies towards the acquisition of external knowledge (R&D conducted under the contract, the purchasing of licences). In particular, those operating in high-tech industries (chemicals, pharmaceuticals, electronics, IT services, and R&D services) are more mature in terms of their technological development than those receiving only public funds, the latter of which are less subject to environmental pressures and the requirements to rapidly market the product in order to make it easier to list the company on the stock market or sell it after a few years.

The empirical estimates generally indicate that venture capital has a positive effect on the growth of companies. There are four arguments for this [GRI 14]. First, venture capitalists are often better able than other players in the capital market to select entrepreneurial companies with a high potential for growth. Second, venture capitalists bring added value to companies that are financed through managerial skills, behavioral control, and the monitoring of results. Third, receiving venture capital funding is seen by third parties as an indicator of a portfolio of high quality companies. Without this indicator, companies have difficulty accessing additional external financial resources and other abilities that often prove critical. Finally, companies that receive venture capital funding benefit from the networks of contacts they obtain through venture capitalists, both suppliers and institutional investors who form their entrepreneurial support network.

10 “Finally, Make-and-Buy is the strategy that combines the two innovation operations, internal R&D and external knowledge acquisition, and entails the creation of a capacity for absorption” [RIN 13, p. 13].

Based on the VICO database (made up of 7 countries, and 2 groups of companies: those that received venture capital funding, and others), Grilli and Martinu [GRI 14] monitored a cohort of 534 companies that received their first round of funding between 1994 and 2004. The research question was: does the growth rate of funded companies increase steadily after the first phase of funding? To refine their analysis, the authors distinguish between independent venture capital funds (private, IVC) that do not receive public funding, and government venture capital funds (GVC) managed by a "General Partner acting in representation of government authorities" [GRI 14, p. 1524]. The mission of the GVCs is to use public financial resources to provide the development and growth of economic projects with high impact.

In the general model tested by the authors, they find a positive and significant impact on sales growth, but the effect of venture capital on employment is not significant. When venture capital funds are differentiated between private and public ones, IVCs have positive effects on the growth of sales, whereas with GVCs, this effect is not significant. This observation leads the authors to question the ability of public entities to stimulate the growth of companies, particularly high-tech companies, through taking action directly on the finance market. The relative ineffectiveness of these entities is not only a product of the low availability of financial resources, but also of their lack of ability in carrying out value adding activities. In addition, the authors estimate the effects on growth when syndication partners are led by a public or private investor. Only one positive and significant effect is obtained on the growth of sales the public investor is not the leader of a syndicate.

In a more recent study [GRI 15], the authors look at the "high-tech" sectors in seven countries (Belgium, Finland, France, Germany, Italy, Spain, United Kingdom), for which they use a longitudinal database (VICO) over the period of 1984–2009. This database contains usable information from 8,391 start-ups in biotechnology, pharmaceuticals, ICT, etc. The originality of the study lies in its more in-depth analysis of the behavior of public players, which are broken down into government (PUVC) and academic (UVC) players. University funds operate through technology transfer offices.

Of the 8,391 start-ups, 761 are backed by venture capital. Private and public funds continue to have a positive overall effect on growth. The study confirms the positive effect of private funds alone, but the effect is more significant if the company is young. As far as public players are concerned,

government funds have a greater impact than university funds, both in terms of the growth in company sales and in employment. On the other hand, there are no effects on so-called mature companies.

The results obtained partly confirm those obtained over a shorter period (1994–2003) and only for Italian companies [BER 11]. The sample consists of 538 companies, 68 of which are backed by venture capital. This confirmation is only partial, since, as mentioned earlier, the venture capital industry is "underdeveloped" in Italy. The investments that are made have a stronger effect in the short term than in the long term, which is to say, much of the positive effect is obtained after the first financing stage. This effect was measured in the following manner: the size of the company (measured by the number of employees) at the end of the year following the first phase increased in comparison with a company that did not obtain such financing. The additional growth that can be attributed to venture capital financing is approximately 40% for employment and sales over the period. The effect on employment is very strong in the short term – the employment rate after the first round is 110% larger than it is without venture capital – and by the second year after the first round of financing, the rate of employment growth decreases. For sales, the effect is 87% when the same time benchmarks are used. By incorporating additional variables into their model, the authors find that the use of venture capital (a treatment effect)[11] makes it possible to professionalize the company's management, and obtain additional financial resources through an IPO. The results confirm Gibrat's law: small companies tend to grow faster than larger companies.

### 1.3.2. *Survival rates and entrepreneurial persistence*

It is difficult to address the issue of entrepreneurial start-ups without considering it within the environment in which these companies operate. Ecosystems of innovation that support entrepreneurial dynamics can have several configurations, ranging from localized "clusters" to incubators and science parks. According to these authors, the important thing is to consider the interplay of similar and dissimilar knowledge in the creation of new companies.

11 In this study, the selection effects (project quality, future growth prospects, etc.) were neutralized, they play no role in the positive relationship between venture capital investment and the company's growth.

On the one hand, the many different players and the variety of technological combinations within a given location lead to the creation of local knowledge bases. These knowledge bases make it possible for knowledge to be transferred and influence the number of venture capital funds and, in turn, the creation of innovative start-ups. On the other hand, venture capital start-ups benefit from the positioning of venture capitalists within information-rich networks of heterogeneous groups of players, often in a central role. The intersection of these two aspects makes it possible to broaden the role played by venture capitalists: not only do they play a role as discoverers, financiers, providers of advisory and control services, but they also play a "liaison role" in the formation of alliances involving a financed company and in the functioning of this alliance [JOL 16]. In particular, as Williamson considers, they lower transaction costs and provide effective protection against contractual risks (opportunism, knowledge leakage, etc.) in collaborations between firms.

New companies seek out alliances to strengthen their competitive position, but they lack the reputation, experience, contacts, and funding to mitigate the risks associated with forming an alliance, including the risk of finding the right partner. Venture capital firms influence the type of collaboration between start-ups (governance decisions) providing legitimacy for the alliances in two main areas:

– cognitive, due to the complementary nature of the knowledge the participants have;

– socio-political, with reference to the reputation and experience of venture capitalists, and the effectiveness of mechanisms of governance to mitigate contractual risks.

Jolink and Niesten [JOL 16] analyze a sample of 564 venture capital-backed start-ups over the period of 2009–2014. They find that, the start-ups studied are more likely to choose a *joint venture* financed by venture capital as the governance structure for a collaboration, and this effect is all the more pronounced as venture capitalists have become involved in syndication networks.

Outside of contractual protections, alliances accelerate the development of start-ups and allow them easier access to additional financial and non-financial resources. More specifically, they bring innovative start-ups into broad networks of knowledge production and technological development

that are made through the combination of relationships structured around R&D and networks organized around value chains.

However, the ability to attract greater and better resources explains the widening gap between entrepreneurs who have successfully validated their projects and others. Their success partly depends on the experience of venture capitalists. When venture capitalists have greater experience, their financing has a largely positive effect on whether or not an entrepreneur succeeds and becomes a serial entrepreneur [GOM 08]. From the perspective of venture capitalists, the persistence effect can be explained in two ways:

– either through establishing syndication networks configured to meet the needs of established or emerging sectors;

– or through the effects of specialization on a specific phase of the process (such as the early stage). These effects partly overlap with the previous explanation since, in this case, venture capitalists have better information and obtain a competitive advantage through the accumulation of resources that are difficult to imitate.

More broadly, the persistence of entrepreneurs also depends on the information that is available on the past actions of entrepreneurs. In this case, there is a wide range of alternatives available to them. In particular, they have the choice of financing their companies by using their own resources, by using bank loans, or by benefiting from equity contributions. By using their own resources, the attitudes of persistent entrepreneurs are embedded in national contexts characterized by innovative cultural behaviors. In the United States, because the persistence of entrepreneurs is self-sustaining, it tends to create an ecosystem:

> "Successful entrepreneurs often reinvest their earnings in other companies, creating a multiplier effect. They provide not only seed funding, but also entrepreneurial skills. This phenomenon is less prevalent in France, mainly because successful entrepreneurs leave for other countries" [EKE 16, p. 5].

## 1.4. Conclusion

The developments described above first draw attention to the theoretical approaches used to analyze the relationships between venture capitalists and

entrepreneurs, as well as the underlying logic behind them. The logic of oversight and penalization is at the basis of the contractual model, the logic of cooperation serves as a pillar of the scheme which postulates mutual dependence between the two actors, neither of which is able to exert unilateral and unbalanced influence on the behavior of innovative start-ups.

Venture capital is an expensive form of financing, given its large number of failures and disappointing investments (exits at zero value) and the significant amount of risk taken by entrepreneurs, which cannot be diversified. The existence of these risks explains the real dimensions of this industry. If we consider this in terms of flows, it is estimated that in 2008, only 1% of the 600,000 new companies created in the United States each year were given venture capital financing [BAL 08]. Puri and Zarutskie [PUR 11] estimate that only 0.11% of the new companies created over the period of 1981–2005 were financed by venture capital. This figure increased 0.22% over the period of 1996–2000. Other studies have confirmed these statistics: for example, the *Kaufman Survey* estimated in the early 2000s that 1% of all start-ups receive venture capital financing. Another study even estimates that, over the same period, less than 0.5% of new entrepreneurs were looking for this type of financing for their businesses. In Sweden, between 2002 and 2009, only 1.2% of the 46,000 companies created each year were financed by venture capital [SOD 12]. On the other hand, despite these low percentages, a large proportion of successful IPO start-ups (around 35%) were financed by venture capital.

The other important element that has been determined from this chapter is that the phenomena of serial entrepreneurs and entrepreneurial persistence that characterize venture capital today cannot be analyzed without taking into consideration the national contexts in which ecosystems develop and the activities around which they are organized. The unique conditions of each country make it possible to identify the institutional advantages obtained within different countries [HAN 99]. For new knowledge to be produced and new activities to form, specific institutional arrangements must be made, including deregulated labor markets, a high mobility of skilled labor, substantial rewards for inventors and innovators, and a sufficiently open capital market for venture capital to be freely accessible (see Chapter 3). An institutional architecture of this type multiplies the places where scientific and technological knowledge is created, encourages people to move between firms or between universities and firms, promotes the creation of new firms, and facilitates access to sources of financing. It is here where the core

rationale for venture capital can be found: it promotes companies' strategies for exploration.

Indeed, using a strict definition of property rights, the logic of a market economy stretches throughout the chain, from basic research to the creation of new companies, by putting universities, laboratories, and research centers, products, processes, and organizations in competition with each other and by providing the resources needed to finance radical innovations through the existence of sophisticated financial markets. In this context, entrepreneurial initiative and competition are the most effective mechanisms for achieving such innovations.

By contrast, the institutional architecture of most European countries, particularly Italy, favors less permissive cultural behavior in terms of innovation, resulting in a robust persistence of family capital and a strong attachment to traditional property values. These norms and values work to restrict innovative behavior intended to achieve objectives legitimized by the social system as a whole. The innovation of products and services is part of a slower, more incremental dynamic. Strengthening this dynamic requires new criteria for performance and rules of allocation that change the incentive structure of companies. In other words, making economic part of a process of acculturation, ultimately providing *new cultural resources* centered on a greater individualization of payment, rewards for inventors and innovators, a respected image of the entrepreneur-innovator within society, etc. This can be seen as a form of innovation, both organizational and institutional.

Once created, ecosystems for innovations in financing, gain efficiency by transforming the position system of the various actors. This is the case with *business angels,* who can be considered as informal venture capitalists [LAH 16]. Until recently, they were involved in the early stages of the lifespan of start-ups, which, on average, are 10 months old when they receive such funding – a time when they have not yet turned a profit. In addition, "business angels" invest in companies located within well-defined geographical areas for relatively small amounts, on average less than $1 million in the United States. In recent years, this community has been changing, and new players have emerged, described as "super angels" [EPS 09]. This term refers to serial entrepreneurs and investors who are able to invest large sums in start-ups, either directly or through funding structures and who have built a reputation for talent, qualifications, and integration into effective networks. These super angels work within a much wider

geographic area, sometimes internationally, financing companies that are technologically advanced and have high growth potential. The dynamics of the innovation financing ecosystem are a closed loop: venture capital products, past successes have allowed these super angels to generate enough gains to be able to provide new entrepreneurs with financial resources, as well as entrepreneurial skills.

# 2

# The Sectoral Dynamics of Venture Capital

The Schumpeterian model assumes that long-term growth is first and foremost the result of the innovations that are implemented within a given economy. The means by which innovation drives growth is a complex process in the sense that it weaves together different technological, social, economic and financial realms. The process of creative destruction can be read as the process of spreading a new idea that redistributes different shares of the market, changing the rules of the game and the formats of production and distribution of existing products and/or services. The dynamics of the process envisioned by Schumpeter are a conflict between the old and the new. Established firms and existing interests are constantly seeking to block or delay the entry of new competitors into their sectors [AGH 17].

In the context of venture capital, the question becomes the influence this type of financing has on the spread of new ideas. Empirical research indicates a multiplier effect of venture capital on the diffusion of innovation in the sense that this process takes place both inside and outside the venture capital industry. This implies that venture capital-backed companies are profitable, but also, and most importantly, that the effects of the spread of these ideas appear at the macroeconomic level, along with the possible consequences they have on the direction of activity in innovation worldwide [GON 13]. In the view of this author, venture capital certifies the value of the innovations proposed, and feeds into sequences of innovations as part of a chain. The means by which ideas are spread is not isolated from the progression of the investment cycle [NAN 12]. The start-ups that are financed during the most active investment periods benefit from successful

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First Edition. Bernard Guilhon.

exits (IPOs or trade sales), they file more patents in the years after their financing period ends, and their patents are more frequently cited than those created by start-ups financed in less active investment periods. As a result, the spread of knowledge and its assimilation by other innovators ("technology spillovers") occurs with greater intensity during periods of greater activity. As a result, venture capital plays a crucial role in the processes of creating and commercializing new technologies.

The overlap of these two mechanisms, that of creative destruction (new technologies dominating existing technologies) and that of the propagation of knowledge, allows us to analyze venture capital, both in terms of the allocation between sectors of this mechanism for financing innovation and in terms of its contribution to the creation of new activities. Against this backdrop, a pattern of development in advanced economies is emerging, which focuses on the slowing pace of innovation in traditional industries, particularly in consumer goods, and on the dynamism of the innovation occurring in the sectors of the digital economy.

In fact, the analysis we have given here addresses only one aspect of the sectoral dynamics at work, since a thorough analysis would need to take into account the many different factors that characterize the different sectors: supply, demand, market structure, international competition, productivity levels, types of financing, and more broadly, the interweaving of the different institutions, networks, and organizations that exist at the sectoral level to form a system.

An approach that begins through venture capital financing sheds light on the sectoral dynamics and the distortion of these dynamics in recent years. It justifies the dualistic approach to innovation (traditional activities/new activities) by highlighting the contribution of venture capital to the emergence and development of high-tech (HT) sectors whose operating logic and impact on macroeconomic performance deserve to be addressed in their own right. Section 2.3 proposes a model for determining investment in the high-tech sectors that we have developed, constrained by statistical information, from the broader perspective of private equity.

Before discussing the content of the three sections, it is worth giving an overview of private equity (PE) and venture capital (VC) operations in Europe, based on the statistics produced by Invest Europe [INV 16]. These

statistics cover 1,200 European private equity firms, representing 91% of the €564 billion of capital managed in Europe.

| 2000 | 2006 | 2009 | 2015 |
|---|---|---|---|
| 0.35% | 0.55% | 0.19% | 0.30% |

**Table 2.1.** *PE investments as a % of GDP[1] (26 countries, 2000–2015) (source: [INV 16])*

This more detailed analysis gives priority to the countries with the most significant amounts.

| United Kingdom | Denmark | France | Germany | European total |
|---|---|---|---|---|
| 0.799% | 0.437% | 0.388% | 0.198% | 0.302% |

**Table 2.2.** *PE investments as a % of GDP (selected countries and total for Europe, 2015) (source: [INV 16])*

The relative importance of venture capital is shown in Table 2.3.

| Denmark | Finland | France | United Kingdom | Germany | European total |
|---|---|---|---|---|---|
| 0.109% | 0.047% | 0.034% | 0.032% | 0.025% | 0.025% |

**Table 2.3.** *Investments in VC as a % of GDP (selected countries and total for Europe, 2015)[2] (source: [INV 16])*

A comparison of Tables 2.2 and 2.3 reveals that the hierarchy has changed. Certain forms of specialization are developing, which may hinder a more broad-reaching spread of certain practices in Europe:

1 These are investments made by funds whose business activity is mainly concentrated in Europe. Infrastructure funds, real estate funds, primary and secondary funds of funds, etc. are excluded.

2 These figures have been obtained from the location of the VC firm and not from the location of the companies that are included in the portfolio of investments.

> "The high concentration of the headquarters of these funds in the United Kingdom is due both to the fact that the UK has become specialized in the production of very high value-added financial services, and to a legal tradition based on the common law legal code, which offers greater protection to investors than what is guaranteed under the Commercial Code in Germany or under the Civil Code in France... Regarding the first aspect, practical know-how is particularly valuable in the management of buyouts. In this context, it does not come as a surprise considering private equity more broadly, that 80% of investments made in the United Kingdom are done on buyout operations" [GUI 08, p. 91].

It can thus be assumed for the UK that by 2015, the difference between PE (0.799%) and VC (0.032%) can be attributed largely to buyout capital. These operations amount to 0.677% of GDP, the rest (0.084%) being allocated to growth operations. More generally, venture capital generally represents only a small portion of Europe's GDP.

Now we will examine the distribution of this venture capital by sector.

## 2.1. Orientation by sector

To analyze the orientation of venture capital by sector, we use the statistical data produced by KPMG in the study "Venture Pulse Q4 2018". Between 2010 and 2015, the outlook on a global level shows significant growth in the capital invested ($45 billion in 2010, $141 billion in 2015) and the number of transactions (8,459 deals made in 2010, 17,992 in 2015). The number of transactions recorded globally decreased in 2016, faster than the capital invested, suggesting that the transactions were larger, with their average size increasing for the early stage phase.

Venture capital is mainly invested in ICT (software and hardware) and pharmaceuticals and biotechnology. The activity of the software sector has seeped into many other activities, particularly in the collaborative economy, by changing the production and distribution formats of traditional services (Uber, Airbnb). The significance of the Pharma and Biotech sector can be explained by the strong demand for innovative technologies. Within this movement, large companies are strengthening corporate venture capital (CVC).

| Sectors | 2010 | 2018 |
|---|---|---|
| Software | 22% | 40% |
| Pharma & Biotech | 13% | 10% |
| Media | 3% | 3% |
| ICT equipment | 12% | 2% |
| Healthcare services and systems | 15% | 7% |
| Medical equipment and supplies | 8% | 2% |
| Commercial services | 8% | 5% |

**Table 2.4.** *Distribution of VC investments by country and sector (source: [VEN 19, p. 15])*

| | 2010 | Q3 2018 |
|---|---|---|
| **Invested capital** | $11 billion | $109 billion |
| **% of total number of operations** | 11% | 18.5% |

**Table 2.5.** *CVC participation, all countries*[3] *(source: [VEN 19, p. 19])*

The share held by large companies of the capital of start-ups, intended to strengthen R&D or to take a position to wait for an acquisition, has increased considerably over the period under consideration. This movement is even more pronounced for the United States, a country in which the share of the CVC has increased significantly since 2013.

As we have noted, venture capital investments increased sharply between 2010 and 2015, declining slightly in 2016, together with a fairly sharp

3 "The capital invested is the sum of all the round values in which corporate venture capital investors participated, not the amount that corporate venture capital arms invested themselves. Likewise, the percentage of deals is calculated by taking the number of rounds in which corporate venture firms participated over total deals" [VEN 19, p. 17].

decline in exits (1,810 in 2014 and 1,285 in 2016). Cyclical phenomena are certainly important, but the fact cannot be overlooked that investors assess profitability and liquidity issues more accurately [VEN 17].

### 2.1.1. *The orientation of venture capital by sector in the United States*

| Sectors | 2010 | Q3 2018 |
|---|---|---|
| Software | 26% | 44% |
| Pharma & Biotech | 12% | 17% |
| Media | 3% | 2% |
| ICT equipment | 9% | 3% |
| Health care services and systems | 15% | 5% |
| Medical equipment and supplies | 9% | 5% |
| Commercial services | 8% | 3% |

**Table 2.6.** *Distribution of venture capital by sector in the United States (2010, 2018) (source: [VEN 19, p. 50])*

Venture capital in the US is on the forefront of global trends, accounting for nearly 55% of capital invested and for 60% of operations. The logic behind the hierarchy of the investment sector in the United States is imposed on a global scale in its favoring of high-tech sectors: ICT, pharmaceuticals and biotechnology, health, etc. An identical phenomenon can be observed for CVC. However, the imposition of a logic through a dominant economy does not imply that a single model is being adopted by the European or Asian economies.

| | 2010 | 2014 | Q3 2018 |
|---|---|---|---|
| Invested capital | $8 billion | $24 billion | $100 billion |
| % of total number of deals made | 10% | 11% | 32% |

**Table 2.7.** *The weighting of CVC in the United States, 2010, 2014, and 2018 (source: [VEN 19, p. 50])*

American corporate venture capital represents 90% of the global CVC (the amount of investments from Europe totals 9.5 billion dollars in 2018). This is accompanied by a slower growth in operations, and therefore an increase in their average size. The increase in this investment (+1,150% over 8 years) requires the motivations of large companies to be considered. These are companies that are seeking to consolidate their position on a global scale in the context of constant technological change in the digital economy, and to remain involved in the various rounds of financing in order to complement their internal R&D efforts. The progression in the industrialization of American venture capital is pushing this activity towards high-tech sectors, transforming certain traditional activities (transportation, trade, the decline of shopping malls, etc.) and inducing profound changes in the organization of large companies.

More specifically, beyond the financial returns of the investments made, CVC firms pursue strategic benefits by gaining the opportunity to open "windows" into new technologies, and to amplify these effects by supporting the R&D efforts of the firms in which they invest. The CVC influences companies' R&D efforts in several ways [PAI 17]. Authors Paik and Woo have identified three effects, the first of which is direct corporate governance. The majority ownership of the property (in the case of syndication) allows for strategic influence to be exercized on the start-up receiving the investment, due to a longer investment horizon than that of independent venture capitalists.

The second effect is described by the authors as the CVC venture interaction effect. Large companies provide the companies receiving the investment with access to complementary assets that facilitate their activities in marketing or informing the public. Finally:

> "Relative to established companies, ventures that develop new technologies suffer from greater uncertainty due to a lack of legitimacy [...] and may hesitate to fully commit their resources to R&D. However, when an established incumbent backs the venture's technology with a significant ownership stake, the overall uncertainty can be reduced due to a technology endorsement effect" [PAI 17, p. 675].

In total, the company receiving the investment can spend more of its resources on R&D than it does on marketing. The three mechanisms by

which the CVC can influence the company's R&D investment strategy, produce effects of a different nature. The effect of technology approval reduces ambiguity; it is taken by the market as an indicator the quality of the technology that large companies consider to be "an industrial standard" [PAI 17, p. 675]. By contrast, the other two effects have the effect of increasing R&D investment through the series of internal mechanisms in place within the start-up receiving the investment.

In particular, CVC investment allows the company to benefit from spillovers of knowledge that can come directly from the large company, or indirectly from other operators via the support these operators provide, forming connections with the parent company's developers, legal experts, marketing consultants, etc. The study cited above validates the relevance of the hypotheses concerning the interplay of these three mechanisms in the high-tech sectors: ICT and biotechnology and pharmaceuticals[4].

### 2.1.2. *The trajectory in Europe*

This trajectory is shown in Table 2.8.

| Years | Invested capital | Number of operations |
|---|---|---|
| 2010 | $9 billion | 2,101 |
| 2011 | $10 billion | 2,657 |
| 2012 | $10 billion | 3,223 |
| 2013 | $10 billion | 4,117 |
| 2014 | $15 billion | 4,723 |
| 2015 | $18 billion | 4,378 |
| 2016 | $16 billion | 3,142 |
| Q3 2018 | $24 billion | 3,424 |

**Table 2.8.** *VC financing in Europe (2010–2018) (source: [VEN 19, p. 63])*

4 Another outcome can be determined from this study: "In general, we find that the average number of patents per thousand dollars of R&D expenditures is higher for companies funded by CVC than for companies funded by IVC, exclusively at the level of 1% materiality [...], which suggests that companies funded by CVC benefit from higher productivity in their R&D expenditures" [PAI 17, p. 675].

The decrease in the number of operations during the years 2015 and 2016 is very significant. This decrease is a reflection of a phenomenon of geographical concentration: the venture capital financing ecosystem continues to grow stronger around major European cities, a shift that is occurring in conjunction with greater financing being provided for companies at the later stage. When we look just at Q4 2016 compared to Q4 2015, we notice a 13% decline in invested capital with total activity down 42% [VEN 17, p. 74]. These figures recovered very significantly in the first nine months of 2018. A breakdown of these figures by sector provides us with additional clarification.

| Sectors | 2010 | Q3 2018 |
|---|---|---|
| Software | 13% | 36% |
| Pharma & Biotech | 14% | 15% |
| Media | 2% | 2% |
| ICT equipment | 22% | 4% |
| Services and systems of health care | 10% | 2% |
| Medical equipment and supplies | 9% | 4% |
| Commercial services | 4% | 4% |

**Table 2.9.** *Distribution by sector of venture capital in Europe (2010–2018, main sectors) (source: [VEN 19, p. 66])*

The importance of ICT is increasing, but not enough to close the gap with the United States. Pharmaceuticals and biotechnology remain at a good level ($2 billion in 2016). The number of operations has increased significantly for ICT, from 26% of the total in 2010 to 43% in 2016.

The CVC statistics reflect a phenomenon that is growing, but remains less significant than in the United States, in which the business capital invested has increased from $3 billion in 2010 to $5.5 billion in 2016 and then to $9.5 billion in 2018. The number of operations has increased significantly, from 13% of total investments in 2010 to 17% in 2016, as evidenced by the operations carried out by a few major French groups (see Box 2.1).

"Large companies have long understood that they need to buy start-ups to 'reinvent themselves and speed up the pace of innovation', as the Boston Consulting Group points out in a recent piece on deep-tech, disruptive innovations. More recently, these companies have begun to play the role of venture capital investors, by creating or participating in investment funds known as Corporate Venture Capital (CVCs), similar to what has been done by American digital and Internet players such as Google, Intel, Microsoft or Salesforce.

For the start-up rating agency EarlyMetrics, 'having a share in the capital of a start-up, even just 10% or 15%, gives access to 100% of its skills and technologies'. And it costs 10 times less than carrying out innovations internally. L'Oréal is well aware of this, and has just invested in a fund, Partech Ventures, an investor specializing in new technologies. 'Our goal is to connect with start-ups around the world with high potential, and help finance the most promising among them', this company says.

**A common fund for eco-mobility**

The Partech Ventures fund has also received investments from Renault. Engie has provided its own investment fund with 115 million euros. Total Energy Ventures participated in Sigfox's €150 million fundraising campaign at the end of 2016. No one wants to be left behind, and to make sure there are no missed opportunities, large companies have joined forces around the activities in which they are most involved. For example, Air Liquide, Michelin, Total, SNCF, and Orange have created the European Ecomobility Ventures fund to invest between €0.5 and €5 million in eco-mobility start-ups. The fund has already invested in six start-ups, including two French companies, Ouicar and ez-Wheel. And the movement has only just begun".

**Box 2.1.** *"When the big names in the CAC 40 get in on the venture capital game" (source: [CAU 17])*

### 2.1.3. *The lessons learned*

On the basis of the sectoral configurations and, more generally, the behaviors of the players, two remarks can be made.

#### 2.1.3.1. *The increasing concentration of the funding ecosystem*

This aspect has already been addressed in previous works, but never in the context of Europe. On this point, we will follow the conclusions of the study carried out by the European Investment Fund [EIF 16]. To carry out their analysis, the authors classified the major cities of Europe on the basis of their volume of activity (particularly those related to venture capital investments backed by the EIF) carried out by their start-ups over the past 20 years. A minimum number of investments (20) is required for a city to be classified as a "VC Hub" over the period of 1996–2014. The top six cities are: London, Paris, Cambridge, Berlin, Munich, and Dublin.

Why use the term "hub"? "The use of the word 'hub' for a city with a high level of venture capital suggests its ability to attract, but also radiate, VC investments across multiple ends" [EIF 16, pp. 21–22]. In quantitative terms, the top 20 metropolitan areas represent 39% of the EIF's venture capital investments. But, as the authors point out, hubs are powerful catalysts for investment development, with 83% of all amounts invested originating from the 20 hubs that were considered. This leads to the conclusion formulated in this study: hubs are certainly not the only entities in this ecosystem that exert a gravitational pull, but they constitute the "beating heart" of a complex network of national and international investments that "often cross each other's path, apparently at random" [EIF 16, p. 24]. Indeed, it is noted that 23% of investments remain in the hub, 40% of them go to other locations within the same country, and 37% cross international borders.

Another indicator of the geographical concentration of venture capital can be seen in the fact that the six largest cities in the United States represent 44.5% of total venture capital investment worldwide.

Overall, the financing ecosystem in Europe seems to be evolving towards both greater geographical concentration and greater centralization of decisions as large companies begin to play an active role through CVCs. From a sectoral point of view, the attractive pull of hubs concerns ICT start-ups and service activities (consumption, finance, transport) most specifically. Thus, it is advantageous for these sectors to locate a start-up near these hubs, whereas the agglomeration effects are less obvious in the life sciences and for "greentechs".

### 2.1.3.2. *The particularities of European and American venture capital*

We know that the very pronounced fragmentation of the venture capital market in Europe does not allow this industry to reach the critical size for it to achieve economies of scale. The investments made by European countries reflect the effects of the economic behaviors and social structures that produce strong differences between countries.

| | |
|---|---|
| United Kingdom | 0.046 |
| France | 0.038 |
| Germany | 0.029 |
| Spain | 0.018 |
| Italy | 0.005 |
| European Union | 0.028 |
| United States | 0.211 |

**Table 2.10.** *Venture capital investment rates (as a % of GDP, average 2007–2015) (source: [BUI 16, p. 18])*

The investment gap between Europe and the United States affects the size of operations.

| | |
|---|---|
| European Union | 1.3 |
| United Kingdom | 2.4 |
| France | 2.0 |
| Germany | 0.9 |
| United States | 6.3 |

**Table 2.11.** *Average size of operations (by rounds of financing), in millions of euros, 2007–2015 average (source: [BUI 16, p. 18])*

The average size is significantly smaller in Europe, with US venture capital-backed companies receiving an average of €6.3 million in each round of financing, almost five times more than their European counterparts. In addition, more than 7,750 companies backed by venture capital received

$69.1 billion in financing in the United States in 2016, the highest annual total (after 2015) in 11 years [NVC 18].

The specific differences with venture capital in the US are made clear through a contrast of the breakdown by sector, as shown by the breakdown produced by PwC [PWC 17] (Table 2.12), with the European data given in Table 2.8.

| | **Internet** | **Health** | **Mobile communi-cations** | **Software** | **Consumption and services** | **Others** |
|---|---|---|---|---|---|---|
| Quarter 2 2015 | 46% | 12% | 17% | 6% | 5% | 16% |
| Quarter 3 2015 | 49% | 12% | 16% | 6% | 6% | 13% |
| Quarter 4 2015 | 48% | 13% | 14% | 6% | 5% | 13% |
| | **Internet** | **Health** | **Mobile and telecom.** | **Software** | **Consumption and services** | **Others** |
| Quarter 1 2016 | 45% | 13% | 16% | 4% | 5% | 17% |
| Quarter 2 2016 | 48% | 12% | 16% | 5% | 5% | 14% |
| Quarter 3 2016 | 48% | 13% | 13% | 7% | 7% | 15% |
| Quarter 4 2016 | 48% | 12% | 15% | 8% | 8% | 13% |
| Quarter 1 2017 | 44% | 1% | 14% | 6% | 6% | 17% |

**Table 2.12.** *Allocation of venture capital by sector in the United States (in %, 2nd quarter 2015 – 1st quarter 2017) (source: [PWC 17, p. 19])*

This breakdown offers the advantage of more clearly demonstrating the orientation of venture capital towards the digital economy. In the first quarter of 2017, the Internet and software sectors accounted for 50% of

investment in the United States, a figure that is probably underestimated, given that a portion of the investment in healthcare is in the digital economy.

| Investments ($ millions) | Number of operations |
|---|---|
| **7 887** | 656 |

**Table 2.13.** *Venture capital and "digital health" in the United States (2nd quarter 2015 -1st quarter 2017) (source: [PWC 1.7 p. 21])*

In Figure 2.1, through a breakdown of the capitalization of firms with venture capital backing by sector, we observe that the industries that received the most investment in 2014 are high-tech industries (Apple, Google, or Cisco) and biotechnology (Amgen, Celgene or Genentech).

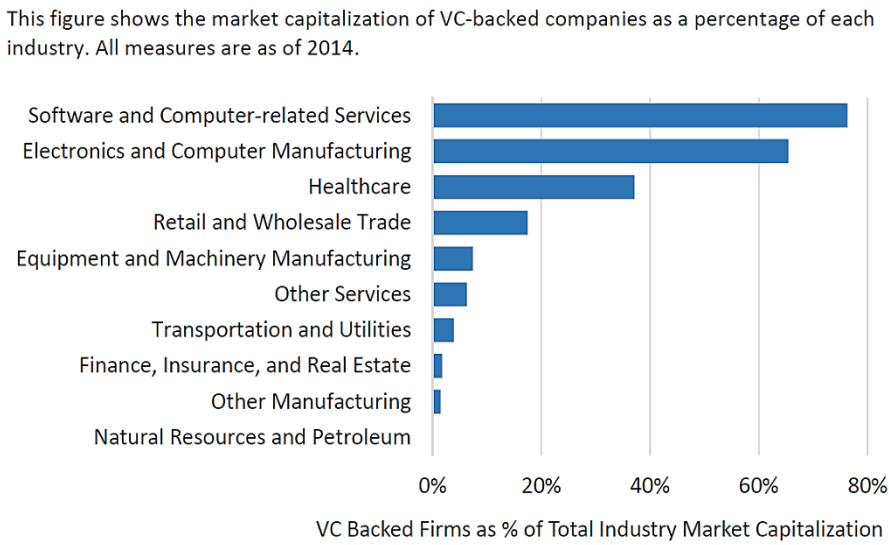


**Figure 2.1.** *Market capitalization of venture capital-backed firms as a % of each industry (source: [GOR 15, p. 10])*

The allocation of greater preferential resources to new technologies would seem to require a more specific analysis of activities in the high-tech fields.

## 2.2. High-tech industries, a less stable group

An analysis of these industries is faced with two difficulties. First, these sectors are supposed to be the sources of innovation in productive systems, and they have been undergoing continual reconfiguration since the 1990s, during the technological revolution in ICT and the Internet. Transformations have accelerated over the past 10 years or so, with the developments that have been made in the digital economy (such as artificial intelligence, Big Data, 3D, etc.). This context of permanent innovation is changing the way these sectors are formed, blurring the lines between them in terms of their desired goals.

Second, the analysis of high-tech industries is done using two main areas of focus. First, the dynamics of these sectors are influenced by macroeconomic and macro-social capacities: public policies, the growth rate, the number of researchers per million inhabitants, the quality of the workforce, the influence of industry, the complexity of exports, etc. The list of these indicators reflects the importance of economic, social, and institutional mechanisms for the production and spread of knowledge. One often-cited example is the relationship between the development of these industries and the extent and quality of a country's industrial base through the processes of expansion, contraction, and transformation this base undergoes.

On the other hand, these industries have their own dynamics. They are embedded in specific innovation systems, and as a result, the innovation processes they spur are carried out on the basis of a group of institutions, networks, and organizations that promote the production of knowledge, the creation of businesses, and the proliferation of highly skilled jobs. However, this does not mean that these sectors form a homogeneous whole. Knowledge- and technology-intensive firms coexist with firms that are less knowledge- and technology-intensive; high-growth firms have innovation processes that, while similar to firms with slower growth patterns, differ significantly, particularly in terms of the connections established with universities and research centers. For slower-growth firms, these relationships are not a major source of information [HÖL 16]. They rely more on internal company information sources and external sources from customers, suppliers and competitors.

The question we are asking here is in two parts. Do innovation policies promoting the development of new knowledge bases have stimulating effects

on the emergence of high-tech sectors and the emergence of start-ups backed by venture capital, to the detriment of existing mechanisms? In other words, what is the influence of macroeconomic policies on venture capital financing in high-tech sectors?

In turn, this leads us to question the influence that high-tech industries hold over macroeconomic performance. We will examine the case of advanced industries in the United States. Then, we will carry out an international comparison to connect certain high-tech sectors and the creation of start-ups.

### 2.2.1. *Knowledge base, high-tech sectors, and venture capital: the macroeconomic influence*

To identify this influence, we use the work of Hopkins and Lazonick [HOP 14] who analyze how the United States accumulates and strengthens parts of its knowledge base on the basis of investments made by three types of organizations: households, governments, and businesses.

Knowledge is a collective good that can be accumulated. This accumulation is done through learning processes that result in the formation of a knowledge base. In particular, the authors consider "the R&D process as an approximation of the collective and cumulative learning through which a high-tech base forms" [HOP 14, p. 28]. This process promotes the growth of high-tech sectors (ICT, biotechnology, clean energy), which differs by activity, and forms an integral part of a system that is not one of innovation on the national level, but is a "global innovation system".

From the standpoint of efforts made by the public sector, Hopkins and Lazonick analyze the role of government agencies that govern the distribution of public R&D funds. At the same time, public programs contribute to the development of a "start-up culture" [HOP 14, p. 42] by providing funding to new companies (SBIR, STTR, ATP programs, etc.). As far as companies are concerned, the division of cognitive labor changes when moving from the Old Economy to the New Economy. Previously, companies mainly carried out internal R&D, partly financed by public funds, to carry out basic and applied research. In the New Economy, research laboratories are scaled back or disappear, giving way to the outsourcing of R&D to start-ups, which these authors claim devote a large part of their

R&D expenditure to developing products. The financing mainly concerns high-risk stages (early stages) to enable these start-ups to overcome technological and commercial barriers[5].

Overall, public and private policies for developing the high-tech knowledge base have fostered the emergence and consolidation of knowledge and technology-intensive activities in the United States, supported by an entrepreneurial model built on and legitimized by the reputation of start-ups backed by venture capital. As a result, the knowledge base is subject to the effects of value extraction (shareholder preference), which drives the restructuring of large companies that innovate on a large scale and on a regular basis[6] – but which, in some sectors such as pharmaceuticals, do not invest enough in basic research.

Hopkins and Lazonick suggest that despite a high level of R&D spending, the arrangements between organizations for investment in the knowledge base have broken down, challenging the collective and cumulative nature of the learning processes that guide the accumulation of knowledge. This, in their view, is the source of the erosion of America's dominance on an international scale.

A criticism of this comes to mind. If learning processes make clear the role of organizations in relation to the market, which is seen as being unable to learn, why not admit that large companies, which often have difficulty exploring new technological paths, *also* learn to use the division of labor within the industrial organization of knowledge production, and to use start-

5 "These start-ups, mainly in the fields of ICT, biotechnology (in particular bio-pharmaceuticals) and clean technologies (e.g. solar energy, wind energy, and electric vehicles), have been able to raise significant capital since the late 1970s in the private equity stages, followed by listings through the issuance of shares if and when they achieve an IPO. When IPOs are not possible, many start-ups seek merger and acquisition (M&A) agreements that provide financial returns for their investors and ensure the start-up's access to the buyers' internal funds" [HOP 14, p. 44].

6 "These are firms such as Western Digital, General Motors, Xerox, Texas Instruments, Qualcomm, Proctor & Gamble, Microsoft, Merck & Co, Johnson & Johnson, Intel, Google, DuPont, Cisco, Apple, Amazon, and Amgen, to name a few. Many of these firms dominate their industries and command considerable influence not only over what kinds of R&D projects are ultimately valued by the economy today (given the technologies they seek to develop), but also over the ways in which educated labor is trained, utilized and rewarded for carrying out their core R&D activities" [HOP 14, p. 48].

ups as a complement to their internal R&D? Especially since large companies, as we have said, are more strongly committed to corporate venture capital in order to strengthen their R&D spending and not to be left behind in the movement toward technological acceleration, particularly in the digital economy.

In addition, the contemporary organization of industries dominated by large companies is increasingly more modular. Large companies externalize their decision-making rights, which is to say, they transfer the design and production of certain modules of knowledge to specialized suppliers. The notion of cognitive modularity proposed by Langlois [LAN 02] refers to the growing process of knowledge specialization and the multiplication of islands of differential knowledge. The transfer of decision-making rights on intangible assets occurs in tandem with the movement to refocus on the core skill sets of companies, and has the effect of focusing the cognitive attention of agents, generating cost savings and efficiency gains and developing *learning*:

> "Cognitive work itself is therefore the subject of an increasingly fine-grained division of the labor process, promoting actions that are carried out by many agents, both inside and outside the firm... In particular, large companies use specialized suppliers (universities, research centers, start-ups, etc.). Particularly in the so-called high-tech sectors, specialized suppliers become responsible for *exploratory* aspects, while established firms assume *exploitation* functions (development, production, marketing)" [GUI 04, p. 25].

However, the complementary relationship between internal cognitive resources (produced by established firms) and external cognitive resources (produced by start-ups, university laboratories, research centers) is not achieved mechanically. It requires fixed costs to be incurred in order for the transfer of knowledge between the sender and the receiver to take place. Fixed costs can be divided into two categories: those for protecting intellectual assets, and, most importantly, those of establishing coordination so that knowledge can be exchanged and commercialized. This requires strong interactions between producers and users, intended to promote the transmission of visible information in the form of technical assistance (know-how, procedures, etc.).

This does not in any way lead to the idea that established firms only play a secondary role in the innovation process. Garcia-Macia, Chang-Tai and Klenow [GAR 16], using US data sets (Longitudinal Business Database from 1976–1988 to 2003–2013), arrive at the following results: established firms are responsible for 81% of the growth in productivity, while incoming firms contribute the remaining 19%. It is true that the authors assess the contribution to growth of the various sources of innovation (creative destruction, synonymous with radical innovations driven by incoming firms and incremental product improvements by incumbent firms) based on an employment dynamic calculated using a specific growth model. The contribution of innovations from newly created firms represents about 25% of growth, most of which is attributed to innovations implemented later by established firms. In this context, it is not surprising that most of the growth is provided by established firms, since "the relative share of employment of incoming firms is modest" [GAR 16, p. 4].

Moreover, the Schumpeterian scheme is essentially dynamic. During the first period, entrepreneurs will launch the first "gazelles" backed by venture capital financing provided either by public programs (Apple, Intel, Compaq, etc.) or by the private financial sector (Microsoft, Digital Equipment, Genentech, etc.). These innovative companies work to renew the core of the American high-tech industry and challenge the industrial and technological supremacy of existing firms. During the second period, they become large companies and concentrate their innovation efforts on a more incremental path. In this way, venture capital financing is at the heart of the redefinition of the productive system in the United States, the rise of high-tech sectors and their increased competitiveness, and, more generally, the high levels of growth that began in the 1980s. A few years later, a massive gap can be seen between the United States and the EU-15, particularly in high-tech activities.

Analyzing the dynamics of high-tech sectors requires considering the complementary forms taken by innovation, which refers to the division of cognitive labor that is particularly marked in high-tech sectors.

### 2.2.2. *The influence of advanced industries on the performance of the US economy*

The topic of advanced industries has been the subject of numerous studies, including the study conducted by Muro *et al.* [MUR 15].

| MANUFACTURING | | ENERGY |
|---|---|---|
| Aerospace Products and Parts | Motor Vehicles | Electric Power Generation, Trans., and Distribution |
| Agr., Construction, and Mining Machinery | Navigation, Measurement, and Control Instruments | Metal Ore Mining |
| Aluminum Production and Processing | Other Chemical Products | Oil and Gas Extraction |
| Audio and Video Equipment | Other Electrical Equipment and Components | **SERVICES** |
| Basic Chemicals | Other General Purpose Machinery | Architecture and Engineering |
| Clay Products | Other Miscellaneous Manufacturing | Cable and Other Subscription Programming |
| Commercial and Service Industry Machinery | Other Nonmetallic Mineral Products | Computer Systems Design |
| Communications Equipment | Other Transportation Equipment | Data Processing and Hosting |
| Computers and Peripheral Equipment | Pesticides, Fertilizers, and Other Agr. Chemicals | Medical and Diagnostic Laboratories |
| Electric Lighting Equipment | Petroleum and Coal Products | Mgmt., Scientific, and Technical Consulting |
| Electrical Equipment | Pharmaceuticals and Medicine | Other Information Services |
| Engines, Turbines, and Power Trans. Equipment | Railroad Rolling Stock | Other Telecommunications |
| Foundries | Resins and Synthetic Rubbers, Fibers, and Filaments | Satellite Telecommunications |
| Household Appliances | Semiconductors and Other Electronic Components | Scientific Research and Development |
| Industrial Machinery | Ship and Boat Building | Software Publishers |
| Iron, Steel, and Ferroalloys | Medical Equipment and Supplies | Wireless Telecommunications Carriers |
| Motor Vehicle Bodies and Trailers | Reproducing Magnetic and Optical Media | |
| Motor Vehicle Parts | | |

**Figure 2.2.** *The 50 components that make up the advanced industries sector (source: America's Advanced Industries [MUR 15, p. 3])*

According to the authors of this report, the influence exerted by these industries is considerable. In 2013, this sector provided 12.3 million jobs (9% of total employment) and the added value it created represented 17% of the GDP, 90% of private sector R&D, 85% of all patents, and 60% of exports. It employed 80% of the country's engineers.

In addition, advanced industries have a high employment multiplier coefficient, with each new job added creating 2.2 additional jobs:

> "This means that in addition to the 12.3 million workers employed by advanced industries, 27.1 million American workers owe their jobs to economic activity supported by advanced industries. In this way, when taken both directly and indirectly, the sector supports nearly 34 million jobs, or nearly a quarter of total employment in the United States" [MUR 15, p. 3].

Since 2010, there has been accelerated growth in this industrial grouping, with employment and output growth rates 1.9 and 2.3 times higher than average. In particular, advanced services created 65% of new jobs (IT service design alone created 250,000 jobs). Its labor productivity is higher than in the rest of the economy ($210,000 compared to an average of $101,000). Advanced industries tend to create ecosystems within large metropolitan areas. However, in many places, the capacity of some ecosystems has been eroded after several waves of offshoring and disinvestment.

Figure 2.2 breaks this sector down into three groups: 35 industrial activities, 3 energy-related activities, and 12 service activities (R&D, software, telecommunications, etc.). In a way, this system of grouping is a reconfiguration of high-tech activities, basing them on inputs and processes that create value. Traditional categorizations lost their meaning when the influence of digital technologies was released on the economy:

> "For that matter, an auto company like Tesla Motors has an occupational profile similar to a software company. Against this backdrop, the delineation of a single, high-value, advanced industries sector – defined by its innovation and workforce assets and characterized by its converging technologies and business models – help keep the focus on what matters at a moment of extraordinary economic change" [MUR 15, p. 13].

Advanced industries are characterized by two variables:

– R&D expenditure/employment > 450 dollars. This ratio ranks advanced activities in the top 20% of all industries, and is considered a significant factor in technological innovation and economic growth through the direct and indirect effects (spillovers) it produces. The advantage of this ratio is that work and R&D are inputs into the production process, while the added value, achieved in the traditional R&D/VA ratio, is an output. In this way, the approach is homogeneous and makes it possible to highlight a coherent set of "high value" economic activities, identified from fixed assets;

– the proportion of jobs in the STEM category must be > 21%. "STEM [science, technology, engineering, and mathematics] workers are closely involved in both the development of new techniques and technologies and in the adoption and spread of these technologies" [MUR 15, p. 20].

As they develop, advanced industries tend to form regional ecosystems centered on knowledge, skills, and innovation capacities. These elements indicate that:

> "Competitiveness is not exclusively microeconomic in nature, and this competition moves toward intermediate levels consisting of localized clusters of companies and institutions. The meso-economic rules of the game imposed by globalization are as follows: the technologies, knowledge, and skills found within one location must necessarily be different from those found in the other areas of concentration, otherwise they become 'commodities'. Above all, it is an issue of carrying out unique outputs of research, products, and services" [GUI 17a, p. 29].

This movement involves public players who devise forms of collaboration in such a way that public sector R&D can be effectively applied to bring it closer to commercialization and the market. For their part, large companies build accelerators for start-ups in order to accelerate technological developments in adjacent markets. In addition, within these ecosystems, innovation centers help start-ups by providing support, advice, and access to venture capital. This is achieved by connecting entrepreneurs with VC funds in an innovation plan that increasingly embraces the configuration of platforms that bring together different agents (universities, laboratories, funders, entrepreneurs, etc.) to formulate and solve problems

that exceed the individual capacities of a single company. In this way, the ambiguity of some innovative projects is reduced.

We will make two remarks to conclude this section:

– R&D expenditures are only a fraction of total innovation expenditure, which includes, in addition to internal and external R&D, the purchasing of new capital goods, the purchasing of external knowledge, and the marketing and training expenditure required by the introduction of new products and processes. The analysis of advanced industries supports this idea by suggesting that organized ecosystems represent "the collective infrastructure of the innovation process" [GUI 17a, p. 122], in which partnerships are defined, tests are carried out, advice is provided, and access to venture capital financing is facilitated. Innovative start-ups find it necessary to access external knowledge and protect their knowledge by formal processes (patents) in order to create indicators to be seen by investors.

– another study presents a different configuration of the high-tech sector in the United States [WOL 16]. It includes 33 manufacturing industries and 12 service activities. In 2014, this total represented 17 million jobs (12% of total employment) and 23% of the country's production. The identification of high-tech industries is based on a single criterion, that of the jobs held by STEM workers in each area of activity. STEM jobs represent 5.8% of all jobs, the authors apply a coefficient of 2.5, and when the 14.5% threshold of jobs held by STEM workers is reached, the industry in question is considered as high-tech. In 2014, high-tech services accounted for 52.6% of high-tech employment, compared to 17% for high-tech manufacturing industries, with the rest being located in agriculture, mining, public services, etc.

### 2.2.3. *Business creation, growth thresholds, and the new technology sector*

Many studies have concluded that European high-tech industries are relatively small in comparison with American industries in the same sector. This conclusion has been particularly well established in the ICT sector [ART 16]. This originates from the fact that providing financing for these companies faces specific challenges. A comparison with the United States provides a clear demonstration of this fact.

In the first chapter, we noted the transformations undergone by the entrepreneurial financing ecosystem upstream of venture capital players by

highlighting the role played by business angels as a kind of substitute for venture capital in the early stages of corporate financing. The influence of informal investors is becoming increasingly important, particularly in the United States, as shown in Table 2.14.

| Country | 2005 | 2010 | 2015 |
|---|---|---|---|
| United States | 22,700 | 265,400 | 304,930 |
| United Kingdom | – | 4,555 | 8,000 |
| France | 1,600 | 4,250 | 10,000 |

**Table 2.14.** *Number of business angels (United States, United Kingdom, France; 2005–2010–2015) (source: [ART 16, p. 2])*

*Business angels* form part of "a group that can be categorized somewhere in between informal founders, 'friends and family' financing, and formal VC investors" [WIL 15, p. 6]. According to this author, the life cycle of a company can be represented in terms of the stages it goes through and the financing methods that it receives. This makes it difficult to manage the options offered by the various financing instruments at each stage that allow the thresholds of growth to be crossed.

There are several interconnected factors that can explain the gap between American and European trajectories. First, it should be recalled that there are significant differences in venture capital investment rates (*stricto sensu*) (see Table 2.10). Considering the outstanding funds for 2010 and 2015 reinforces this claim.

| Country | 2010 | 2015 |
|---|---|---|
| United States | 23.5 | 60.1 |
| United Kingdom | 0.7 | 1.9 |
| Germany | 0.0 | 1.5 |
| France | 1.2 | 1.5 |
| Spain | 0.2 | 0.1 |
| Italy | 0.0 | 0.1 |

**Table 2.15.** *Outstanding funds ($ billion), United States and European countries, 2010–2015 (source: [ART 16, p. 2])*

These disparities are highlighted even further during the exit process. The low number of new companies that are able to carry out IPOs is a relevant indicator of the difficulties these companies experience in obtaining the

additional financing needed for them to grow. With the exception of the United Kingdom, European financial markets are lacking in depth, and do not have sufficient liquidity for high-growth securities. The risk is that venture capitalists will quickly sell companies that are not sufficiently consolidated, since they do not expect satisfactory financial outflows on the stock market.

| Country | 2010 | 2015 |
|---|---|---|
| United States | 1,110 | 1,210 |
| United Kingdom | 507 | 537 |
| Germany | 141 | 111 |
| France | 92 | 109 |
| Italy | 52 | 73 |

**Table 2.16.** *IPOs, number of transactions, United States[7], European countries, 2010–2015 (source: [ART 16, p. 4])*

The difficulties in growing businesses are not in contradiction with the high number of new business start-ups in Europe and, in particular, in France (Table 2.17).

However, the increase in the number of start-ups has not led to the consolidating of the new technologies sector, and, more specifically, the NICT sector, whose contribution to total production remains low in France (Table 2.18).

| Country | 2010 | 2015 |
|---|---|---|
| United States | 0.24 | 0.29 |
| United Kingdom | 0.38 | 0.54 |
| Germany | 0.38 | 0.31 |
| France | 0.99 | 0.62 |
| Spain | 0.61 | 0.75 |
| Italy | 0.51 | 0.54 |

**Table 2.17.** *Number of new business start-ups (as a % of the total population), in the United States and European countries, 2010–2015 (source: [ART 16, p. 4])*

7 In the United States, between 2010 and 2018, IPOs "remain the main extreme valuation factor for 'unicorns' in their early stages. However, despite the existence of these overvaluations, mergers and acquisitions remain the most common course of action given the volumes of revenue that are achieved" [VEN 19, p. 53].

| Country | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|
| United States | 5.85 | 5.71 | 5.67 | 5.81 | 5.85 |
| United Kingdom | 4.99 | 5.18 | 5.10 | 5.16 | 5.19 |
| Germany | 4.54 | 4.73 | 4.74 | 4.87 | 4.94 |
| France | 4.57 | 4.43 | 4.36 | 4.29 | 4.13 |

**Table 2.18.** *Added value of NICTs (as a % of total VA) (source: [ART 16, p. 4])*

There are two points to be made about statistics. The breakdown by sector is different from that used in the previous tables; it is based on data from the OECD and Natixis. The list of advanced industries (see section 2.2.2.2) is based on a finer-level breakdown (four-digit, NAICS Code) and includes total production and not the added value, as in Table 2.18.

In addition, the gap between the United States and France widened between 2010 and 2014 (from 1.28% to 1.7%), which suggests a higher level of fragility for this sector in France.

### 2.2.4. *Elements of explanation*

The high level of sensitivity to macroeconomic and macro-institutional frameworks and the difficulty of accessing complementary productive resources would appear to be the defining features of young innovative companies. In addition, the costs and constraints of innovation take a particular form in high-tech industries.

#### 2.2.4.1. *Sensitivity to macroeconomic and macro-institutional frameworks*

There are no statistics for venture capital-backed start-ups on their own. Given this constraint, we look at companies with high growth potential (high-growth firms or HGFs; see the introduction to this chapter). The document produced by the European Commission [HÖL 16] states that HGFs are spread throughout all sectors, but are over-represented in the knowledge-intensive services sector. HGFs are defined as companies that have an annual growth rate of 10% or more for three years and have 10 employees at the beginning of that period. In Europe, HGFs represent 10.4% of the business population and 14.7% of employment over the recent period[8].

8 The influence wielded by HGFs is also affected by developments in demand. If we reduce the *gap* between real and potential GDP (output gap) in the share of HGFs, we can see that

On average, European countries have a larger proportion of slow-growing and stagnant firms than the United States. This phenomenon is not only due to the inadequacy of projects to generate innovation. More than anything else, the differences between countries and large regions also depend on favorable institutional conditions (entrepreneurship, the quality of the workforce, legal and administrative regulations, etc.) and the patterns of specialization, all of which reflect a country's ability to embrace and benefit from radical technological change [HÖL 16, p. 251].

These considerations are much broader in scope than a narrow focus on start-ups. Still, they reveal the importance of the quality of the knowledge base (R&D indicators, etc.) and the importance of institutional variables. As far as R&D is concerned, we know that the differences between Europe and the United States are an outcome of specific business demographics. The further down we move in the distribution of companies by size, the more we notice a very significant presence of American companies that invest in R&D. R&D therefore appears to be a crucial indicator, with the potential to transform a small company into a high-growth firm with the ability to become an important player in its sector.

Let's explain how this mechanism works. In the US, small companies invest more in R&D than their European counterparts, and are concentrated in the most R&D intensive sectors [VEU 15]. The lack of innovative start-ups ("yollies" – young leading innovators) in innovation-based growth sectors is the main source of the lack of innovation in Europe. The authors observe a very high level of inertia in R&D performance in Europe, and this persistent innovation gap is correlated to the industrial structure:

> "New firms fail to play a significant role in the innovation dynamics of European industry, especially in the high-tech sectors. This is illustrated by their inability to enter the market, and more importantly, for the most efficient innovative entrants to grow to world leadership. The churning that characterizes the creative destruction process in a knowledge-based economy encounters significant obstacles in the EU, suggesting barriers to growth for new innovative firms that ultimately weaken Europe's growth potential… This inability of new European

this gap is associated with a lower share of HGFs in times of crisis or cycle reversals, while in periods of expansion, this share increases [HÖL 16, p. 252].

> firms to grow large seems to manifest itself particularly in the high-tech, high-growth sectors, most notably in the ICT sector" [VEU 15, p. 6].

It is also noted that there is a lower degree of specialization of the European economy in high-growth and R&D-intensive sectors. In the United States, 35% of total business R&D is carried out by yollies, compared to 7% in Europe. When considered in their own right, European yollies are no less R&D-intensive than their American counterparts in certain sectors, but they most often operate in less R&D intensive sectors. The structural effect is due to the lower presence of yollies in "innovation-based growth sectors"[9]. The burden of financial constraints, both internal and external, are the main barriers to innovation. These come in addition to the cultural barriers related to the degree of social acceptance of innovations, administrative constraints, a lack of skills, and the difficulties in forming partnerships. Given these considerations, there are two recommendations that are of particular interest to us: embedding venture capital in a global innovation policy, and promoting an integrated market for this mode of financing so as to achieve a critical size that alone can make it "viable, fluid, and dense" [VEU 15, p. 9].

#### 2.2.4.2. *The sensitivity of innovative companies to cash flow and R&D performance*

Like many authors, we address the problem of the behavior of innovation in Europe and the United States by analyzing the difficulties of accessing external financing for innovators who are not small start-ups facing risky projects. The sensitivity of R&D investment to cash flow reveals the intensity of financial constraints [CIN 15]. Yollies are more sensitive to the availability of internal financing (in the case of start-ups, internal financing can be assimilated to the resources provided by the entrepreneurs, their families, or even business angels) and, as a result, they face increased financing constraints. The study shows that this greater sensitivity exists only for European yollies, particularly in the medium and high-tech sectors.

In a study already mentioned, Cincera and Veugelers [CIN 13] put forward an explanation that is made in terms of the rate of return on R&D

9 In short, everything that is related to ICT and health: biotechnology, computer hardware & services, HC equipment & services, Internet, pharmaceuticals, software and telecom equipment, etc.

investments to justify the low density of European yollies, particularly in high-tech sectors. As we can see, these firms have higher rates of return than the average for innovative firms, and it is in the United States that the gap is most pronounced between the yollies and the average innovator[10]. For Europe, the results are not significant. In this context, European policies must go beyond reducing administrative barriers for innovative start-ups. Indeed, low rates of return reduce the level of appetite for highly innovative risky projects. Low rates of return with respect to the risks involved have the effect of blocking venture capital investments. As the authors point out, the problem is not simply a lack of venture capital supply.

#### 2.2.4.3. *The difficulty of accessing additional resources*

The issue facing Europe is how it can efficiently channel productive resources towards high-tech firms with high growth potential. The differences with the United States, as we have said, lie in the difficulties new European companies have in crossing growth thresholds. Over the period from company creation to age 35, employment increases by a factor of 10 in American companies and by a much smaller factor in Europe. The growth of firms in the United States is driven by a more dynamic distribution, in which the most dynamic firms grow faster, while those that are less dynamic contract faster. The differences observed could reflect a higher degree of experimentation and learning through practical experience among incoming American firms. These differences are more pronounced in high-tech and emerging sectors, where the need to experiment and increase investment in knowledge capital (computer data, design, brands, organizational know-how, etc.) is more pressing.

In other words, the difficulty in capitalizing on the growth of the new technologies sector faced by Europe, and France in particular, can be attributed to the obstacles faced by young innovative firms when seeking access to complementary resources to test their ideas (prototypes and business models), to develop marketing strategies and to produce on an economically viable scale. In this context, their location within innovation ecosystems can provide an answer to this problem, but this requires better targeted industrial policy measures.

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10 In this study, yollies are companies created after 1990 and which have a particularly strong presence in the high-tech sectors. The sample consists of 363 companies: 218 are American, 59 European, 3 Japanese, and 83 are from the rest of the world.

On a broader level, we must consider the process of reallocating productive resources to its full extent and remember that firms that produce patents attract twice as many jobs to the United States as they do to the average OECD country. The literature indicates that there are several factors that influence this process: the quality of resources, the quality of the legal and administrative environment, the transmission of information between producers, and the intensity of competition [SYV 14]. The combined interplay between these elements causes considerable changes in the economic fabric. Syverson indicates that in the United States, the standard deviation of sales growth rates can reach 50%, which means "that in a typical year, fully one-third of firms can expect to see their revenues grow very quickly (by 60% or more) or shrink very quickly (by 40% or more)" [SYV 14, p. 3]. Strong surges cause high entry and exit rates that reallocate economic activity in a direction that most often rewards high-productivity firms. Of course, these variations primarily concern young innovative companies for which the selection process is even more marked due to the wide dispersion of performance in terms of level and variation. The consequence is not insignificant since the strong growth of successful companies consolidates the sectors, especially the high-tech sector, in which they operate.

#### 2.2.4.4. *The costs and constraints of high-tech investment*

From the point of view of venture capital investment, high-tech activities have both similarities and differences with other activities.

The constraints of funding have already been mentioned. Innovation is an inherently uncertain process. Innovation returns are extremely biased, requiring specialized intermediaries who make use of their instrumental and interpretative knowledge to determine whether or not to invest [KER 14b]. Information imbalances are high, and these firms have no history. Finally, companies have a high percentage of intangible assets, with knowledge embedded in human capital and patents.

Investment levels vary widely in high-tech sectors, a fact which is linked to the marketing of new concepts that are declined to form a system within a wave of new technology. As Kerr *et al.* point out, "the actual distribution of returns in such ventures (notably those linked to high-tech sectors) has a low medium value but very high variance" [KER 14a, p. 3]. This means that the majority of venture capital investments are failures and, in this context, an

institutional environment that facilitates experimentation is crucial to maintaining a dynamic entrepreneurial ecosystem and reducing the ambiguity around innovative projects.

The authors mentioned above identify three reasons why the experimentation process is primarily characteristic of high-tech industries. First, VC firms need to experiment and their business model facilitates experimentation – especially in sectors that are "capital-efficient". The relevance of certain financial commitments and the subsequent scaling up of such commitments (e.g. ICTs) should both be tested. Secondly, the costs of experimentation have dropped sharply in the high-tech sectors (ICTs, software, computer simulations, etc.) and "the frequency with which one learns new information about the product is very high" [KER 14a, p. 15]. Finally, more generally, the experimentation approach makes it possible to approach venture capital in a less banal way. VC firms do not simply put together a portfolio of early-stage start-ups and entities that take risks that they seek to reduce by distributing it; they carry out numerous tests based on knowledge that is still intuitive and uncertain. Their behavior is most akin to sequential investors, which reserve the possibility to invest more at a later date. From this perspective, syndication and staged financing are part of the overall experimentation process.

The main issue is the emergence of radical innovations and the expected consequences this has for industries and forms of organization during certain periods.

At the end of the second stage of this chapter, there are two remarks that emerge:

– the dynamics of high-tech sectors are at the heart of the renewal of the productive fabric in the United States and are driven by the emergence of young, innovative companies. The related selection process leads to the elimination of the least efficient companies, and the consolidation of those most likely to attract additional productive resources and continuously improve their own skills [SYV 14]. This form of competition results in a small number of winners, and therefore gives rise to quasi-monopolistic markets (Microsoft, GAFA). Venture capital is permeated by a two-way logic [GUI 17b]. When the initial high-risk project carried out by the entrepreneur and financially supported by the venture capitalist is successful, the growth of the companies helps drive growth in the sector or sectors they

are part of, while creating monopoly rents and promoting the abuses of a dominant position (see the case of Google). Moreover, in the case of digital platforms, these take the form of private governance structures that encroach on existing institutions. Triggered by algorithms, they define a number of rules that transform the production and distribution formats of certain services (i.e. Uber, Airbnb, etc.). In a way, these rules define "what can be done by whom and under what terms" [KEN 16]. As Kenney and Zysman point out, these organizations tend to give precedence to the computer code created by the platform over legal codes, particularly in the area of labor law.

It is easy to understand why digital platforms would be linked to venture capital financing. Langley and Leyshon [LAN 16] identify two effects in particular. First, the platform's business model improves the time structure of venture capital funds because returns are obtained more quickly. The accelerated expansion of the scale of operations, the construction of a niche around a network of multiple markets (a "multi-sided market network"), and the ease of sharing and carrying out transactions made possible by digital connections, create network effects that promote the economic scale-up of the platform:

> "In terms of time structure, venture capital funds are therefore managed by the platform's business model, precisely because this model is built on the revenue streams that can be generated by the rapid evolution of platforms. To borrow the expression of Feng *et al*. applied to the Internet boom, the platform's business model specifies the 'variable form of the relationship between innovation [supported by venture capital] and the cost recovery [for investors] under the current form of capitalism'. When the business model makes extracting rents viable for the platform's rapidly evolving intermediaries, the growth trajectory of start-ups is achieved, and it is valued by venture capital and leads to a situation of liquidity." [LAN 16, p. 14]

Second, the business model of the business platform improves the composition of the portfolio of the venture capital funds. This model explicitly coordinates network effects to create revenue. The explanation scheme borrows both from the processes of experimentation and selection of venture capital before reaching the market (see above) and from the efforts made by platforms to ensure their dominance in their own market niche. This is a form of market selection that takes the form of acquisitions of small

rivals, or the implementation of strategies aimed at strengthening market positions. In this case, the extraction of rents by the platforms is in line with the strengthening of oligopolistic and even monopolistic trends in the intermediary process. This is the logic of "winner takes all": "Platforms seek to extract rents from their network, which are essentially monopoly rents" [LAN 16, p. 15]. Inevitably, public policies will be needed to oversee the deployment and operation of these structures. In some cases, they should not hesitate to dismantle these quasi-monopolies in order to reproduce areas of competition where necessary.

We did not mention venture capital investments in the clean-tech sector. These have grown since the late 1990s, with their volume and number of transactions increasing from 1995-1 to 2008-3 before falling sharply in 2009 [SHA 13]. Between 2011 and 2016, investments fell by almost 30%, and their share in total venture capital increased from 16.8% in 2011 to 7.6% in 2016 [DEV 17]. Venture capital has two aspects in this sector: it is highly concentrated in a few metropolitan areas, and is mainly present in the late stage and in a few technological areas such as energy efficiency, solar, and transportation. However, these fields have technological foundations closely linked to traditional software areas in total venture capital. These technologies are less capital-intensive than other clean technologies, have a shorter time frame, and can be applied to a wide range of products and services [DEV 17, p. 7].

For these authors, traditional venture capital is poorly suited for clean-tech sectors for two reasons. On the one hand, the literature has reported a gap between venture capital and clean technologies [KER 14b]. The capital invested and the duration of the investment required for learning about the viability of a project are so high "that innovative projects with great potential are not carried out without the support of the government" [KER 14b, p. 12].

On the other hand, budgetary restrictions in the United States have created considerable uncertainty in this area. One possible solution is to strengthen public-private partnerships, as these forms of organization increase laboratory participation in the commercialization, entrepreneurship, and operation of local innovation systems. In addition, "technology-to-market" programs facilitate private sector access to technical leadership and expertise found within national laboratories and renowned research institutes. Thus, new forms of organization are needed, which will have to base project financing on three aspects, namely an increased time horizon,

adequate incentive structures, and mission-based investment strategies [DEV 17, p. 11].

The first two sections of this chapter have presented a collection of materials showing the interest that should be paid to the high-tech sectors. Intensive in technology and knowledge, these sectors are at the root of the what are often radical disruptions introduced into the fabric of the production system. They have polarized a large fraction of venture capital investment for more than 20 years, particularly in the United States, and their growth cannot be separated from the dynamics of innovative start-ups. Their sensitivity to the macroeconomic and institutional framework, their R&D behavior, and the conditions for the entry and exit of firms seem to indicate a specific configuration of venture capital investment in these sectors, which we will model within the context of European countries.

## 2.3. An econometric model for determining high-tech investment in Europe

The creation and development of high-tech firms are a major challenge that European countries must face in order to improve their capacity for innovation.

How are European countries addressing this problem? Does intangible capital play a key role in the growth of the sectors considered?

It should be noted that, given the constraints of the available statistical information, we did not consider venture capital, but instead private equity (PE)[11]. Indeed, to our knowledge, the declination of the variables representing human capital (R&D, full-time R&D personnel, per capita R&D personnel, etc.) only exists for private equity. It should be recalled that

11 "[EVC 11] provides data on PE capital invested in high-tech companies, defined as having 'exclusive ownership of certain intellectual property rights (such as design rights, patents, copyrights, etc.) that are critical to adding value to a company's products and activities, and which are developed internally by its permanent team" [EVC 11, p. 7]. EVCA points out that "although companies with these attributes are not limited to specific industries, they are most often found in telecommunications, Internet technology, computer equipment, computer software and services, electronics, semiconductors, biotechnology, nanotechnology, medical instruments, and devices" [EVC 11, p. 7]. The developments in this section use the work published in [GUI 16b].

private equity includes venture capital, and extends it to investments in more mature companies with high growth potential.

### 2.3.1. *The approach used: the analytical framework and assumptions made*

To analyze the factors for determining PE investment in high-tech sectors (HTPE), we took the approach used by the Industrial Organization (I/O), based on three factors: market structures-behavior-performances [SCH 80]. In this nested scheme, performance is the result of the behavior of companies, which in turn is conditioned by the structure of the industry and the nature of the basic conditions. What influences do the basic conditions exert on the industry being considered and the behavior of PE firms?

The basic conditions are traditionally considered from the point of view of supply and demand. Supply is considered to be provided by fund management firms that raise capital from investors (banks, pension funds, insurance companies, etc.), and the demand comes from companies that may receive capital investments. We consider that the determining factors of investment are composed of four elements: the macroeconomic framework, the institutional framework, the exit conditions of the companies receiving the investment, and the dynamics of innovation:

– to assess the macroeconomic situation, the first basic condition is economic growth. A favorable situation of economic growth encourages capital providers to invest more in PE firms, which increases their investment capacity. For their part, the entrepreneurs increase their demand for financing [GOM 98, FEL 13]. Economic growth is thus a favorable condition for investment, on both the supply and the demand side (H1);

– the second macroeconomic indicator is the interest rate. Suppliers face a trade-off between investing in PE and venture capital funds and making alternative financial investments repaid at the prevailing interest rate [GOM 98, BON 12]. In this context, a high interest rate can penalize the PE's activity. From the demand side, the interest rate determines the choice of financing between equity and debt for companies. High borrowing costs will accelerate the demand for equity capital. The overall impact of this variable thus depends on the predominance of an effect of supply or demand: if the influence is $< 0$, the supply effect prevails (H2a), if it is $> 0$, the demand effect is required (H2b). From this, there are, three assumptions that characterize the overall macroeconomic context:

H1: economic growth has a positive impact on HTPE investment.

H2a: the interest rate has a negative impact on the HTPE investment.

H2b: the interest rate has a positive impact on the HTPE investment.

– the institutional environment is basically favorable to equity financing. From a regulatory point of view, the institutional framework corresponds to the legal and tax-related regulations that govern the behavior of agents, that is PE firms, investors, and entrepreneurs. Again, this is a basic condition that affects both the supply and demand for financing. For the HT segment, we assume that a favorable legal and tax framework has a positive impact on investment in companies of this type (H3). To our knowledge, this hypothesis has not been tested in the literature.

H3: a favorable legal and tax environment has an impact > 0 on HTPE investment;

– the exit conditions are another determining factor to be considered. The risks faced by PE firms and investors are essentially that of not recovering their capital, or that of obtaining insufficient profits. In this context, the existence of actionable exit mechanisms is crucial for the development of this industry. More specifically, market-based systems, which generally correspond to deep and structured financial markets, provide exit opportunities for fund management companies via public offering (PO) of investee companies, thereby promoting private equity and venture capital activities on the supply side [AMA 99, ARM 04]. Moreover, on the demand side, the importance of initial PO gives entrepreneurs "an additional incentive to start a company" [JEN 00]:

> "Regarding HT companies in particular, there are specific stock markets that can accommodate these companies, such as the NASDAQ in the United States. It should be noted that the exit opportunities for private equity firms are not limited to stock markets, including in countries with market-based financial systems. Indeed, trade sales (TS), corresponding to the sale of the shares held in investee companies to industrial corporations, also constitute an exit mechanism with high potential, considered by Félix *et al*." [FEL 13]. [GUI 16b, p. 447]

Thus, we assume that good exit conditions, whether in general or specifically for the exit channels used (notably PO and TS) positively

influence the HTPE investment (H4). In their work, the authors conclude that there is a positive impact on venture capital investment of the total offering proceeds raised by IPO companies, and the value of the mergers and acquisitions (MA) transactions made. More precisely, the extent of the impact of the context of the exit on HTPE investment is differentiated according to the exit channels used, with the influence of the PO exit being stronger than that of the trade sale exit (H5). This assumption is justified by the fact that private equity financing and stock markets are closely linked. This relationship is well-established in the literature. This leads to the following assumptions:

H4: a favorable exit context (IPO or TS) has an impact > 0 on HTPE investment.

H5: the intensity of the impact of this variable is differentiated according to the exit channels used, with a greater influence of the PO exit compared to the TS exit;

– finally, innovation is a basic condition on both the demand and the supply sides [FEL 13]. It expands entrepreneurial opportunities, thus increasing the demand for financing. In addition, it has the potential to attract investors and PE firms, particularly to companies in the high-growth HT segment. The dynamics of innovation can be assessed on the basis of R&D expenditures, the human resources employed in the R&D activities, and the outputs of this activity (patents). The human resources in R&D can be assessed by taking into account all R&D personnel or, more restrictively, only researchers. All these indicators can be used on all PE segments or exclusively on the HT segment.

In general, we assume that the dynamics of innovation, considered in these different aspects, has a positive impact on HTPE investment (H6). The indicators related to the HT segment have a stronger impact on these investments (H7). Finally, we hypothesize that research resources have a higher impact than total R&D personnel, whether in all segments or only in the HT segment (H8). Researchers may be seen as repositories of the tacit and explicit knowledge necessary for innovation.

H6: the dynamics of innovation, as measured by R&D expenditure, total R&D personnel, researchers, and patent applications, in general or in the HT segment, have an effect > 0 on HTPE investment.

H7: the impact of the innovation indicators defined on the HT segment alone is more significant on HTPE investment.

H8: The impact of research resources on HTPE investment is greater than that produced by total R&D personnel, for all fields and for the HTPE segment.

### 2.3.2. *The econometric model*

We will first present the model variables, then the analytical structure of the model, and finally the results obtained and the discussions they generate.

#### 2.3.2.1. *The variables selected*

This econometric study is carried out on a sample of 17 European countries: Austria, Belgium, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Netherlands, Poland, Portugal, Spain, Sweden, and United Kingdom. Due to the limited availability of certain data, the period examined is 2002–2009.

The list of variables is shown in Table 2.19.

| Variable | Definition | Role | Expected sign |
|---|---|---|---|
| Macroeconomic Variables | | | |
| $GDP_{t-1}$ | Real GDP growth rate (delayed by one year) (*Eurostat*) | Measures the influence of economic dynamics (H1) | + |
| $Int_{t-1}$ | Ten year government bond yields (delayed by one year) (Eurostat). | Emphasizes whether the interest rate appears as a trade-off criterion from the point of view of investors or companies (H2a, H2b). | -/+ |
| Institutional Variable | | | |
| $Inst_t$ | Index of the legal and tax environment that favors the development of PE and VC, and entrepreneurship (a weak index indicates a more favorable environment) (*EVCA*). | Assesses the influence of the institutional environment (H3). | - |

| Variable | Definition | Role | Expected sign |
|---|---|---|---|
| Exit variables | | | |
| $ExitTot_{t-1}$ | Total PE divestments divided by GDP (delayed by one year) (*Eurostat*). | Evaluates the impact of the overall exit context (H4). | + |
| $ExitPO_{t-1}$ | PE divestments by PO (public offering) divided by GDP (delayed by one year) (*Eurostat*). | Evaluates the impact of the exit by PO (H4) (H5, *ExitPOt-1>ExitTSt-1*). | + |
| $ExitTS_{t-1}$ | PE divestments by TS divided by GDP (delayed by one year) (EVCA). | Evaluates the impact of exit by TS (H4). | - |
| Innovation variables | | | |
| $RD_{t-1}$ | BERD (Business Enterprise Research and Development) expenditure divided by GDP (delayed by one year) (*Eurostat).* | Identifies the impact of financial resources invested in BERD (H6) (H7). | + |
| $RDHT_{t-1}$ | BERD expenditure in the HT sector divided by GDP (delayed by one year) (*Eurostat*). | Identifies the impact of financial resources invested in BERD in the HT sector (H6). | + |
| $Perso_{t-1}$ | BERD personnel in full-time equivalent per inhabitant (delayed by one year) (*Eurostat).* | Measures the impact of total human resources employed in R&D (H6). | + |
| $PersoHT_{t-1}$ | BERD personnel in HT sectors in full-time equivalent per inhabitant (*Eurostat).* | Measures the impact of total human resources employed in BERD (H6) (H7 $PersoHT_{t-1} > Perso_{t-1}$). | + |
| $Research_{t-1}$ | BERD researchers in full time equivalent per inhabitant (delayed by one year (*Eurostat).* | Evaluates the impact of human resources in terms of the researchers employed in BERD. (H6) (H8). | + |

| Variable | Definition | Role | Expected sign |
|---|---|---|---|
| $ResearchHT_{t-1}$ | BERD researchers in HT sectors in full-time equivalent per inhabitant (delayed by one year (*Eurostat)*. | Assesses the impact of human resources in terms of researchers employed in BERD in the HT sectors (H6) (H7 $ResearchHT_{t-1} > Research_{t-1}$). | + |
| $Patent_{t-1}$ | Patent applications to EPO (European Patent Office) per inhabitant (delayed by one year) (*Eurostat*). | Evaluates the impact of innovation results in terms of patent filings to the EPO (H6). | + |
| $PatentHT_{t-1}$ | HT patent applications to the EPO per inhabitant (delayed by one year (*Eurostat*). | Assesses the impact of innovation results in terms of patent filings to the EPO in the HT sectors (H6) (H7 $PatentHT_{t-1} > Patent_{t-1}$). | + |

**Table 2.19.** *The variables used: definition, role, assumptions and expected results (source: [GUI 16, pp. 451–452])*

We used the EVCA index to identify the legal and tax environment. This indicator includes three elements: the legal and tax environment for Limited Partners and PE firms and for invested companies, as well as the retention of talent in companies and PE firms[12]. The first element is a basic condition of supply, the second is demand-related, the third encompasses both aspects.

With regard to the exit context and in order to assess its impact on HTPE investment (H4), we consider disinvestments made in full (by PO, by TS, by

12 "More specifically, the tax and legal environment for limited partners and management companies takes into account criteria related to investors, such as pension funds and insurance companies, fund structures, and tax incentives. The tax and legal environment of the beneficiary companies refers to the incentive of companies and tax incentives for research and development, while that for retaining talent in the beneficiary companies and fund managers takes into account the taxation of stock options, interest, etc. Thus, several criteria are used to evaluate these three categories. The assessment is based on a scale ranging from 1 (the most favorable environment for the development of risk capital and the venture capital industry) to 3 (least favorable environment). An average of the scores assigned numerically is used to produce a composite score for each country" [GUI 16b, p. 450].

a sale to another PE fund, by a sale to financial institutions, by a sale to management, etc.) divided by GDP (ratio delayed by one year), and then disinvestments by PO/GDP (delayed by one year) and disinvestments by TS/GDP (delayed by one year). The last two indicators are used to test whether PO exits have a stronger influence on HTPE investment than TS exits.

The innovation indicators are as follows (EUROSTAT): business R&D expenditure divided by GDP, business R&D expenditure in the HT sector divided by GDP, full-time equivalent personnel per inhabitant, full-time equivalent personnel in the HT sectors per inhabitant, full-time equivalent R&D researchers per inhabitant, and patent filings with the European Patent Office. As mentioned, all explanatory variables are delayed by one year, with the exception of institutional variables.

### 2.3.2.2. *The structure of the model: the determining factors of PE investment in high-tech sectors*

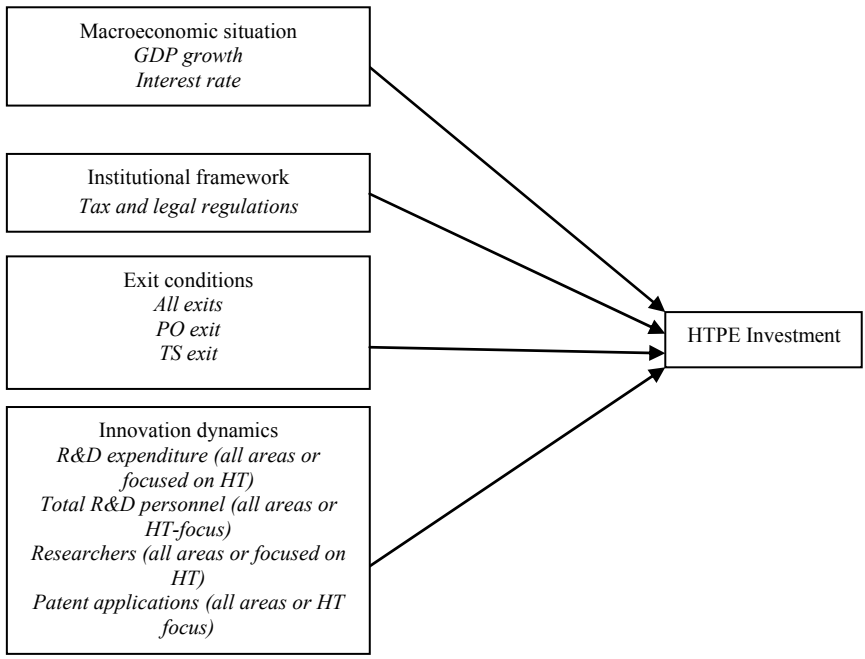


**Figure 2.3.** *The structure of the investment model in high-tech sectors (source: [GUI 16b, p. 449])*

### 2.3.3. *Results and discussion*

Table 2.20 shows the results of several regressions specified according to the logic of the analytical model and taking into account the constraint on the correlation of variables. The regressions named A, B, and C incorporate the total exit, PO exit, and TS exit variables respectively. Type 1 and 2 regressions correspond to global innovation and high-tech innovation respectively. Regressions a, b, c, and d correspond respectively to business R&D expenditure, total R&D personnel, R&D researchers and patent filings. The number of observations varies according to the availability of information. All regressions obtain a satisfactory adjusted $R^2$.

| | Reg. A1a | Reg. A1b | Reg. A1c | Reg. A1d | Reg. A2aa | Reg. A2b | Reg. A2c | Reg. A2d |
|---|---|---|---|---|---|---|---|---|
| GDP_1 | -0.002 5225 (-0.89) | -0.0030 793 (-1.08) | -0.0042 352 (-1.47) | -0.0016 256 (-0.55) | 0.00139 49 (-0.72) | -0.0022 488 (-0.73) | -0.0030 057 (-0.94) | -0.0024 298 (-0.82) |
| Int_1 | 0.01570 57*** (3.13) | 0.01735 23*** (3.33) | 0.01645 24*** (3.20) | 0.01500 23*** (2.75) | 0.00313 32 (0.95) | 0.00648 2 (1.25) | 0.00596 76 (1.07) | 0.01178 2** (2.36) |
| Inst | -0.000 3413* (-1.95) | -0.0003 082* (-1.80) | -0.0002 842* (-1.67) | -0.0002 329 (-1.28) | -0.0002 483** (-2.04) | -0.0001 714 (-1.00) | -0.0002 143 (-1.15) | -0.0001 617 (-0.94) |
| Exit Tot_1 | 0.20227 59*** (6.80) | 0.20915 15*** (7.15) | 0.20734 82*** (7.05) | 0.21742 49*** (7.04) | 0.08728 61** (2.28) | 0.24265 4*** (8.56) | 0.24198 49*** (7.93) | 0,.2211 885*** (7.23) |
| RD_1 | 0.02965 11*** (4.13) | – | – | – | – | – | – | – |
| Staff_1 | – | 0.12703 94*** (4.17) | – | – | – | – | – | – |
| Resear_1 | – | – | 0.20687 32*** (4.21) | – | – | – | – | – |
| Patent_1 | – | – | – | 1.75769 8*** (2.92) | – | – | – | – |

| | Reg. A1a | Reg. A1b | Reg. A1c | Reg. A1d | Reg. A2aa | Reg. A2b | Reg. A2c | Reg. A2d |
|---|---|---|---|---|---|---|---|---|
| RDHT_1 | – | – | – | – | 0.1052574*** (4.98) | – | – | – |
| StaffHT_1 | – | – | – | – | – | 0.3676072** (2.14) | – | – |
| ResearHT_1 | – | – | – | – | – | – | 0.5105033* (1.67) | – |
| PatentHT_1 | – | – | – | – | – | – | – | 4.726*** (2.82) |
| Cons-tant | -0.000926 (-0.27) | -0.0002437 (-0.69) | -0.0001836 (-0.52) | -0.0001766 (-0.49) | 0.0003246 (1.33) | 0.0000615 (0.17) | 0.0002049 (0.54) | -0.0000722 (-0.20) |
| Nber of obs | 110 | 109 | 106 | 113 | 62 | 79 | 75 | 113 |
| $R^2$ | 0.5065 | 0.5093 | 0.5174 | 0.4549 | 0.3984 | 0.6042 | 0.5776 | 0.4523 |
| Adjusted R2 | 0.4827 | 0.4819 | 0.4933 | 0.4295 | 0.3447 | 0.5771 | 0.5470 | 0.4267 |
| | Reg. B1a | Reg. B1b | Reg. B1c | Reg. B1d | Reg. B2a | Reg. B2b | Reg. B2c | Reg. B2d |
| GDP_1 | -0.0035873 (-1.10) | -0.0042298 (-1.29) | -0.0057888* (-1.75) | -0.0023345 (-0.68) | 0.000723 (0.36) | -0.0059299 (-1.58) | -0.0065798* (-1.68) | -0.0034795 (-1.02) |
| Int_1 | 0.0161776*** (2.78) | 0.0179262*** (2.97) | 0.0170601** (2.88) | 0.0158247** (2.51) | 0.0027324 (0.79) | 0.0073441 (1.15) | 0.0065275 (0.93) | 0.0113617** (1.98) |
| Inst | -0.0006207*** (-3.13) | -0.0005603*** (-2.89) | 0.0005296** (-2.77) | -0.0005232** (-2.56) | 0.0003312** (-2.66) | -0.0004864** (-2.40) | -0.0005095** (-2.26) | -0.0004165** (-2.17) |
| ExitPO_1 | 0.6903625*** (2.99) | 0.7985015*** (3.54) | 0.8000809** (3.55) | 0.7848743** (3.28) | -0.0778858 (-0.27) | 1.108293*** (4.77) | 1.005642*** (4.05) | 0.8734988** (3.75) |

| | Reg. B1a | Reg. B1b | Reg. B1c | Reg. B1d | Reg. B2a | Reg. B2b | Reg. B2c | Reg. B2d |
|---|---|---|---|---|---|---|---|---|
| RD_1 | 0.0402098 *** (4.97) | – | – | – | – | – | – | – |
| Staff_1 | – | 0.1687575 *** (4.93) | – | – | – | – | – | – |
| Resear_1 | – | – | 0.2763107 ** (5.03) | - | - | - | - | - |
| Patent_1 | – | – | – | 2.589898*** (3.81) | – | – | – | – |
| RDHT_1 | – | – | – | – | 0.1130145 ** (4.56) | – | – | – |
| StaffHT_1 | – | – | – | – | – | 0.2822856 (1.31) | – | – |
| Resear HT_1 | – | – | – | – | – | – | 0.4715233 (1.23) | – |
| Patent HT_1 | – | – | – | – | – | – | v | 7.258359*** (3.91) |
| Constant | 0.0004747 (1,23) | 0.0002681 (0.68) | 0.0003299 (0.83) | 0.0004076 (1.01) | 0.0005756 ** (2.40) | 0.00085** (2.06) | 0.0009592 ** (2.16) | 0.0005304 (1.33) |
| Nber of obs | 110 | 109 | 106 | 113 | 62 | 79 | 75 | 113 |
| $R^2$ | 0.3437 | 0.3411 | 0.3588 | 0.2751 | 0.3436 | 0.3959 | 0.3474 | 0.2799 |
| Adjusted $R^2$ | 0.3121 | 0.3091 | 0.3267 | 0.2412 | 0.2850 | 0.3545 | 0.3001 | 0.2462 |

| | Reg. C1a | Reg. C1b | Reg. C1c | Reg. C1d | Reg. C2a | Reg. C2b | Reg. C2c | Reg. C2d |
|---|---|---|---|---|---|---|---|---|
| GDP_1 | -0.0045162 (-1.51) | -0.0051209* (-1.70) | -0.0062422** (-2.04) | -0.0038218 (-1.23) | 0.0010918 (0.55) | -0.0028354 (-0.85) | -0.0039544 (-1.13) | -0.0046649 (-1.49) |
| Int_1 | 0.0152357*** (2.85) | 0.0167756*** (3.02) | 0.0160933** (2.92) | 0.0145861** (2.55) | 0.0026086 (0.77) | 0.0050388 (0.90) | 0.004972 (0.81) | 0.0109749** (2.08) |
| Inst | -0.0005061*** (-2.81) | -0.0004744*** (-2.69) | -0.0004659** (-2.65) | -0.0003979** (-2.17) | -0.0002809** (-2.29) | -0.0002611 (-1.43) | -0.0003454* (-1.73) | -0.0003184* (-1.82) |
| ExitTS_1 | 0.6743346*** (5.39) | 0.705158*** (5.77) | 0.6882777** (5.51) | 0.7510991** (5.95) | 0.2147936 (1.54) | 0.9767595** (7.24) | 0.9401517** (6.45) | 0.7662512*** (6.03) |
| RD_1 | 0.0294557*** (3.75) | – | – | – | – | – | – | – |
| Staff_1 | – | 0.1250022*** (3.78) | – | – | – | – | – | – |
| Resear_1 | – | – | 0.2018726** (3.73) | – | – | – | – | – |
| Patent_1 | – | – | – | 1.757795*** (2.74) | – | – | – | – |
| RDHT_1 | – | – | – | – | 0.1068622** (4.94) | – | – | – |
| StaffHT_1 | – | – | – | – | – | 0.3518728* (1.89) | – | – |
| ResearHT_1 | – | – | – | – | – | – | 0.5386077 (1.61) | – |

| | Reg. C1a | Reg. C1b | Reg. C1c | Reg. C1d | Reg. C2a | Reg. C2b | Reg. C2c | Reg. C2d |
|---|---|---|---|---|---|---|---|---|
| PatentHT_1 | – | – | – | – | – | – | – | 4.381857** (2.42) |
| Constant | 0.0003114 (0.88) | 0.000171 (0.48) | 0.0002518 (0.69) | 0.0002221 (0.61) | 0.0004331* (1,80) | 0.0002953 (0.78) | 0.0005058 (1.26) | 0.0003396 (0.93) |
| Nber of obs | 110 | 109 | 106 | 113 | 62 | 79 | 75 | 113 |
| $R^2$ | 0.4425 | 0.4413 | 0.4461 | 0.4005 | 0.3696 | 0.5386 | 0.4961 | 0.3918 |
| Adjusted R2 | 0.4157 | 0.4142 | 0.4184 | 0.3725 | 0.3133 | 0.5069 | 0.4595 | 0.3634 |

**Table 2.20.** *Econometric results (source: [GUI 16b, p. 454-455-456]). Value of the t statistic in brackets. *: significant at 10%, **: significant at 5%, ***: significant at 1%*

The following observations can be made about the results that were obtained:

– economic growth does not play a significant role (H1 is not validated). With regard to venture capital investment (not limited to the HT segment), the empirical literature shows mixed results: there is no relationship for Jeng and Wells [JEN 00], Armour and Cumming [ARM 04], Bonini and Alkan [BON 12], positive impact for Gompers and Lerner [GOM 98] and Felix *et al.* [FEL 13]. It is therefore necessary to take into account the composition of the investment. Indeed, according to Jeng and Wells, "the expansion stage is less influenced by macroecomic dynamics than the seed and start-up stages". In this case, the product has already reached the market, the company is starting to earn profits, and the financing is more focused on increasing production capacity and supporting R&D. Veugelers [VEU 11] points out that in Europe, most of the activity is focused on the expansion stage, which reflects the existence of an "early-stage European equity gap". Moreover, in a way, considering total private equity financing in high-tech firms supports the analysis of Hopkins and Lazonick, who consider that, for the United States, economic growth directs public financing towards high-risk stages, that is early stages, which has developed a "start-up culture" and has encouraged the disengagement of large companies that outsource a large proportion of their R&D spending. The relationship between economic

growth and equity financing for companies is thus mediated by the public policies that are implemented. Finally, it should be noted that the lack of any significant influence by economic growth on private equity investment is the case, to the extent that economic activity is relatively stable in its level over the period studied, where large fluctuations only generate effects during the following years;

– the positive and significant impact of the interest rate in most regressions suggests an interpretation in terms of demand (H2b is validated). Indeed, from the point of view of entrepreneurs, an increase in interest rates makes financing through debt more expensive, and thus makes equity financing more attractive. Moreover, debt does not seem to be an appropriate form for high-tech companies with high-risk innovative projects (high information asymmetries, absence of track records, low or non-existent collateral, highly uncertain yield) [CAR 02, GUI 08b]. It should also be noted that the rise in interest rates disrupts relations between bankers and entrepreneurs, as it causes the elimination of good projects due to the phenomenon of adverse selection. These elements create a positive demand effect in favor of private equity. However, we do not claim that the interest rate has no effect on supply, since in this case, investors would switch to other classes of assets by abandoning private equity. It simply means that the effect of demand prevails. On this point, the literature provides contrasting results that reveal that the influence of this variable depends strongly on the samples that are used;

– the institutional variable is significant in many regressions. It has the expected negative sign (H3 is validated). High-tech investment is logically favored by an appropriate legal and tax environment, both from the point of view of investors and entrepreneurs. The results obtained are consistent with those of Armour and Cumming, who use the same variable to explain venture capital investment across all segments. These results highlight the role played by public policies in creating favorable conditions for the development of this form of financing. Indeed, the legal and tax framework creates constraints and incentives. These are not only the operational rules that govern the creation, operation, and liquidation of private equity funds. There are also rules that more broadly that can influence the behavior of players and the orientation of this financing towards the HT segment. Public policies can also take other forms, such as the financing of public investment funds, public research, the establishment of public incubators and accelerators, etc.;

– the exit variables are very significant and have a positive impact on the HTPE investment (H4 is validated). This is in line with the results found in the literature. In addition, the results indicate a stronger effect of the PO exits relative to the TS exits, in agreement with H5. Hege [HEG 01] had already noted the preferences of management companies and contractors for PO exits. Indeed, PE firms are motivated by the search for profitability and the creation of reputation effects. As for entrepreneurs, in addition to the expected benefits, they seek to preserve their independence (see Chapter 1). They are reluctant to exit through the sale to industrial partners who would place them in a situation of dependency. The results also suggest a strong relationship between stock markets and HTPE investment, while the link with venture capital investment is not as clear in econometric studies;

– H6, H7, and H8 are validated. R&D expenditures, total R&D personnel, researchers, and patent filings, whether or not these variables are limited to the HT segment, are often significant and have a positive impact on HTPE investment (H6 is validated). To our knowledge, variables related to total R&D personnel and researchers have never been tested in previous publications, regardless of the dependent variable.

The variables representing the HT segment have a stronger influence on the HTPE investment (H7 is validated). In addition, the researcher variable has a stronger impact than the total personnel assigned to the R&D activity, for all segments or only the HT segment (H8 is validated). This result shows the decisive role played by knowledge and skills in advanced technological fields (see section 2.1).

The consideration of the elements that make up the innovation environment therefore makes a significant contribution to the existing literature. Knowledge-based assets play a key role in the expansion of companies and the growth of high-tech sectors. This proposal is consistent with the analyses carried out at the national level. For example, Germany has developed internationally recognized high-tech activities and the investment in these areas is based on high R&D expenditures, a large number of scientific and technical staff, and a major position in Europe in terms of patents. It should be noted that innovation as considered here is limited to the business sector. It is logical to include the public sector as a source of skills and as a provider of funds (i.e. through R&D expenditures), which refers to the role of public authorities in building innovation capacity.

These proposals are in line with the findings of Veugelers and Cincera [VEU 15]:

> "An important initial observation is that a general innovation policy aimed at improving the innovation environment remains necessary. Economic policy measures are also needed to address the specific obstacles faced by new companies in new sectors. This includes *inter alia* access to external financing for fast-growing, highly innovative projects, through public funding and/or by leveraging private risk funding" [VEU 15, p. 9].

These elements must all be coherent. It is necessary to think in terms of innovation environments and consider the measures that would be suitable for this objective.

## 2.4. Conclusion

This chapter is implicitly based on the distinction between traditional and high-tech activities. The differentiation between these two possible allocations of venture capital is based on their rate of innovation and their contribution to the growth of sectors that generate technological spillovers to the rest of the economy (ICT, the digital economy, etc.). High-tech activities take on particular importance in cases in which companies carry out innovative projects that may challenge the structure of the sector, and as a result, lead to a renewal of the fabric of the productive system.

These industries – which, as we have seen, are unstable in their scope – have two characteristics. Empirically, they would lead us to believe that venture capital is becoming internationalized, due to the fact that it does not conform to a uniform development pattern for these industries from a dominant economy, the US economy. The innovation gap between Europe and the United States is primarily linked to a smaller population of new companies and, above all, to different positions of different sectors. The difficulties in successfully crossing the growth thresholds are also due to the less developed forms of organization in Europe (such as business angels), the varied structure of European funds, and the specific features of the legal, tax and operational environment in which these activities exist on both sides of the Atlantic.

Analytically, the focus should be on R&D spending, which is characterized by high levels of inertia in Europe. More fundamentally, R&D does not seem to be considered by private players as a crucial variable with the potential to transform a small company into a high-growth firm, which it feeds both through the patents it files and through its attractiveness to qualified productive resources. Moreover, if venture capital is a privileged place for analyzing entrepreneurship from the perspective of experimentation [KER 14a], it does not seem that processes of learning through step-by-step financing (including those performed by business angels) and syndication have been able to spread as innovative practices as widely as in the United States. However, these practices are a consequence of a limited capacity for attention, and furthermore, they can strongly influence the forms that innovation takes, and in particular the trade-off between exploration and exploitation. Therefore, cultural attitudes cannot be overlooked in understanding the importance of high-tech activities at the national or regional level.

# 3

# The Three Structures for Interpreting Venture Capital: The Market, Industry and Institutions

In this chapter, we will seek to provide a summary of the thinking developed in this book. The first chapter focused on economic agents in their desire to reach a contract and in their ability to bring about changes in the risk boundaries, particularly with regard to venture capitalists. With the financing applicants, we analyzed the entrepreneurial risk and the careful consideration of the trade-offs they would make between being in a position of managing a start-up versus the situation they would face as employees. The various contractual terms that are used give rise to an analysis of venture capital in terms of the market.

The second chapter considered the sectoral orientation of venture capital. Venture capital is a mechanism for financing innovation which affects a wide range of activities, including high-tech industries. The investments made in these industries are the vehicle for radical innovations and, as such, are preferred as an area to implement policies, particularly in the United States. In analyzing the decisive factors for this mechanism with respect to high-tech industries in Europe, we have introduced macroeconomic and macro-social variables, including institutions.

In this third chapter, we analyze venture capital more systematically as an industry for financing innovation, with the consideration that the foundations of this activity are institutional. Both markets and industries, as means for players to coordinate, are embedded in institutional

*Venture Capital and the Financing of Innovation,*
First Edition. Bernard Guilhon.

arrangements that design specific national configurations. This analysis of institutional architectures will be carried out after presenting a model for determining investments made by venture capital in European countries.

## 3.1. An interpretation of venture capital in market terms

From the 1970s–1980s onwards, the relationship between economic structures and financing methods was profoundly transformed through the disruption of the hierarchy of institutional forms. Before the mid-1970s, economic and social processes allowed economic growth to manifest itself in both its intensity and its duration. In this context, the dominant institutional form is the relationship of wage relation, defined as the series of conditions that govern the use and compensation of labor (work time, mobility, direct and indirect components of wages, etc.). In many countries, production systems mainly seek out opportunities internally. Employee-management bargaining ensured that economic behaviors were relatively homogeneous, promoting adherence to a system of values and representations concerning the functioning of the economy and the "rules of the game" for the society in question. A grammar was established that created a connection between the growth-productivity-modernization of productive systems-wage compensation.

Once external pressure became stronger, the forms of competition, that is, all institutions and organizations involved in the competitive process in the markets, came to be the dominant form of institutions. The dynamics of growth imply a faster pace of modernization of the productive system, and in particular, of the industrial technological base. As it expands, globalization reflects the idea of a higher level of integration of economies into the global division of production and trade. The external constraint becomes an "objective" constraint, the system of the positioning of the various different countries is defined by the mapping of global competition and the demands of modernization. Economic, social and technological transformations are no longer imposed in the name of progress, and are instead justified through the threat of losing competitiveness.

Technological development tends to depreciate the specific capital accumulated through seniority, and to accelerate the obsolescence of human capital, while at the same time requiring updated strategies for the production and spread of knowledge. The production of new knowledge and the emergence of new activities are transforming economic and social

relations: the downgrading of activities and companies, the multiplication of locations where scientific and technological knowledge is created, the increased mobility of people, etc. These transformations work to promote a new culture that values the emergence of new companies capable of creating marketable technological knowledge and that requires access to specific sources of financing, radically different from financing by banks.

This new situation, a situation that is the product of technological, institutional and organizational factors, gives rise to "a general shift in the boundaries of risk driven by competitive pressure, in favor of innovation" [AMA 99]. In this context, venture capital would appear to be a mechanism for financing innovative projects to explore promising technological paths that are left unexplored by large companies. The deregulation of financial systems that originated in English-speaking countries favors market-based systems and, as a result, threatens the stability of the configuration of European financial systems, which are based on banking. The financing behavior of companies is diversifying at the same time as private savings offer new opportunities. Venture capital funds are multiplying, and while the professionalization of these funds is developing rapidly across the Atlantic, their development is much slower in Europe. The literature focuses on the emergence of a new market.

### 3.1.1. *From market efficiency to wealth creation*

There are three designs that compete to explain this phenomenon [BOE 10]:

– neoclassical theory, which is based on two pillars: the rationality of individual behavior, which is reduced to optimization, and the coordination of individual behavior ensured by the market. From this perspective, markets are efficient and all opportunities for profit opportunities are taken. "This view focuses on the economic situation that exists when all changes have ceased. In an efficient market, the prices are set in response to the quantities supplied and requested, and fully reflect available information" [FAM 95]. Therefore, an efficient market is a means of processing information;

– the neo-Keynesian approach, which holds that markets are imperfect and inefficient, which means that public intervention is necessary to counteract the failures of the market;

– by focusing on market processes, the classical and institutional perspective leads to the idea that there are many untapped opportunities. In contrast to standard theory, this perspective analyzes the mechanisms by which markets create knowledge within a field of activity, rather than reducing them to the status of simple means for processing information. In other words, the supposed advantage of the market is not in its properties for creating balance, but in its properties for spurring innovation and learning. Markets can contribute to "knowledge solutions", that is, they can encourage the combination of modules to produce new knowledge when a problem arises or a new project for production is considered. Our analysis of venture capital will use this as its basis.

This dynamic perspective considers both the need to include the contributions of the information economy (to justify that venture capital is different in nature from bank financing) and to go beyond this aspect. First, there are two arguments that explain the difficulty for small entrepreneurial businesses to access bank financing. It should be recalled that the lack of transparency in information is considered to be the most significant feature of start-up financing. The concept for a new product or process that they define is a strategic asset that they must protect if they wish to earn future profits. In this context, limiting the dissemination of information is a rational strategy for a company wishing to retain control of its intangible assets. In addition, young, innovative companies are prone to overestimating the potential of their project in terms of its technical characteristics and the supposed receptivity of the market, and consequently, to underestimate the real risks. Thus, entrepreneurs have privileged information on the situation and prospects for the development of their project with regard to their financiers.

More specifically, we have seen that information imbalances between the company and its lenders give rise to three types of difficulties: adverse selection, agency problems described as moral hazards, and opportunism (see Chapter 1). In the credit market, the increase in interest rates as a selection instrument increases the risk taken by lenders, in particular by discouraging entrepreneurs with the safest investments, or encouraging them to develop riskier projects. Therefore, in order to make an appropriate selection, a serious assessment of projects and the capacities of expertise must be made for technology-intensive projects. After the loan agreement is signed, the lender may have difficulty monitoring the use of the funds that are borrowed and ensuring that a portion of the borrowed funds will not be

used to finance any alternative projects with higher levels of risk than the original project. These problems are considered as moral hazards. Finally, if an entrepreneur declares an income lower than the income obtained in order to obtain, for example, a restructuring of his/her debt, then this is considered as opportunism.

However, Stiglitz [STI 01] acknowledges that it is necessary to go beyond the information economy. History plays a part, and the events that occur at the beginning of a given development path influence the current behavior of different players, forcing them to create and acquire new knowledge to understand and, potentially, influence new developments. "In this case, knowledge is different from information in that it is the *result* of the economic process and not what determines it *a priori*" [COH 12]. Indeed, as markets develop, they have a stimulating effect on the processes of invention and innovation, ultimately leading to greater efficiency in production processes. This interpretation is based on the conception formulated by Smith, which draws a connection between three elements: the expansion of opportunities (the size of the market), the division of labor, and the choice of new production techniques. This in turn serves as the basis for the formulation of the "Kaldor–Verdoorn law", reflecting the existence of dynamic returns at scale. It is interesting to note that the dynamics of increasing returns must be understood at the industry level, despite the fact that each company faces decreasing returns. In fact, the increasing complexity of the division of labor reduces the proportion of social knowledge controlled by a unit, though each company becomes more competent in its specialization.

Dynamic efficiency is considered by modern theorists as the most significant function. The market becomes a place for creating/acquiring new knowledge and learning from mistakes, and no longer just a mechanism for allocating resources within a static efficiency framework (in terms of transaction costs, low price dispersion, and the role of incentives, risk selection and management). The coordination mechanisms are established both on the basis of information held by one economic player on the behavior of other players and on the means of acquiring new knowledge, in order to respond to imbalances that arise during the path to growth. The dynamics driven by the market allow new things to be considered, fueled by innovations developed by companies benefiting from equity contributions from venture capitalists, among other things.

### 3.1.2. *Characteristics and functions of the market*

This is the approach taken by several authors [ROS 11] who have chosen three groups of parameters to characterize markets in a dynamic perspective. The technical parameters involve the definition of the good or service, the dominant concepts and product standards, the tangible or intangible location, the critical mass of supply and demand, the critical volume of transactions, and the measurement of the stability of supply and demand. The behavioral parameters include agent interaction, reputation effects, and the transparency of the transaction. The economic parameters reflect the learning effects that save transaction costs by allowing for "sparse actions". For this, it is essential to put in place institutions and regulations relating to product quality, the certification of agents, and the transparency of transactions. The interactions between agents outweigh the utility functions of the agents individually and as social institutions, markets are more than just a mechanism for exchanging and reducing transaction costs.

Markets differ significantly in their characteristics and, as a result, they are able to perform different functions. "A well-functioning market is capable of performing a variety of functions that a series of isolated transactions cannot do" [ANT 09, p. 12]. The role of the market has changed: it is not only a mechanism for allocating resources (the place where supply and demand are balanced), but also, and most importantly, a process by which economic agents learn and innovate by identifying and seizing on latent opportunities (a place where new ideas are generated and continuous improvements are made). Instead of using a formal logic of choice applied to a group in which the alternatives are known, the consequences arising from each alternative and the value of each consequence are known, companies apply the rules for making decisions that allow them to improve their knowledge of their environment. This perspective has already been established by A. Marshall[1].

The knowledge created by the market is created through dynamic adaptations to constantly changing circumstances. As a result, the market evolves and performs its function of coordination by preventing misalignments from accumulating.

1 "Marshall's agents do not pick optimal points *ex ante* from given opportunity sets. Instead, they obey simple feedback-based decision rules in less than completely known environments" [LEI 93, p. 9].

### 3.1.3. *The venture capital market*

A venture capital market is created when "a set of previously isolated precursor transactions spark an emergence process" [ROS 11, p. 183]. But for this process to materialize, a number of conditions are required, including the creation of a new type of intermediary operation known as a *qualitative pre-emergence condition*. The existence of new supply-side agents (venture capitalists), organizing relations between investors and firms receiving financing, as well as the development of new strategies and forms of intervention (contracting), have gradually formed the structure of venture capital markets.

In particular, for Gilson [GIL 02], the structuring of contracts makes it possible to respond not only to information asymmetries and problems, but also to the particularly high level of uncertainty in the case of high-tech companies in the seed or start-up phase. Through contracts, venture capitalists define the terms and conditions for the allocation of funds, as well as the mechanisms for monitoring and incentivization. An incentive contract is used to align the agent's actions with the interests of the principal. In this case, the aim is to encourage companies to act in the direction desired by venture capital organizations. From this perspective, the contract is necessarily the result of negotiations between venture capitalists and company managers, with the determining factor being the bargaining power of each party. This step is the financial arrangement and the drafting of the shareholders' agreement.

In addition, as we have seen, step-by-step financing allows venture capitalists to monitor the company's progress while still allowing for the possibility of abandoning the project, and thus limiting losses[2]. It is thus an effective mechanism for dealing with information asymmetries, agency problems and uncertainty. Moreover, for Gompers and Lerner, step-by-step financing has the advantages of closely controlling the owner/manager's actions and reducing potential losses caused by a wrong decision. While a venture capital market can be identified in its totality, this is less so in part: the product being marketed here is the provision of equity capital, together with the provision of value-added services. The evolution of this market

2 Gilson [GIL 02, p. 9] points out that "the implicit right of venture capital funds to participate in subsequent *rounds* of financing [...] is protected by an explicit right of refusal".

results from individual and collective learning processes that have made it possible to identify venture capital funds with knowledge and experience.

It is on this basis that *a new venture capital market* can be established, whose emergence gives rise to very specific processes [ROS 11]. First, this new market gives rise to the creation of business groups, within which the various partners create apprenticeships and join privileged networks. The theory of "entrepreneurial spawning" focuses on this aspect.

The replication process [GUI 08] can be addressed on the basis of whether the focus is on the contractual structure of the venture capital market or on the learning of future entrepreneurs and their integration into privileged networks. This design was proposed by Gompers *et al.* [GOM 05]. The mechanism of the design focuses on the creation of new businesses, with the basic idea that the reproduction of entrepreneurial capacities can be achieved in two ways.

In the first of these two, replication is the result of the bureaucratization of large industrial companies (the "Xerox view"). These companies are reluctant to finance highly innovative projects for three reasons. First, their organizational structure suffers from an inability to respond to radical technological changes that challenge organizational knowledge and accumulated collective skills. In addition, they have difficulty assessing the quality of entrepreneurial opportunities that are outside their main areas of activity comprised by their fundamental skill sets. The information asymmetry regarding these opportunities is considered very high, which leads these companies to determine that they have not accumulated enough skills and experience to engage in projects they consider to be innovative. In other words, the cognitive attention of these companies' R&D laboratories has not been directed towards these new technological perspectives. Finally, the allocation of capital by these widely diversified industrial firms between their different units is very poor, with the budgeting of their operations functioning as a kind of "socialism" [SCH 98]. Indeed, they have a tendency to waste capital on business activities that are characterized by a low Tobin Q ratio (firm market value/book value of assets) by investing more than independent firms. The opposite is true for business activities with a high Q coefficient. Investment inefficiencies are compounded in companies in which managers have low shareholdings in the company's capital, which causes agency problems and control costs between management and investors.

Given the fact that the "Xerox view" hypothesis is not sufficiently exhaustive, the second mechanism used by Gompers *et al*. is called the "Fairchild view of spawning". In this context, employees of venture capital-backed companies learn to become managers by gaining experience in an entrepreneurial environment. This experience constantly provides them with networks of suppliers of goods, capital and labor, as well as with consumers. Moreover, these employees are less averse to risk than their counterparts working in long-term firms.

It is therefore not a venture capital market in the strict sense, but a replication process in which the positive externalities produced by location in a given area are important, although geographically limited. The firms that feed into this process of reproduction are located in areas of high venture capital density (Silicon Valley and Massachusetts). The effects of localization, which must be analyzed more as effects of agglomeration than as effects of concentration, are therefore preponderant, almost becoming a tautology, since the venture capital industry already exists (companies are venture capitalists in a sense, and vice versa) and it is at the root of the economic dynamism of these clusters. The authors therefore deliberately place themselves on the demand side of the capital demand *created by* innovative firms, *since the supply of capital to be invested already exists*.

It can also be argued that the process of replicating entrepreneurial capacities is somewhat mechanical in nature, since the companies that feed into this process have technologies that are more appropriate for venture capital financing. In reality, this is not the case: the effect of technology does not play a role. Firms located in such environments tend to reproduce fewer technologically related companies than those located outside these privileged areas. Therefore, it is not the firm's technology feeding into this process that is important, but the skills and experience accumulated by future entrepreneurs. In this context, the public policies intended to increase the supply of capital or stimulate investment are misguided. Entrepreneurial activities are subject to increasing returns, and the most crucial aspect of these activities is the knowledge some of its employees gain, who have the ability to become entrepreneurs.

This approach undermines the role of venture capitalists, who are gradually phased out through agglomeration effects. To a certain extent, the proposed thesis recreates the behaviors of a general investment model for venture capital activity on a reduced scale, with the condition that it is

limited to high-tech activities (software, electronics and biotechnology). Overall, the dynamics of this model of entrepreneurial talent supply are based on the mobility of skilled labor and the experience acquired by certain employees.

The comments that may be made on this model involve the smooth transitioning from the employees to entrepreneur-innovators.

There are arguments to be made in favor of this thesis. Competition policy in the United States encourages large companies to adopt a prudent policy of technological diversification, thereby encouraging employees to take advantage of certain technological opportunities. Large companies are potential areas where innovations can be made, thanks to the patents they hold that may be of interest to venture capital funds. Similarly, younger companies whose creation has been financed by venture capital are themselves the source of new entrepreneurial firms. This implies that the dynamics of venture capital in the US are not a response to the bureaucratization of large companies. They are fully in line with the global innovation dynamics in that they confer a very high level of social legitimacy to the creation of companies and the exploitation of new technological opportunities.

However, there are two objections that can be made. The first assumes that the existence of a strong entrepreneurial culture provides employees with the skills required to run a company. Admittedly, the unbalanced distribution of critical resources to certain clusters offers more opportunities for businesses to be created. However, the analysis of the problem that is adopted leads to the point that the spread of knowledge justifies the supply by venture capitalists and experts of the services needed to select projects and coordinate the actions of the company. By contrast, Gompers *et al.* consider that the critical resources needed by future entrepreneurs already exist in existing companies.

A more realistic conception of critical resources invites us to focus on three aspects [STU 03]. In some areas, a higher rate of creation of young innovative companies benefits from the proximity effect of existing companies (the mobility of highly skilled employees), but also from the presence of technical experts and venture capital funds. Such funds are not only providers of capital. They also encourage some employees to leave their companies to create new ones. They also identify strategic partners and

appropriate networks of suppliers/users. In addition, by providing funds and expertise, venture capitalists increase the ability of start-ups to file patents, which may convince other venture capitalists that the firm clearly stands out from its competitors [MAN 06]. Finally, the necessary intervention of venture capitalists is highlighted in many studies. It does not make sense to consider that the supply of entrepreneurial talent actually exists. While future entrepreneurs possess scientific and technological knowledge, they often lack the productive and commercial knowledge to ensure the operations of their companies are effectively managed.

The second objection is that the authors only consider the positive aspects of localization. However, there are negative externalities that result from increased competition between firms that are located close to each other. Indeed, as Stuart and Sorenson note, firms that benefit from an open labor market and expanding labor mobility risk "occupying structurally equivalent positions", both in supplier/user networks and in their technological and strategic choices. The growth of organizations can be inhibited when firms recruit qualified personnel from the same set of organizations. The process of endogamy eventually leads to decreasing yields, with the effect of the spatial proximity of resources tending to weaken as the industry in the area becomes more mature. Negative effects are generated from the very proximity of venture capital, since acute competition between firms tends to lower the rate of IPOs.

However, despite the reservations about the development of a venture capital market based on entrepreneurial spawning, the fact remains that when the technology path is characterized by an exploration/exploitation type innovation model, complementary aspects and cumulative effects can be created between large companies and new technology start-ups. Indeed, thanks to the previous experience accumulated by some of their employees, the technological assets of a company – all elements which do not necessarily have a direct link with the core capabilities of this entity – are likely to produce elements that can be used in start-ups.

Other processes are fueling the rise of these new venture capital markets as well, including the co-evolution of venture capital funds and start-ups driven by foreign investment, as shown in the case of Israel [AVN 06]. This process of co-evolution has led to the development of collective learning and the establishment of relationships between actors with interchangeable roles: entrepreneurs who have become venture capitalists, venture capitalists who

have become involved in foundations dedicated to start-ups, etc. On this basis, effects of reputation have been generated that have spurred foreign investment (foreign investment has accounted for 50 to 60% of total venture capital investment since 1999). For these authors, the co-evolution process "was the main driver of the overall dynamics".

This process is not automatic: the supply of funds has been stimulated by interventions made by the public sector (the "Yozma program"). In particular, the profitability of the *Yozma funds* has led to new venture capital funds being injected, and the internationalization process has helped to achieve a critical mass. Therefore, analyzing venture capital as an intermediary activity is insufficient. On the one hand, a critical mass of transactions must be achieved, a necessary condition for new knowledge to be obtained. On the other hand, the entry of new venture capitalists into this market, even one that includes tax regulations and appropriate institutions, could not have taken place without a massive, coordinated and deliberate entry driven by public policy.

### 3.1.4. *Why talk about a new market?*

In the light of the arguments developed above, we freely agree with the cited authors in that systemic and evolutionary arguments add a significant component to the analysis of venture capital activity. However, can this activity be reduced to a market? When Gilson refers to a venture capital market, he defines it directly from a private contractual structure that covers the entire venture capital cycle. But the hierarchy of roles is very clear: public authorities are and should only be passive investors, since if they intervene, they may cause the selection process to be biased by attracting the right investors.

The analysis proposed by Rosiello, Avnimelech and Teubal is much more syncretic. It considers the critical mass of stakeholders and the volume of transactions; it shows that an interconnection of public and private agents (local and foreign) is needed, and it establishes the co-evolution between venture capitalists and start-ups as the central framework on which the dynamics of the process of emergence is based. This analysis considers that learning is created from relationships between agents that capitalize on individual and collective experiences.

First, it should be recognized that the knowledge held by the future entrepreneur is the key to unlocking potential inventions and innovations (this entrepreneur imagines things that others do not). Therefore, the opportunity for production that is associated with new knowledge is only a subjective and cognitive category – that is, it exists only in the mind of the person carrying out the project. This person must persuade venture capitalists that the idea being proposed has the potential to be turned into a marketable product. In this context, venture capitalists make use of interpretative knowledge that helps to define situations, build representations of reality and give meaning to a productive activity. The goal is to identify the contributions of new knowledge in relation to existing solutions and to evaluate technological projects in terms of efficiency and utility (a "business idea"). The judgment of venture capitalists and the individual experts who assist them is formulated on the basis of a "representativity heuristic" [TVE 86]:

– Are different elements of new technological knowledge complementary to each other, and thus able to be combined with existing knowledge? How do they fit into the value chain?

– Have they taken costs into account and recognized objective qualities?

– What is their value to consumers?

Overall, in emerging businesses, the uncertainty faced by venture capitalists is of a qualitatively different nature from that faced by mature industries. This can be expressed in the following question: what is the *dominant design* concept that will ultimately structure this emerging productive activity, and more generally, what are the elements of the function of the objectives that innovative firms will favor?

To assess the quality of the project and the degree to which it is inventive, plans for financing are developed within an institutional framework that is provided by the entrepreneurial support network. Formed on the basis of the rather complex division of labor in the United States (law firms, venture capitalists, individual experts, investment banks, specialized consulting groups), this organizational structure is based on cooperation. It is a form of social interaction that facilitates not only communication and coordination, but also learning. The significant actions of these networks require creating rules that can be easily communicated (declarative knowledge) and creating new routines, that is know-how that make it

possible to translate the project into action, namely expertise and the assessment of technological choices, the assessment of intangible assets (patents, the value-relevance of R&D), the positioning in the value chain, the selection of an appropriate organizational form, the definition of an appropriate business model, etc. In other words, the technological project is configured by the entrepreneurial support network in such a way as to acquire the necessary legitimacy to obtain the support of private investors and/or public authorities and reduce its ambiguity. This complex process of interactions goes far beyond the market and does not appear to fall within the usual interactions between the supply and demand sides that are formed on a market, even if it is a place for creating knowledge as well as a place for learning to occur.

The limits of an interpretation made in terms of markets are also made clear by implementing the arguments developed in Chapter 1.

### 3.1.5. *Risk management at market levels*

The emergence of venture capital coincides with the need to create ways to finance innovations that explore promising technological pathways. The funding constraints are very specific. Innovation is an extremely uncertain process. The returns it offers are extremely biased, requiring specialized intermediaries who use their instrumental and interpretative knowledge to make judgments that encourage investment in a project. Indeed, information asymmetries are significant, entrepreneurial firms have no history to draw from, collateral is low or non-existent, the percentage of intangible assets is high, and knowledge is contained in human capital and patents.

In this context, any references made to a market cannot refer to its properties of equilibrium or dynamic efficiency. Indeed, how can we imagine a market when such a market would involve exchanging an equity contribution accompanied by providing value-added services for knowledge that can be transformed over *time* into a marketable product or service [GUI 17c]? In fact, all these elements are part of a series of individual and collective learning processes that create social interactions and, as we have noted just now, lead to the formation of entrepreneurial support networks. In the United States, this form of organization is based on cooperation and learning, and has also identified venture capital funds with the knowledge and experience to support and assist entrepreneurs. Thus, the barriers for

entry into entrepreneurial activities are not only financial or informational, but also social and psychological. The investment process is sufficiently complex that it requires the intervention of several financial partners and the implementation of processes of experimentation and selection.

An analysis of the involvement of large companies from this point of view would offer some noteworthy results. A venture capital transaction very often involves several financial partners. This is referred to as syndication, the analysis of which can be compared to corporate venture capital through the study by Paik and Woo (see Chapter 1). As we have noted, a large company that invests in a start-up on a majority basis will influence the strategic R&D decisions of the invested company by implementing three mechanisms for wielding influence. The effects of direct governance effect inflate the start-up's R&D expenditures since it is part of an extended time horizon, especially if the current project strengthens the core competencies of the large company. In addition, interaction effects are generated when the start-up has access to complementary assets or relevant information, as well as effects stemming from the approval of the technology, which reduces uncertainty due to the adoption of the newly created technology generating confidence in the quality of the innovation. All in all, these effects have an impact on decisions on the strategic allocation of resources, given that they shift the boundaries of R&D spending and their effects are only felt through internal mechanisms in the relationship between large companies and start-ups. The market does not come into play in these cases.

More specifically, the influence of corporate venture capital on innovation may be less related to the transfer of knowledge that is able to be patented to the parent company than to increasing the level of attention paid by top management to significant changes in the environment of the large firm [MAU 13][3]. According to these authors, corporate venture capital can

3 "CVC can therefore be considered as a kind of 'radar' that identifies and highlights emerging technologies and new companies [...]. As such, the investments made by CVCs can have a significant impact on the knowledge of business opportunities and the corresponding business models among managers and executives of a CVC. Even when an established company does not transfer a specific technology that a start-up can commercialize, CVC investments can provide important information about the evolution of an area of technology. The information provided by CVC's investments can also influence how senior managers view the possibility that an area of technology may become important to the existing

be analyzed through the inter-organizational links that are built through syndication, as a "warning mechanism".

In addition, the process of experimentation that is inherent to the practice of venture capital is reinforced for the three reasons mentioned above [KER 14a]. First, it involves testing the relevance of different financial commitments and the scaling up of these commitments at a later date. Also, the costs of experimentation have dropped sharply in high-tech sectors (ICT, software, digital simulation, etc.) and knowledge of new products is rapidly accumulating.

Finally, the approach of experimentation implies that venture capital firms do not simply build up a portfolio of start-ups in response to a risk they seek to reduce, but that they carry out a number of tests on concepts that do not yet have a solid foundation. Venture capitalists behave primarily like sequential investors, who have the opportunity to spread their involvement in a project over a period of time. In this way, funding provided in stages is part of the overall experimental approach.

In this context, market mechanisms cannot be used as a guide in the phases of experimentation. The "survivors" are not chosen by consumers and competition, as is the case with the Darwinian natural selection process of the market. The decision of whether or not to continue investing in a project is taken by venture capitalists, well before the start-ups begin to compete on the market or have generated positive cash flow.

Venture capital is an expensive form of financing. Taking risks on the limits of currently understood technology implies that strategic decisions on the allocation of resources will be made on the basis of the entrepreneurial support network. In terms of the transfer of knowledge, companies make use of mechanisms outside the market to organize these transfers and reassess the investment process through financing in stages.

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company. These higher-level learning processes are not always influenced by the individual start-ups that receive investments from the established company. Rather, they are influenced by the information received during the project screening process from experienced venture capitalists, as well as by the portfolio of transaction proposals they process for investment purposes, as part of the syndication process" [MAU 13, p. 942].

It should also be noted that the geography of the venture capital market differs from that of the venture capital industry. The respective investment flows of this industry can be compared geographically. The breadth of the market and the cash flows in the venture capital industry was different in 2015 ($3,806 billion versus $4,000 billion) due to their magnitude and orientation [INV 15, p. 37]. The market aggregates investments in European companies, regardless of the location of the venture capital firm that makes these investments. The industry aggregates investments according to the geographical origin of the venture capital firm's registered office and, at the European level, the total figure indicates investments made by European venture capital firms regardless of the location of the companies in the portfolio. The tendency toward internationalization that characterizes the venture capital industry in Europe can therefore be interpreted at two levels: intra-European and international.

These developments lead us to think more in terms of industries, a category chosen by many authors and specialized bodies [AVN 06, NVC 18], etc., whose dynamics are based on complex interactions and on the implementation of structural European and national policies, giving priority to R&D and innovation.

## 3.2. An interpretation of venture capital in terms of industry

The industrialization of a financing operation is part of an evolutionary process. The qualitative conditions that shape this type of operation give rise to two types of arguments: the diffusion of an industrial logic, and the influence of internal and external factors in this activity. Previous works have identified these factors [GUI 08]: the importance of venture capital investment in relation to GDP, the public support for R&D and innovation, the orientation by sector of investments, and the existence of specialized financial markets. We will focus in particular on the first two factors, as the third was discussed in Chapter 2. The fourth factor will be addressed in the third section of this chapter.

### 3.2.1. *The spread of an industrial logic*

A clarification of what this logic is comprised of allows us to analyze certain points and illustrate certain aspects of venture capital.

#### 3.2.1.1. *Specialization of firms and managerial capital*

The logic of the industrial sector connects elements such as the investments that are made (physical capital, human capital, etc.), market growth, the performance achieved, and the recovery of capital invested for reinvestment. With regard to venture capital and taking into account venture capitalists and entrepreneurs, we may establish the following sequence:

> Tangible and intangible investments → increase in tangible and intangible capital → market growth (number of deals → performance returns → recovery of invested capital (outflows) and reinvestments

Venture capital firms have constanly been searching for highly qualified individuals over the past 30 years, particularly in the United States and later in Europe, to coordinate their actions with the players in the entrepreneurial network and improve their managerial capital. Recent studies [BLO 16] point out that the capital stock, in the broad sense of the term, bears the adjustment costs, in particular the costs of organizational resistance to new management practices. With regard to private equity and consultancy activities, the authors specify that "management practices are likely to be harder to change than plant or equipment" [BLO 16, p. 10]. In contrast to the approach that specifies that specific practices can be adapted to different environments ("management as a design"), they propose to consider management as a technology, that is as a set of best practices that are suitable for a wide range of environments. For example, the collection of a large amount of information before making decisions, distributing investment decisions over time, etc. In this context, managerial innovations can be considered as technological innovations, which reinforces the theory of industrialization.

Gompers *et al.* [GOM 09] investigate the ways in which organizational structure affects behavior and performance. They question the extent to which the level of specialization of the management teams of venture capital firms affects their results. Using a large database covering the period 1975–2003 in the United States, the authors refute the following two hypotheses:

> "1) Generalist venture capital firms will be better at allocating capital across industries.

> 2) Capital will be better allocated in generalist venture capital firms if the venture capitalists themselves are generalists" [GOM 09, p. 820].

Venture capital is suitable for this analysis due to the diversity of organizational structures. The top management of venture capital firms has sought to improve the quality of human resources and its attributes.

One way in which it has done this has been to recognize that the economic value of existing human resources increases through specialization. Indeed, the observation is that the performance of specialized firms seems to be generally better: there is a positive relationship between the specialization of management teams and the future success of their investments. Past performance plays a significant role in determining the funds that are raised in the future.

Therefore, managerial practices reinforce management technologies that focus on specifying resources, including skilled human capital.

In other words, rather than considering human capital as a general resource, venture capital firms choose to make investments that change the characteristics of their human resources in order to implement more effective actions. A diversification of activities and skills may occur, but this can only be achieved within the limits defined by the characteristics of future technological innovations and those of the corresponding human capital.

As a result, industrialization is a slow process, carried out through trial and error, that allows venture capitalists to create better endowed and more efficient[4] funds. The improvement of managerial capital influences the governance of venture capital funds, while at the same time affecting the performance and growth of the business.

#### 3.2.1.2. *Internal rates of return (IRR)*

> "The IRR is the rate of return that cancels out the net present value of a series of cash flows. The Net Internal Rate of Return

4 This practice makes it possible to put other forms of industrialization into perspective, such as risk management, using purely financial techniques. Once listed on the stock exchange, companies are faced with other forms of industrialization. In particular, "the industrialization of shareholding that has strengthened large institutional investors and equipped them with professional techniques to maximize their profits" [SEG 19].

(NIRR) is also called the investors' internal rate of return, because it measures the net performance achieved by investors on their investments in a private equity vehicle (FCPR, SCR, Limited Partnership, etc.). It takes into account the negative flows relating to successive calls for funds and positive flows relating to distributions (in cash and sometimes in securities), as well as the net asset value of the shares held in the vehicle on the calculation date. The IRR is the net of management fees and carried interest. It includes the impact of cash flow, the time effects and the estimated value of the portfolio" [INV 17].

| | Venture capital | Growth capital | Buyouts |
|---|---|---|---|
| Net IRRs since inception | 1.4% | 7.1% | 13.6% |
| Net IRR over 15 years | 2.3% | 5.9% | 15.1% |
| Net IRR over 10 years | 2.6% | 4.5% | 8.3% |
| Net IRR over 5 years | 5.5% | 7.0% | 14.5% |
| Net IRR over 3 years | 1.8% | 12.8% | 14.8% |

**Table 3.1.** *Net returns on risk capital in France at the end of 2017 (source: [INV 17])*

The spread of the performance remains significant. The 30-year average IRR for venture capital is 1.4%, which is lower than the European average (see Chapter 1). The transmission capital has the highest performance, with an average performance of 13.6%.

The United Kingdom has the strongest performance in private equity due to its high level of specialization in the production of very high value-added financial services and the accumulation of expertise, particularly of persons qualified in the management of this type of capital (buyouts). In this context, as we have noted (see Chapter 2), a very high proportion of investments in the United Kingdom are in transmission operations.

For closed funds, that is those that have already returned their money to investors (or not), the spreads are even more pronounced. Over the same

period, venture capital has an average IRR of -1.7%, while growth capital has an average IRR of 9% and buyout capital of 20.4%.

#### 3.2.1.3. *Activity growth*

Several indicators can be used. We have chosen the number of supported companies and the increasing concentration of this activity.

The increase in the number of companies supported in 2016 and 2017 in France is shown in Table 3.2.

| | Amount invested in million euros | Number of companies supported |
|---|---|---|
| Total capital-investment | 5,495 (2016)<br>6,395 (2017) | 1,040 (2016)<br>1,179 (2017) |
| Venture capital | 507<br>571 | 359<br>458 |
| Growth capital | 1,765<br>1,717 | 521<br>552 |
| Buyouts | 3,222<br>4,193 | 153<br>156 |

**Table 3.2.** *Amount invested and number of companies supported per segment in France in 2016 and 2017 (source: [BPI 17])*

The strongest growth was seen in venture capital. The number of companies supported grew by 28% between these two years.

The second indicator is the concentration of this activity in the United States:

> "– In 2016, 253 venture capital funds raised $41.6 billion, a ten-year high, to deploy in promising start-ups;
>
> – twenty-two first-time funds raised $2.2 billion in commitments last year, the largest amount by first-time managers since 2008;
>
> – the concentration of capital managed by fewer funds increased in 2016 as seven funds closed with more than $1 billion in commitments, driving the annual median VC fund size to $75 million (the highest median size since 2008)" [NVC 18, p. 10].

However, "while the sector has become more concentrated in terms of the capital accumulated and managed by a few venture capital firms, small businesses remain numerous and powerful. Contrary to what is widely believed, at the end of 2016, only 68 companies managed more than $1 billion in US venture capital assets. By contrast, 334 companies managed $50 million or less" [NVC 18, p. 10].

All in all, the spread of an industrial logic acts as a factor in the selection of the most efficient practices, as well as acting as an organizational factor because of the repercussions on human capital in general and on managerial capital in particular. The performance of venture capital funds is improving, and the inevitable consolidation is taking place within the industry.

### 3.2.2. *The relative weight of venture capital investment in relation to GDP*

Venture capital only represents a small fraction of GDP. Its overall effectiveness depends both on the total amount of funds that are implemented and on the distribution of the financial efforts over the different stages. There is a significant difference between the efforts made by various different countries.

#### 3.2.2.1. *Statistical benchmarks*

| | |
|---|---|
| Israel | 0.37 |
| United States | 0.35 |
| Canada | 0.15 |
| Korea | 0.086 |
| Ireland | 0.08 |
| Finland | 0.05 |
| Sweden | 0.040 |
| France | 0.035 |
| Spain | 0.035 |
| Denmark | 0.03 |
| Germany | 0.029 |
| United Kingdom | 0.028 |
| Belgium | 0.027 |
| Norway | 0.027 |
| Japan | 0.022 |
| Australia | 0.012 |

**Table 3.3.** *Venture capital investments as a % of OECD countries' GDP, year 2016 (source: [OEC 18a, p. 125])*

The statistics indicate that venture capital only represents a small percentage of GDP, often less than 0.05%. From these statistics, two countries clearly stand out: Israel and the United States. These are countries with high percentages of R&D expenditures with respect to GDP, and which have oriented their innovation policies towards disruptive innovations. However, these figures must be interpreted carefully, because they do not take into account the differing realities from one country to another[5]. Also, a look behind these figures reveals behaviors that are quite different.

Many studies have indicated that US R&D policy gives great importance to SMEs. Does this mean that venture capital financing is more oriented towards the seed/start-up/early stage phases rather than the expansion phase?

| | Seed/start-up/early stage | Later stage |
|---|---|---|
| Israel | 0.265 | 0.111 |
| United States | 0.139 | 0.218 |
| Canada | 0.087 | 0.068 |
| Korea | – | 0.086 |

5 "There is no standard international definition of venture capital, nor any breakdown of related investments by stage of development. In addition, the methods by which data is collected differ from country to country. Venture capital data are mainly derived from national or regional associations of venture capital investors who produce them themselves, in some cases with the support of commercial data providers, with the exception of Australia, where venture capital statistics are collected and published by the Australian National Statistical Office. The statistics presented give the aggregation of investment data according to the location of holding companies, regardless of the location of private equity companies, except for Australia, Korea and Japan, where the data refer to the location of venture capital companies. For Israel, the data refer only to venture capital-backed companies in the high-tech sector. Data for the United States also include venture capital investments made by companies that are not venture capital companies, excluding investments that are 100% financed by companies and/or business angels. The data for Australia, Japan and New Zealand refer to the budgetary year. For Europe, they include only venture capital investments (seed, start-up and later stages of development) made by conventional fund managers such as private equity funds making direct investments, mezzanine private equity funds, co-investment funds or rescue/turnaround funds; investments made by business angels, incubators, infrastructure funds, real estate funds, distressed debt funds, primary funds of funds or secondary funds for funds are excluded from these data; the amount of investments only reflects the amount of equity invested by conventional fund managers and not the value of the financing cycle as a whole. Development capital or capital to finance the acquisition of companies by their managers or employees, currently or previously financed with venture capital, is also not included" [OEC 18a, p. 126].

| | | |
|---|---|---|
| Ireland | 0.056 | 0.020 |
| Finland | 0.039 | 0.011 |
| Sweden | 0.021 | 0.019 |
| France | 0.017 | 0.018 |
| Spain | 0.018 | 0.017 |
| Denmark | 0.025 | 0.005 |
| Germany | 0.014 | 0.015 |
| United Kingdom | 0.018 | 0.010 |
| Belgium | 0.011 | 0.016 |
| Norway | 0.014 | 0.013 |
| Japan | 0.019 | 0.003 |
| Australia | 0.009 | 0.003 |

**Table 3.4.** *Venture capital investment as a % of GDP by phase, year 2016 (source: [OEC 18a, p. 126])*

Israel can rightly be considered as a start-up incubator, with investments made in Israel in the early stages being twice as much as in the US, and with the expansion phase often taking place abroad. In France, investments in start-ups increased by 34% to €2.24 billion. The number of transactions increased at a more modest pace (+18% for a total of 587). This is due to the massive amount of fundraising that is new in France, and reflects the increased maturity of this industry. However, the amounts invested remain lower than in many European countries, even though the number of deals increased sharply in 2016.

It is true that venture capital benefits from low interest rates, a kind of godsend, which allows operators to undertake riskier investments. The figures are likely to be lower for the years 2018 and beyond. Indeed, the end of the ISF will probably have negative consequences for the financing of new companies. According to a study by France Digitale, the expected loss is between 150 and 300 million euros for start-ups. The actions of the public authorities are therefore not neutral with regard to the financing of this activity.

### 3.2.2.2. *The role of public authorities*

We will focus here on three points: the public financing of R&D, the means used to channel savings towards the development of start-ups, and the proposals put forward by the *Conseil d'Analyse Economique* (Economic analysis board) to strengthen venture capital in France.

#### 3.2.2.2.1. Public financing of R&D

The structural characteristics of public R&D expenditure in France have been analyzed in a recent report [DEM 18]. Public expenditures in France represent 0.86% of GDP, but the growth of these expenditures is low, at about 1.5% in volume. It is unique in that it employs a large number of support staff (117,787 researchers at full-time equivalent positions), or 3.8 researchers per 1,000 workers. Researchers have lower relative salaries than researchers in other OECD countries.

The French public research system is largely based on public research organizations whose members are often associated with universities in mixed laboratories. Looking at the sectors of execution (higher education, State, non-profit institutions), it can be seen that the State represents 53% of the total, while in Germany, universities account for 55% of public expenditures.

As a result, it does not come as a surprise that in France, 58% of expenditures are allocated to fundamental research, 28% to applied research and 4% to experimental development. Project financing accounted for 10% of resources in 2012, placing France last among OECD countries. In terms of results, France represents 3.3% of the world's scientific publications, which places it – in comparison to the active population – on the low end of the average of developed countries (1.8 annual publications per 1,000 workers). In the total number of global citations, France's relative share is 3.8% (29% for the United States). The share of patents increased from 7.2% to 12.1% between 1999 and 2011.

Using a sample of 23 countries, the authors of this report linked government domestic civil R&D expenditures (GERD), expressed in constant $ and in purchase parity power, to three performance indicators: the total number of scientific publications, the number of publications ranked within the top 10% and the total number of patents filed. Thus, it was possible to estimate the technological frontier in order to deduce the distance from each country to the frontier. As it turns out, France is not on the forefront of efficiency:

> "France is relatively far from being in the lead, in an intermediate position among countries with similar expenditures. French public research has a lower performance score than Korea, with a 60% higher level of expenditures over the period" [DEM 18, p. 9].

Using the same approach, the United States is not positioned as a leader in efficiency, which may suggest that returns decrease at scale and that threshold effects may be in play.

In the case of France, if we're being optimistic, we might hope that the elements mentioned above may change somewhat through the major orientations of the current innovation policy in a way that would favor start-ups and breakthrough innovations. The government seeks to give priority to public research in its own way by encouraging teacher-researchers from the public sector to establish links with the private sector. They will now be able to devote 50% of their time to creating businesses, compared to 20% today, and retain 49% of the capital if they leave the company that was created. Therefore, this would not commit additional resources to increasing the salaries of teacher-researchers, and would seem to take into account the low salaries of the public sector and its consequences on the migration of intellectual capital to high-wage countries, particularly the United States. Will this measure be enough [GUI 18a]?

Public support for R&D activities is likely to create a demand for venture capital financing in order to develop innovative products, services and/or processes. Indeed, public intervention in R&D is a critical factor in the creation and development of research infrastructures, the implementation of mission-oriented research, and the support of research projects characterized by the anticipation of important social benefits that companies do not find sufficiently attractive.

On the side of the companies seeking financing, a study sought to evaluate the sources of knowledge that entrepreneurs prefer based on the perception of an opportunity and the actions they trigger [AMO 17]. For this purpose, the authors of this study selected a sample of "knowledge intensive entrepreneurial" firms (KIEs) from 10 European countries. These firms are located in high-tech sectors. KIEs are favored as the main areas for growth and societal well-being. Eleven sources of knowledge were identified in the questionnaires sent to the 420 KIE firms. The Likert scale ranks responses from 1 to 5, with 1 being unimportant and 5 being extremely important.

The average level of knowledge sources is then compared with data on the experience, age and education of the entrepreneurs. This functions as if companies were to press different keys on a keyboard according to their activity, their constraints and their environment. The results indicate that the

most educated entrepreneurs rely on research institutes, "probably due to their higher level of absorptive capacity" [AMO 17, p. 12], which facilitates the transition from research to the commercialization of new concepts. In Southern and Eastern European countries, first-time entrepreneurs attach great importance to the firm's internal R&D (probably due to the weakness of public research) and have less experience in the sector. These are the ones that, in our opinion, have a high likelihood of being supported by venture capitalists. In Western and Northern Europe, great importance is given to public research programs funded by the States and the EU, as well as to relations with private research institutes. Research programs are preferred by less experienced and more educated entrepreneurs. Overall, this finding, which does not make an explicit link with venture capital, fits well enough with the EU's European Venture program to set up a mega-venture capital fund to finance particularly innovative entrepreneurial projects (see below).

To clear up any misunderstandings, it should be recalled that while small and mid-size companies represent a larger share of R&D carried out by companies in Europe than in the United States, it must be acknowledged that many European countries have low levels of R&D, and relatively less developed public research systems (Estonia, Poland, Czech Republic, etc.) that are not large enough to allow companies with intensive R&D operations to emerge. This explains the significant proportion of small and mid-size companies in the R&D expenditures carried out by companies overall. Moreover, a higher concentration of R&D expenditures to small and mid-size businesses does not imply higher levels of performance.

While some companies, particularly technology-intensive ones, can grow rapidly and become important players in certain sectors, for start-ups, crossing the growth thresholds is likely to lead to greater success in the United States than in Europe:

> "Start-ups are comparable in number in Europe and the United States, but ten years after their creation date, American start-ups have twice as many employees on average compared to their European counterparts... Today, successful start-ups are more commonly found in America and Asia than in Europe. In 2015, Europe had only 15 'unicorns', compared to 90 in the United States and 31 in Asia. Five of the top ten US companies are former start-ups, and play a key role in the economy. A comparative analysis of the average age of market

> capitalizations in France and the United States shows that the gap has doubled over the past 15 years: in 2015, it was 91 years in the United States versus 132 in France (by contrast, it was 84 and 104 years in 2000)" [FRA 17, pp. 1–2].

This analysis suggests that there are different paths of development that may be taken by innovation financing between countries or regions. To the extent that the venture capital industry is divided into stages (start-up, early stage, later stage), the industrial development paths that may be taken very much depend on the capacities deployed by venture capitalists as well as the general and the specific knowledge they have of the entire value chain, together with experts and the players in the entrepreneurial network.

Moreover, as we have just seen, the knowledge of the players can only be developed through the actions of the public sector necessary to correct the imperfections of the venture capital market for the financing of innovation: in the United States, these may include the first programs to support innovative companies (SBIC, SBIR), the solvency of demand for dynamic small businesses (Small Business Act), or public interventions that favor R&D.

Therefore, if there is one common element that can be found among all these, it is that the development of this industry on a European scale clearly requires this market to be made more dynamic and relatively homogeneous, but also the implementation of structural policies deliberately intended to favor R&D and innovation.

#### 3.2.2.2.2. Public initiatives in favor of venture capital

Now, we will analyze the European initiatives favoring the VentureEU program and the proposals for putting savings to use to finance start-ups in France.

##### *The creation of a European venture capital megafund: VentureEU*

VentureEU is a €2.1 billion public and private investment program launched by the European Commission and the European Investment Fund (EIF) to boost investment in Europe's innovative start-ups and "scale-ups" (expanding companies):

> "Europe is full of talented people, top researchers and skilled entrepreneurs, but it must build better capacities to transform this potential into success. The access to venture capital plays

an essential role in innovation. Today, the Commission and the EIF announced the names of the six participating funds that will receive support from the EU to commit to investing in the European venture capital market. With funding from the EU of €410 million, these funds are expected to raise €2.1 billion in public and private investment, which is estimated to result in €6.5 billion in new investment in innovative start-ups and scale-ups across Europe, doubling the amount of venture capital currently available in Europe...

Venture capital is essential for the capital markets' union to function correctly, but it still has yet to develop fully in Europe. In 2016, venture capital invested around €6.5 billion in the EU, compared to €39.4 billion in the US. In addition, the size of venture capital funds in Europe is too small: the average size of such firms in Europe is €56 million, compared to €156 million in the United States. As a result, start-ups with high potential are moving to ecosystems where they are more likely to develop rapidly. The number of companies that had reached 'unicorn' status by the end of 2017, i.e. a value of more than $1 billion, totaled to 26 in the EU, compared to 109 in the United States and 59 in China.

VentureEU will offer European innovators new sources of financing, which will give them the opportunity to grow into global companies. Some 1,500 start-ups and scale-ups from across the EU are expected to have access. Venture EU will be financed initially by the EU, which will provide up to €410 million of investment – including €67 million from the EIF's own resources: €200 million under the Horizon 2020 InnovFin Equity program, €105 million under the COSME program (European program for small and medium-sized enterprises), and €105 million under the European Strategic Investment Fund (under the 'Juncker plan'). The remaining financing will be raised mainly from independent investors by the managers of the selected funds.

The six funds will acquire shares in a number of smaller venture capital funds and cover projects in at least four European countries each. The funds in which they will invest will help to

finance small and mid-sized enterprises (SMEs) and mid-cap companies in various sectors, such as information and communication technologies (ICT), digital, life sciences, medical technologies, resource use efficiency and energy efficiency.

Investments by the EU in VentureEU will be managed by the EIF under the supervision of the Commission, and will be deployed through six professional and experienced fund managers, which will ensure a true market approach. This will attract further investment and significantly increase the access to this type of financing by start-ups and scale-ups in the EU...

The Commission has announced the creation of a pan-European venture capital fund of funds (VentureEU) program within the framework of the capital markets union (UMC) and the start-up. This initiative was first proposed in 2015 by Commissioner Moedas as part of the 'Open Science, Open Innovation' strategy in 2015. In November 2016, the Commission and the EIF launched a call for expressions of interest, which attracted 17 applications before the deadline of January 31, 2017. For its first step, the Commission examined all investment proposals and pre-selected them according to their suitability for the program. The EIF then submitted the candidates that had been pre-selected to its standard due diligence procedure, from which six were selected to receive funding and invited to enter into negotiations with the EIF at the end of 2017. The first two agreements, between IsomerCapital and the EIF, and between Axon Partners Group and the EIF, were signed in Brussels. The other four (Aberdeen Standard Investments, LGT, Lombard Odier Asset Management and Schroder Adveq) were expected to be completed in 2018.

VentureEU is part of the larger ecosystem currently being created by the EU to give Europe's many innovative entrepreneurs every opportunity to become global companies. In particular, as part of the action plan for the establishment of a capital markets union, the Commission has presented a series of measures to improve access to finance for small and growing businesses in order to create jobs and stimulate growth. The

> Investment Plan for Europe also seeks to improve the business environment in the EU by making better use of financial resources and removing barriers to investment.
>
> On March 1, 2018, new regulations governing venture capital funds (EuVECA) and European social entrepreneurship funds (EuSEF) took effect, allowing for such funds to be more easily managed by their managers, regardless of their size, and a wider range of companies can now benefit from their investments. These new regulations also reduce the costs for the cross-border marketing of EuVECA and EuSEF funds, and simplify registration procedures.
>
> As announced in the revised EU Industrial Policy Strategy, the Commission is currently studying the complementary establishment of a European scale-up action for risk capital (ESCALAR), allowing venture capital funds to increase their investment capacity" [COM 18].

The main objective of establishing pan-European venture capital funds is to use public funds more effectively, serving as a magnet for private investment, which is often reluctant to engage in European venture capital since there is no appropriate vehicle. Fund-of-funds intermediaries can fill the gap between large institutional investors and small venture capital funds.

This program takes into account the system of the position of venture capital players in Europe. Private investors have reduced their investments since 2008, which has created financing problems for European start-ups. Government investments in venture capital funds have stepped in to bridge the gap. However, national authorities often invest with the idea that they would like to promote their own companies at the expense of activities within the entire community.

In addition, existing venture capital funds do not have the size and scale to meet the financing needs of expanding companies. This has given rise to the idea of creating a mega fund to channel private resources into community leadership.

At the same time, this institutional and organizational innovation at the European level reinforces the liberal conception of the EU, with 50% of the funding coming from independent private investors. "VentureEU will be

managed by six professional and experienced fund managers under the supervision of the Commission and the EIF, which will ensure a real market approach" [COM 18]. This mechanism can be integrated into the "Smart Specialization Strategy", which is based on an interactive process in which entrepreneurs identify market opportunities based on new technological applications and produce information. Then, the public authorities assess these potential opportunities and work to incentivize the players capable of updating them [GUI 17a].

In this context, entrepreneurship is distinctive in nature. The entrepreneur is not a "subsistence entrepreneur", that is, an individual who has made a trade-off between independence and employment, and who, above all, seeks to be his/her own boss. The entrepreneur is also not part of the structural approach that considers the firm or industry as the unit of analysis:

> "Indeed, the idea that one company, sector, or economy may be more entrepreneurial than another suggests that entrepreneurship is associated with a particular market structure (i.e. a market made up of many small or start-up companies)" [FOS 08, p. 76].

The underlying assumption of this analysis appears to be a functional concept of entrepreneurship. Entrepreneurship is a function, activity, or process characterized by judgment, innovation and energy, regardless of occupational or structural dimensions. "The entrepreneur can be an owner, a manager, or even a team of managers who follow(s) the entrepreneurial discovery process and take(s) actions" [FOS *et al*. 08, p. 76].

### *National savings used to help start-ups*

The question posed in the report by France Stratégie is: how would it be possible to channel savings into venture capital financing [FRA 17], given the knowledge that:

– the creation of start-ups in Europe is as dynamic as in the United States, but the growth rate of these start-ups is much lower, and;

– the percentage of venture capital in France in relation to GDP in 2016 is 2.4 times lower than that of Korea, 4 times lower than that of Canada, and 10 times lower than that of the United States?

The report cited above indicates that the increase in the level of financing should set a target of a fourfold increase of €8 billion, the stakes of which

are twofold: to increase the overall flows invested, and to allow the emergence of larger players, since the size of existing funds is insufficient to meet the financing needs of growing companies. In this context, the report states that "the most logical solution, and also the most radical one, is to rethink the tax regime in order to equalize the tax rates on capital income" [FRA 17, p. 3]. This first option has resulted in the introduction of a *flat tax* of 30% applied to all capital income.

The second option consists of rescaling existing niches and improving the way they are targeted. Indeed, the existing tax relief schemes have much weaker effects than those of other countries, notably the United Kingdom.

"– FCPIs (*Fonds commun de placement dans l'innovation* – Mutual fund in innovation), whose assets are mainly invested in the equity capital of innovative SMEs (the eligibility of SMEs corresponds to an amount of R&D expenditure, or is issued by the BPI), and FIPs (*Fonds d'investissement de proximité* – Proximity investment funds), whose assets are mainly invested in SMEs within a given geographical area, allow their investors to benefit from an 18% reduction in their income tax on the amounts invested. This reduction is capped at €4,320 for a couple, which corresponds to an investment of €24,000. For those subject to the *Impôt de solidarité sur la fortune* (ISF – Solidarity tax on wealth), the tax due in this respect may be reduced by an amount equal to half of the sums invested, capped at €18,000, which therefore corresponds to an investment of €36,000. These two schemes generated around €800 million in 2015.

– The so-called IR-SME and ISF-SME schemes allow a part of the funds invested to be deducted from the income tax due by the taxpayer, without going through a fund (as in the two previous cases). The tax advantage for these direct investments is limited to €18,000 (IR-SME, for a maximum investment of €100,000) and €45,000 respectively (ISF-SME, for a maximum investment of €90,000). Although these schemes have an age criterion for determining the eligibility of companies (less than seven years), they are not specifically intended for innovative companies".

**Box 3.1.** *Existing measures in France in favor of SMEs (source: [FRA 17, pp. 3–4])*

By comparison, the three British schemes (the "Enterprise Investment Scheme", "Seed Enterprise Investment Scheme", and "Venture Capital Trust") raised nearly €3.3 billion in financing in 2015, a figure well above the €2.2 billion raised in France, only part of which was used to finance venture capital.

In addition, the French Court of Auditors recommended merging the FIP and FCPI schemes, which would increase the average size of the funds, thus enabling them to "finance larger tickets or projects, attract foreign fund holdings and generate economies of scale on management fees" [FRA 17, p. 4].

The third option is to review the composition of existing savings products and how they are targeted. In this context, venture capital financing would be increased by encouraging institutional investors to make more of such investments.

As the authors of this report rightly point out, this option would strengthen the derogatory tax regime while directing investors to favor contracts that would provide more efficient financing for the economy. However, the difficulty lies in the complexity of the devices and their poor readability – unless we rethink the overall tax architecture, particularly by incorporating tightening measures that may not be well-accepted in the current climate.

### *Proposals to strengthen venture capital in France*

The authors of the report cited above [EKE 16], after having reviewed the current state of venture capital in France, question the interventions of the public sector, raising two questions: what doctrine, and what governance? Public interventions can have negative effects, despite their laudable intentions at the outset. In particular:

> – public intervention may displace certain private actors who are in *de facto* competition with an actor who does not face the same objectives of profitability or raising capital from third parties;
>
> – pressure groups, through the political process, can prompt choices to be made that are different from those that independent experts would make;
>
> – political figures may be tempted to use public interventions for electoral purposes, either to capture the votes of groups they target or to position themselves on strong symbols that convey their message to the electorate;

> – in a similar sense, it is very difficult to stop public initiatives. This is true whether or not the initial project is justified. These factors mean that industrial policies are not always successful in the long term, and that institutions come to be stacked on top of each other over time;
>
> – the significant influence of the public sector may be perceived negatively by foreign investors, who would consider Bpifrance as the 'strong arm' of the French government, marred by a reputation for 'protectionism' (especially after the conflicts with Uber and its blocking of the sale of Dailymotion), or would fear geographical quotas of French exposure [EKE 16, p. 6].

Based on this observation, the authors make seven recommendations [EKE 16, pp. 8–11]:

1) "to clarify the industrial policy doctrines underlying Bpifrance's direct interventions and those of the PIAs (French future investment programs), to interconnect them and to adopt best practices in this area";

2) since Bpifrance's action may hinder the emergence of an autonomous ecosystem, it is necessary to "conceive the actions of Bpifrance as an industrial policy intended to give rise to an autonomous venture capital industry (and not as a permanent substitute)";

3) "to provide Bpifrance with a system of governance that ensures its independence and long-term responsibility as well as an enlightened vision on international best practices. To interconnect Bpifrance's strategies with the *Commissariat général à l'investissement* (General commission for investment) to optimize public intervention and the evaluation of these actions";

4) "to promote the involvement of the scientific community in the entrepreneurial dynamic in France";

5) "to clarify the taxes levied on foreign investors, be they individuals or institutions, who invest in French venture capital funds and simplify their access to these funds";

6) "to ensure that the way in which entrepreneurial taxes are applied encourages the reinvestment of the capital gains generated within the ecosystem";

7) "to evaluate the effectiveness of all public policies involving venture capital (both fiscal and industrial *through* the action of Bpifrance and the

PIAs) in optimally allocating the budgetary effort allocated to the creation of an autonomous entrepreneurial ecosystem".

Recommendations 5, 6 and 7 speak to the issue of a tax review, and they are not unrelated to option 3 proposed by France Stratégie. This paper broadens the issue of funding from an upstream question on public intervention, creating a coherent system. This intervention should be organized around the primary objective of promoting the development of an autonomous venture capital industry.

Recommendations 1 and 3 propose to select and adopt international best practices in this area. The collective performance of the venture capital industry would be enhanced if information on these practices were able to be observed and transferred. But even if it is, there is no evidence that a convergence will occur around the best practices. The necessary learning in a changing environment is based on the idea that the players in the ecosystem have multiple connections and limited attention. If international practices are easily observable, the ability to process the information will be limited in relation to the amount of information available. The entire system depends on the visibility of these practices and their innovative nature. However, innovative organizational practices are relatively easy to observe and, even when they are, they tend to spread without firmly established information being produced on what it is that is truly effective. In addition, practices often incorporate tacit knowledge, which plays the role of an active integrating agent. It is not part of processes of inference or deduction. This element makes innovative practices difficult to observe [NIG 14].

Finally, the promotion of scientific research (recommendation 3) should enable researchers to engage in creating businesses, which implies measures on the protection of intellectual property and the possibility for entrepreneurs to file provisional patent applications.

## 3.3. The role of institutions in the dynamics of the venture capital industry

We will approach this area in two steps. The first step adopts an approach of applied economy. An econometric model of investment determination allows us to highlight the role of certain institutions in this type of financing. The second step analyzes the influence of institutional architectures more

broadly whose characteristics largely shape the development of the venture capital industry.

### 3.3.1. *An econometric model for determining venture capital investment*

Following the model presented in Chapter 2, we analyze the determinants of venture capital investment using the *Industrial Organization* (I/O) approach. This approach is based on the set of economic, institutional and organizational variables that influence the behavior of players, without neglecting adjustments to the market. In this approach, firms are not studied in themselves, but as part of an industry whose behavior and performance we are trying to explain. The point of reference is the structure/behavior/performance paradigm, three areas of focus that are related to the basic conditions in an industry.

In our analysis, we will prioritize the basic conditions, because they contain the institutional factors whose impact on the venture capital industry is being assessed. "Behavior" refers to the investments that are made, that is the amounts invested by venture capital firms in the companies in their portfolio. As in the previous model, the supply corresponds to fund management companies that raise capital from different investors, and the demand is generated by companies seeking financing for their projects. The basic conditions include the macroeconomic, institutional, entrepreneurial, and exit characteristics that form the environment for this activity. An econometric study is undertaken to explain venture capital investment from a sample of 18 European countries over the period 2002–2009 [GUI 15]. We wanted to extend the model until 2012, but the difficulties of aligning the variables with their definitions over the initial period 2002–2009 left us no choice but to abandon it, due to the problems encountered regarding how robust the estimates were. That is why we have limited ourselves to the period of 2002–2009.

There is only a small amount of economic work on the issue addressed here [GOM 98, ARM 04, FEL 13]. The studies cited are the closest to our investment determination analysis. The structure/behavior/performance paradigm provides useful elements for analyzing the dynamics of the venture capital industry.

### 3.3.1.1. *The analytical framework*

The basic conditions are traditionally considered from the point of view of supply and demand.

On the supply side, the macroeconomic environment is reflected in the GDP growth rate, which is likely to influence fundraising from investors. The more funds raised, the greater the amount of capital that is available to operators for investment.

The interest rate is a macroeconomic indicator that is a trade-off variable. It is considered that if the interest rate increases, the attractiveness of venture capital investment decreases, which in turn affects the amounts allocated to the companies in the portfolio[6]:

> "Of course, the trade-off question does not arise for all capital holders, as some of them will immediately ignore investments in venture capital funds due to the considerable uncertainty surrounding the success of companies, and its corollary in terms of future returns on investment" [GUI 15, p. 197].

The institutional environment is a variable that encompasses regulatory, normative, and cultural aspects, with the former corresponding to public policies and rules that govern the activity and behavior of agents.

*On the supply side*, we must also consider the tax and legal framework that governs the behavior of fund management companies and investors. This variable is part of the tax and legal environment that promotes the development of venture capital and entrepreneurship. It is proposed by EVCA for European countries (2008).

Armour and Cumming [ARM 04] also consider political interventions by means of the allocation of public capital to venture capital. They consider two scenarios: that of a positive impact on the amount of funds raised, and that of a negative impact on these two variables[7]. In addition, we must

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6 It is also conceivable that very low interest rates could, as mentioned above, encourage riskier investment by operators, particularly in periods of quantitative easing.

7 "Logically, a positive impact on fundraising and investment is expected in so far as government-sponsored funds can encourage private investment. This is confirmed by Leleux and Surlemount's study (2003) based on 15 European countries during the period 1990–1996. However, a reduction of fund-raising and investment levels can be envisaged due to the fact

consider the nature of the financial system as part of regulatory institutions. A market-oriented system (see below) provides opportunities for exits through IPOs held by the companies receiving the funds, and should encourage venture capital activity. This is less true in the case of a bank-oriented system. The various studies on this question lead to contrasting results. Therefore, the opportunities for exits in the following model are not limited to financial markets (IPOs), even in countries with a market-oriented financial system. As for the sales of companies to industrial enterprises (trade sale), we consider them an important exit mechanism for the development of this industry[8].

On the demand side, the macroeconomic situation influences entrepreneurial dynamism by multiplying opportunities for the creation and development of new businesses. As for the interest rate, it is a basic condition of the venture capital industry, considering that a low rate makes bank financing more attractive or encourages riskier investments. Most of the work on this point does not identify any positive impact of this variable on venture capital activity.

The institutional factors that emerge on the demand side primarily concern the tax-related and legal environment of companies seeking financing[9]. With regard to the companies' exits, it is also possible to consider stock markets and mergers and acquisitions (M&A) from the perspective of

---

that government-sponsored funds can crowd out private investment. Such a crowding out effect is highlighted by Cumming and MacIntosh (2003a) for Canada following the introduction of legislation establishing subsidised Labour-Sponsored Venture Capital Corporations (LSVCCs). Armour and Cumming's econometric study (2004) confirms its crowding out effect. Consequently, this raises the question of how governments can efficiently support VC activity" [GUI 15, p. 198].

8 "According to EVCA, divestments by trade sale represent 28.4% of the total amounts divested in 2009 in Europe, and those by public offering represent only 11.9%" [GUI 15, p. 199].

9 "Anything that encourages entrepreneurship, namely advantageous corporate taxation, attractive stock options devices, etc., creates favourable conditions for VC activity. That is why the tax and legal environment of investee companies is taken into consideration in the previously mentioned EVCA's (2008) composite index of the tax and legal environment favouring the development of private equity, VC and entrepreneurship. This index incorporates dimensions affecting both the supply and demand of VC financing. However, in their analysis, Armour and Cumming (2004) neglect the demand dimension of this index, considering only that of supply" [GUI 15, p. 200].

the demand for venture capital. Some studies mention that financial returns (IRRs) and the existence of speculative financial bubbles are also potential factors for demand.

As for entrepreneurial dynamics, these are affected by the macroeconomic business environment, whose influence on venture capital is reflected in increased demand for financing. Beyond the general aspects related to entrepreneurial dynamics, a specific dimension has caught our attention: the innovative capacity of businesses, because companies that develop innovative projects are a priority target for venture capitalists. Two indicators were used: R&D expenditure and patent filings, which Armour and Cumming's study notes have a positive impact on venture capital investment.

### 3.3.1.2. *The econometric model*

The sample selected includes 18 European countries[10]. Limited by the information available and the problems of homogenization of certain variables, the period studied is from 2002 to 2009. The structure of the model is as follows:

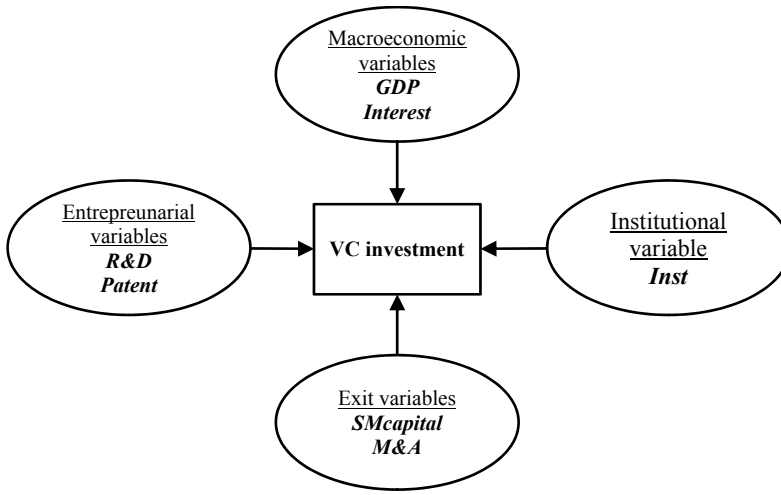


**Figure 3.1.** *The variables considered in the model (source: after [GUI 15, p. 201])*

10 Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Netherlands, Poland, Portugal, Slovakia, Spain, Sweden, and the United Kingdom.

The dependent variable is the total venture capital investment divided by GDP. The GDP growth rate delayed by one year is a basic condition of supply and demand:

> "On the supply side, a dynamic economy can have a positive effect on venture capital commitments, and it is fundraising that determines the scale of investment. On the demand side, if the economy grows rapidly, entrepreneurs may have more opportunities to create or expand their businesses. Therefore, we may observe increases in the demand for VC funds" [GUI 15, p. 202].

In terms of supply and demand, the expected impact of economic growth on the dependent variable is positive.

The real interest rate used corresponds to the real yield on government bonds. This variable is delayed by one year. The EVCA Composite Index refers to the fiscal and legal environment that supports the development of venture capital and entrepreneurship in European countries[11]. More specifically, this index includes three elements: the tax and legal environment of limited partners and fund management companies, the environment for invested companies, and the environment that allows capabilities to be maintained in invested companies and fund management companies. As in the previous model, this composite index is calibrated from 1 (most favorable environment) to 3 (least favorable environment). The expected relationship between this variable and the dependent variable is negative.

The context of the exit is assessed using two indicators. The first is the capitalization of stock markets divided by each country's GDP (a variable delayed by one year). We also used the value of mergers and acquisitions (M&A) divided by GDP (delayed by one year), which represents opportunities for exits in terms of divestments by sale to other companies. These two variables are expected to have a positive effect on venture capital investment, particularly from the supply side.

11 This indicator provides information on the competitiveness of risk capital and venture capital performance by country [EVC 08].

The context of innovation is understood through two variables. R&D expenditure of businesses divided by GDP (one year later) expresses R&D intensity and corresponds to an indicator of resources committed. Patent applications submitted to the European Patent Office (EPO) per capita and delayed by one year are used as a performance indicator. The expected impact of these two innovation variables on the dependent variable is positive.

The explanatory variables are presented in Table 3.5.

| Variable | Definition | Role | Expected effect |
|---|---|---|---|
| Macroeconomic variables | | | |
| *GDP_1* | Real GDP growth rate (one year behind). (*Eurostat*). | Measures the influence of economic dynamics. | + |
| *Interest_1* | Real ten-year government bond yields (delayed by one year). (*Eurostat*). | Underlines whether the interest rate is a trade-off criterion between investment in VC funds and alternative investments remunerated by the interest rate from the point of view of the investor or as a trade-off between private equity financing from VC organizations and debt financing from banks from enterprises' point of view. | -/+ |
| Institutional variable | | | |
| *INST* | Index of the fiscal and legal environment conducive to the development of PE, VC and entrepreneurship (a low value represents a more favorable environment) (*EVCA*). | Assesses the influence of the institutional context. | - |
| Output variables | | | |
| *SMcapital_1* | Stock market capitalization divided by GDP. (delayed by one year) (*Eurostat*). | Assesses the impact of the financial market environment as an exit opportunity. | + |
| *M&A_1* | Value of mergers and acquisitions divided by GDP (delayed by one year) (*EVCA*). | Assesses the impact of mergers and acquisitions as an exit opportunity. | + |

| Innovation variables | | | |
|---|---|---|---|
| *R&D_1* | BERD expenditure divided by GDP (delayed by one year) (*Eurostat).* | Assesses the impact of resources invested in innovation | + |
| *Patent_1* | Patent filings to the EPO per capita (delayed by one year) (*Eurostat*). | Assesses the impact of the results of innovation activity in terms of patent filings. | + |

**Table 3.5.** *Presentation of the explanatory variables (source: [GUI 15, p. 205])*

### 3.3.1.3. *The results obtained*

Table 3.6 presents the results of four regressions (A1, A2, B1, and B2) that take into account the correlation constraints of the variables. The different regressions (ordinary least squares method – OLS) obtain $^{R2}$ and adjusted$^{R2}$ values with good quality.

| | Reg. A1 | Reg. A2 | Reg. B1 | Reg. B2 |
|---|---|---|---|---|
| GDP_1 | -0.0045462 (-0.86) | -0.0063474 (-1.21) | -0.0038759 (-0.82) | -0.0033056 (-0.68) |
| Interest_1 | 0.0103541* (1.70) | 0.0116272* (1.96) | 0.0131707* (1.76) | 0.0161141** (2.12) |
| INST | 0.0000896 (0.29) | 0.0002542 (0.84) | -0.0005571** (-2.04) | -0.0004794* (-1.74) |
| SMcapital_1 | 0.0018932*** (6.01) | 0.0020634*** (7.01) | – | – |
| M&A_1 | – | – | 0.0102126*** (4.71) | 0.0112383*** (5.05) |
| R&D_ 1 | 0.0096471 (0.65) | – | 0.0386361*** (3.58) | – |
| Patent_1 | – | -0.4624055 (-0.43) | – | 1.745646** (2.03) |
| Constant | -0.0005646 (-0.80) | -0.0007981 (-1.15) | 0.0009625* (1.74) | 0.0009089 (1.62) |
| Number of observations | 91 | 94 | 110 | 113 |
| Ajusted R-squared | 0.4702 | 0.4711 | 0.3788 | 0.3302 |

**Table 3.6.** *Econometric results (source: GUI 15, p. 206). Value of t in brackets. *: significant at 10%, **: significant at 5%, ***: significant at 1%*

Shifting the growth rate by one year has no impact on venture capital investment. This confirms the results of several studies that reflect the difficulty of establishing a relationship between these two variables. The sample tested is composed of European countries whose venture capital activity is more focused on the expansion phase. The fragmentation of European economies and the low investment returns on the initial stages meant that "over the period 1985–2009, Veugelers [VEU 11] noted that the seed and start-up investments made in 13 major European countries represented only 38% and 22% of the investments that were made in America over the same period" [GUI 15, pp. 205–206]. The relationship between venture capital investment and GDP growth was studied by Meyer. Although there is a two-way relationship between these variables, countries with high venture capital activity grow faster, but the opposite is not true. Granger's tests to assess the direction of causality indicate that "venture capital investments in the United States...lead to real GDP growth" [MEY 06].

The positive and significant impact of the interest rate leads to an interpretation in terms of demand. This does not mean that the interest rate has no effect on the supply side, as an increase in the interest rate may lead investors to prefer other asset classes. The results obtained, as was the case with the model presented in Chapter 2, simply mean that the effects of demand outweigh the effects of supply.

The INST variable is significant in two regressions with the expected negative sign. This confirms the result obtained by [ARM 04] with the same variables. The two output variables SMcapital_1 and M&A_1 are very significant at the 1% threshold, and the relationship is positive. Thus, favorable exit conditions create strong incentives to invest in venture capital.

More specifically, the incidence of the variable M&A_1 is particularly high, and even higher than that of SMcapital_1. This may be explained by the fact that some of the economies selected in the sample do not have developed financial markets, that is those that are established and structured, and in this context, that sales to other companies represent a preferred exit channel for venture capitalists in Europe.

Finally, innovation variables have a positive and significant effect in several regressions, showing the close connection between venture capital and innovation.

Venture capital is a mechanism for financing innovation, very often oriented towards breakthrough innovations. Venture capital financing frequently defines new technological paths and leads to the chain multiplication of highly innovative projects by offering investment opportunities to venture capitalists. The variable RD_1 is significant at the 1% threshold in the B regression. The growth of R&D expenditure as a percentage of GDP increases opportunities for investment. This result confirms previous developments in public R&D spending that may increase the demand for financing from entrepreneurs with marketable projects. The Patent_1 variable is less significant (at the 5% threshold in the B2 regression). An increase in the number of patents filed sends a good signal to investors, it promotes the establishment of a "track record" for start-ups and a lower-risk venture capital investment.

### 3.3.2. *Specific analysis of institutional factors*

Institutional factors produce specific architectures, which we will analyze in our first step. This will allow us to go beyond the model presented in our second step.

#### 3.3.2.1. *Institutional architectures*

Many authors have stressed the importance of institutional architectures on the dynamics of innovation [GOM 98, AMA 99, HAN 99]. In a market-based institutional architecture, high-tech activities develop rapidly, because market-based governance mechanisms are able to resolve major organizational conflicts that affect this activity [CAS 00]. First, a flexible and deregulated labor market is particularly active. Managers protect the company's assets through hiring and firing when required by certain circumstances, while scientists and skilled workers are free to move from one firm to another through employment contracts that incorporate explicit non-disclosure clauses applied to specific technologies. This explains the high labor mobility that exists within technology clusters in the United States [GUI 17a] and, in the relationships between firms, of career opportunities based on the likelihood of high turnover. In addition, a dynamic labor market facilitates retraining that compensates for the depletion of skills produced by rapid technological change.

Second, the financial risks of innovation are borne by venture capitalists who trade-off technological uncertainty for short to medium-term financial losses, against the prospect of significant long-term gains. In addition, IPOs represent a favorable mechanism for exits, since firms can adopt a portfolio strategy that allows them to spread risks across different investments and test different concepts through lower experimental costs. This allows deferrals and capital savings.

Third, wage labor is becoming more financialized: company shares are becoming a common form of compensation for recruiting and retaining qualified staff, through the practice of stock options. The prospect of significant financial compensation, provided to varying degrees according to the status of individuals, makes it possible to enhance employees' individual motivation (bearing in mind this mechanism alone is insufficient to ensure the organizational integration of employees). The contribution of scientists to codified intellectual property is recognized to the extent that they can publish under their own name, alongside that of the firm. This mechanism is part of a virtuous circle. Successful firms are able to attract renowned scientists who, for their part and thanks to the contacts developed within their own network, attract the attention of venture capitalists. An illustrative case can be found in biotechnology.

The complementary nature of institutions that characterizes market-based systems encourages the emergence of radical innovations produced by companies that explore new technological paths. By contrast, the institutional architecture in Germany creates obstacles to radical innovations, but it favors the organization of incremental and continuous progress within sophisticated, but previously formulated, technologies.

Therefore, an economy based on private ownership and employment can give rise to different configurations depending on the precise (institutional) forms that social relationships take over time. In this context, it is possible to contrast the institutional characteristics of wage labor, the financial system, and the organization of companies on a case-by-case basis. The US labor market is based on decentralized negotiations and high labor mobility, that is the preponderance of an external market to attract high-level skills. By contrast, in Germany, the coordinated system for wage negotiations promotes the progression of employees along educational and professional trajectories and makes long-term employment practices in companies more

meaningful, even if there is a decline in this type of employment at the present time.

As a result, employees are involved in the organization of work and changes in remuneration. Co-management mechanisms generally make it possible to anticipate and absorb shocks of demand and to plan the management of the employment cycle, while allowing for necessary retraining. The system is more brutal in the United States: shareholder preference (shareholder value) prioritizes stockbroker redundancies and the imposition of minimum legal constraints on the organization of the company.

In addition, the financing provided is mainly directed towards productive operations. It is largely based on the attitude of banks and of the *Länder* to promote training and learning processes. Financial games (hostile takeovers, for example) are not the priority in the relationship between companies. By contrast, mergers and acquisitions are increasing in the United States: a fluid and abundant capital market encourages the development of purely financial strategies; and the possibility that financial arrangements may lead to takeovers in order to absorb capital in the form of knowledge and skills held by targeted firms (quality of R&D laboratories, number of patents, etc.) and to consolidate market positions.

More generally, differentiations characterize successive phases of the investment. Market-based systems, particularly in phases of rising economic activity, can be considered to be more suitable for financing early stage investments, while bank-based systems are more suitable for financing projects in the expansion phase, once the company's economic performance has been established. Similarly, an exit through an IPO is emblematic of market systems, while a transfer to another industrial company is more frequent in countries where investment banks and public interventions can promote such solutions [AMA 99].

All these elements suggest that the institutional environment somehow "locks" the company into a specific development trajectory that remains extremely sensitive to its initial conditions. The opportunities for resources offered to businesses by their entrepreneurial support network (human and financial resources, advice and expertise, etc.), the existence of well-established university-enterprise transfer mechanisms and, on the other end of the spectrum, the presence of liquid and established financial markets,

allow start-ups to engage in projects to create and market new products, new technologies, etc. To say that the conditions in which these firms are created and developed are important as much for their organizational growth would be to significantly minimize the importance of strictly technological strategies, which are not enough by themselves. It is probably the combination of these elements that justifies the effectiveness of the institutional environment in the United States in promoting radical innovations.

Taking into account the institutional framework makes it possible to analyze the configuration European countries are adopting in their quest to develop a venture capital industry. These countries have been adopting new principles for financing innovation for the past 20 years or so, the shaping of which cannot be found in the existence of an active labor market for experienced scientists and managers, nor in the American contractual model governing the venture capital market (see Gilson's thesis).

#### 3.3.2.2. *Beyond the model presented*

The study of the different varieties of capitalism offers interesting perspectives for analyzing venture capital [HAL 01]. According to Hall and Soskice, economies draw upon their institutional architectures to build "comparative institutional advantages" that give them a better capacity to develop certain activities than other countries. In this analytical framework, "venture capital is better suited to thrive in a liberal market economy" [SIN 13, p. 23]. In addition to a more pronounced orientation towards disruptive innovations, we have seen that liberal market economies have specific characteristics: a deregulated labor market, a training system conducive to the acquisition of high qualifications and general skills, and a liquid, established, and structured financial market.

The characteristics of coordinated market economies conflict with this description. Organized around bank-based systems, they focus on building networks and various forms of collaboration, as opposed to the competitive relationships of market economies. In addition to the different capacities of these two types of economies to promote radical versus incremental innovations, a hierarchy can be established between the different institutional components. The existence of open and specialized financial markets encourages venture capital investment, while other institutions such as the tax and legal system, the labor market, the education system, and the

corporate governance system are complementary elements in the development of financial markets. Singh [SIN 13] constructs a variable referred to as an aggregate financial structure that includes three indicators: activity (a measure of stock market activity relative to banks), size (market capitalization relative to the bank credit ratio) and efficiency (liquidity of financial markets relative to banking system inefficiencies approximated by the amount of overhead costs).

In his work, the author identifies the following elements: a developed financial market, a fluid labor market, human capital corresponding to radical innovations and cultural factors (which are informal institutions) that favor entrepreneurship. More specifically, barriers to entrepreneurship hinder the development of the venture capital industry. The most important barrier is the rigidity of the labor market, which has been confirmed in several studies [ROM 04]. Due to the greater aversion to risk in this area, the entrepreneurial culture in Europe is considered to be "lagging behind". Econometric estimates lead to the following results:

– a more market-based structure is associated with more sustained venture capital investments. This is particularly the case in the United States and Canada;

– the two determining factors in explaining venture capital investments are the development of the aggregate financial structure and the rigidity of the labor market.

These different elements are organized in Figure 3.2.

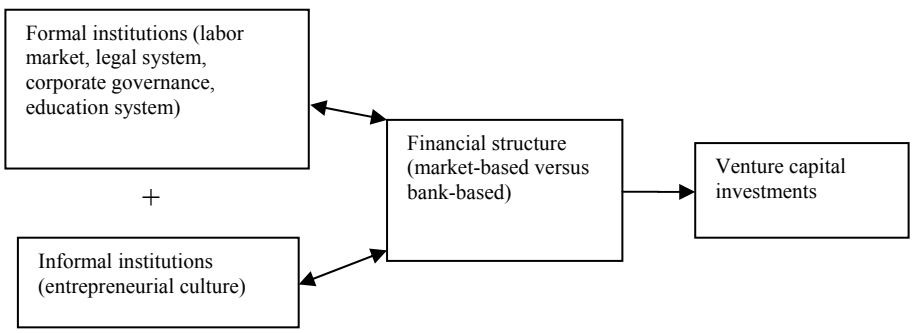


**Figure 3.2.** *The market configuration of venture capital*

This pattern of analysis leads to the conclusion that the United States has a comparative institutional advantage that classifies its growth as "venture backed-growth" [SIN 13, p. 64]. Its innovation-led macroeconomic growth performance owes much to the development organized by the public and private players in its venture capital industry. The long and often contradictory learning processes in the economic context (e.g. the Internet bubble) that are carried out by venture capitalists, with the corollary of the formation of entrepreneurial support networks often organized within clusters, dedicated to a given activity (semiconductors, biotechnology, pharmaceuticals, etc.), have made it possible, despite significant failure rates, to reconcile the demands of investors and the needs of entrepreneurs.

Venture capital in Europe (with the exception of the United Kingdom) would seem more like a niche [SIN 13, p. 64] within a system more heavily dependent on bank-based financing. However, we are witnessing a shift in the financial structures in Northern Europe towards the market. In other countries, niches are gradually being created thanks to partial developments in the tax and legal system and in the relationships between public and private players. However, this organization could be improved by more clearly connecting the economic doctrine that could make venture capital an instrument of industrial policy. As Ekeland, Landier, and Tirole point out, the challenge is to build a truly autonomous venture capital industry and to create an entrepreneurial ecosystem that many European countries, and France in particular, need more than anyone else.

## 3.4. Conclusion

In this chapter, we have presented the three structures for interpreting the venture capital industry. We have accepted the idea of the emergence of a new venture capital market that requires very specific processes to function. First, this new market is giving rise to the emergence of business groups within which the various partners are learning and joining privileged networks. The investors and entrepreneurs are no longer those presented in standard theories: they acquire knowledge, learn, build interactions that put them on the path to innovation, and no longer of equilibrium. But very often, the agents are replaced by the effects of agglomeration (as in the thesis of the reproduction of entrepreneurial capacities) or by a massive and coordinated public intervention, necessary to form the basis of a process of co-evolution. In addition, the relationship between risk and the market was analyzed

within the market to identify the non-market processes underlying the relationships between large companies and start-ups, and the processes of selection and experimentation implemented by venture capitalists.

In the second step, this mechanism for financing innovation was analyzed as part of an evolutionary process. Indeed, time is an essential factor in the formation of an industry. The qualitative conditions that shape the trajectories of industrialization are based on two types of arguments: the spread of an industrial logic that develops within an investment/reinvestment loop and that favors the creation of specialized managerial capital, and the influence of factors that are internal and external to this activity. Among these factors, we have favored the relative weight of venture capital investment in relation to GDP and the role of public authorities at the European and French level, whose interventions are intended to improve the coordination of public and private players and express a strong desire to build an autonomous venture capital industry.

The third step in our approach focused on the role of institutions. The econometric model we used allowed us to assess the influence of certain institutions on the volume of venture capital investments. A more in-depth analysis of institutional factors reveals national configurations that could encourage further development of this industry. However, the venture capital industry in Europe is extremely fragmented. Indeed, the legal, fiscal, and operational environment in which this industry develops is still largely determined at the national level, a factor that blocks the emergence of economies of scale. Similarly, the particularities of national institutions were brought to light, which show the United Kingdom to be closer to the United States (market-based systems), while France and Germany have a configuration that makes them more akin to bank-based systems.

In this context, the institutional arrangements that are being put in place are giving rise to a more hybrid form of organization in this industry [GUI 08], which reflects the progressive arrangements, and the long and sometimes contradictory learning process that takes place in the different countries. The industrial organization of venture capital, analyzed in terms of its structures, behavior and performance (types of funds, types of investment, positioning on the different phases of projects, orientation of investments by sector, incentive schemes, etc.), expresses both the specificity of national contexts and the homogenization tendencies reflected in the different practices that are adopted.

This dynamic of homogenization/differentiation influences the ways in which European countries adopt new principles for financing innovation that develop under the influence of tax and legal systems, and the changes affecting the labor market. In light of this, we may make two remarks:

– on the one hand, the spread of best practices, if this does in fact occur, does not mean that the reproduction of these practices occurs identically. In fact, it must be considered that the trend towards homogenization is partly based on the idea that "the range of financial support mechanisms is not infinite" [DUB 03];

– on the other hand, forms of specialization are being reinforced and developed that may hinder widespread dissemination of certain practices and legitimize the perpetuation of certain national particularities. It is worth noting that innovative practices such as syndication and staged financing have not spread as widely as in the United States. In addition, the venture capital industry at the European level is based on the existence of specific constraints that do not exist in the American economy: high fragmentation, differences in profitability, much lower average investment size, and much lower number of public policies oriented towards R&D and innovation. Overall, the venture capital industry in the United States reinforces a model of specialization with a science-based nature that is more pronounced than in Europe.

# Conclusion

Venture capital has its own history and geography. The gradual implementation of a mechanism for financing innovative projects, led by new companies, only became a reality in the United States after the Second World War with the creation of the ARD firm in 1946. This organizational innovation has a wide array of lessons to offer. It is not just a question of raising funds and providing financial support to small local businesses, but also, and most importantly, one of assessing the technological, productive, and commercial opportunities that are emerging in small businesses. The functions of venture capitalists take shape over the course of a long chain of interventions, from seeding to maturity, requiring VC firms to implement their interpretative knowledge (based on the entrepreneurial support network) and instrumental knowledge (productive, managerial, and organizational) required to effectively manage the companies receiving the investments.

It is here that the intersection with geographical considerations takes place. The United States is in a leading position because it is able to activate the entire financing chain. The division of funding works greatly facilitates the development of start-ups by allowing venture capitalists to focus on the *early* and *late stages*. The transformations taking place in the world of finance and the development of financial markets clearly show the rise of China, India and Japan, etc. At the same time, the development of new paths of internationalization, driven by large-scale financial movements, have secured China's pre-eminence within the region of Asia.

Venture capital is a significant component of a country's overall innovation dynamic, which is based on a pattern that alternates from phases

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of rupture and progression – highlighting the fact that, over the past 40 years, the literature has focused more on the relationship between venture capital and radical innovations. This can be justified when we consider the number of venture capital-backed companies during this period that have changed the way they produce, purchase, and communicate. We can also consider that the spread of computer and digital technologies has transformed the nature of relationships between social groups, between teachers and educators, between places of power and centers of protest.

In a way, venture capital itself is a form of contradiction. It highlights the role of the entrepreneur-innovator as the carrier of an innovative project that places him in the forefront of the procession, and inscribes him in the logic of a contemporary capitalism that is profoundly different from organizational capitalism. As Rosanvallon points out, technological objects increasingly incorporate scientific applications, and "creativity has become the main factor of production" [ROS 11, p. 300]. This is one of the aspects of a kind of capitalism that favors singularity and autonomy, and characteristic of an economy strained by a state of permanent innovation. The largest market capitalizations are those of companies (Apple, Google, Microsoft) [GOR 15, p. 2] that have gone from being "gazelles" to holding a quasi-monopolistic position on their market within a few years. The singularity goes so far as to identify the company with its creator (Facebook with M. Zuckerberg, Amazon with J. Bezos, etc.), tying together their personal wealth with the company's market capitalization, forgetting that there are also other stakeholders: shareholders, employees, etc.

On the other hand, the capitalism of creativity puts in perspective the individual action. We agree that, unlike other economic decisions (financial investments, business expansion), innovation is a process that is unlikely to be made more likely, involving chances of success or failure that cannot be determined in advance and requiring deliberation. Moreover, innovation obeys a path of dependence, with the most novel items of today based on works done yesterday. These characteristics mean that innovation is not an individual, high-risk act along the lines of a lottery, but one that requires strong economic, social, and cognitive interactions between players. As we have determined in our analysis, the places where these interactions occur lie within the entrepreneurial support network, which is an important factor in reducing the ambiguity of innovative projects.

These elements justify treating venture capital, not as a market (although offers and requests for financing exist and lead to deals), but as an industry characterized by the existence of many different players, the spread of new logical systems of operation (specialization, testing, selection, and experimentation) and the strong influence of institutions (the labor market, education system, tax and legal climate, financial markets). Giving sufficient consideration to these issues legitimizes the questions which Chapter 3 has attempted to answer. This allows us to buttress the analyses made in terms of stakeholder and the logic of the sector with macroeconomic and institutional considerations. This approach involved presenting two econometric models which sought to successively highlight the determining factors of venture capital investment in the high-tech sectors and at the macroeconomic level of the European countries selected in our sample.

Considering the work done on the performance of this method of financing, particularly in the United States, the results obtained are indisputable regardless of the variable used: the number of patents filed, R&D expenditures, growth and employment, etc. [GOR 15]. Despite the fact that it is costly and often unsuccessful, since, as we recall, it involves *testing the economic relevance of highly uncertain concepts*, the contributions this mechanism makes to the financing of innovation are indisputable. This is evident by the rapid expansion of this type of financing in Europe and in the Asia/Pacific region.

Nevertheless, in the light of this reading, what conclusions are to be drawn regarding the thesis of creative destruction, developed in the introduction to this book?

Like other forms of investment, venture capital is subject to cycles of boom and bust. In particular, from the mid-1990s onwards, the financial community's beliefs shifted in favor of venture capital-backed start-ups. This led to a massive transfer of financial resources from traditional sectors to the new economy. The dynamic companies that wield so much influence today (Intel, Cisco, Microsoft, etc.) are considered to be the top players from among those start-ups that will succeed in establishing themselves on the market. From that point forward:

> "Analysts do not examine the solidity of their organizations, let alone how viable they are, because they are convinced of the specificity of start-ups: they must spend the funds they receive

> from venture capitalists very quickly, because they are the first company likely to take the entire market. As a result, financiers will reward ambitious entrepreneurs who consume and actually waste large amounts of capital" [BOY 02, p. 114].

In addition, the proliferation of venture capital firms has the effect of promoting the creation of young and inexperienced funds with very limited industrial skills and experience. These organizations have no qualms with refinancing new companies that apply for different "financing rounds", even though their losses have increased.

This implies that newly created start-ups can easily find financial resources. And the result of this is a net destruction of capital invested in the disappearance of young companies from the new economy. This trend began when the dot-com bubble burst (in the early 2000s) and the drop in stock prices occurred. This led to a contraction in investment and employment, which first affected the financial sector and then spread to the sectors of the new economy.

The Schumpeterian model no longer applies, since capital is destroyed in the economy by the very act of financing new innovative companies, which are supposed to provide opportunities for profit. In addition, there is a clear crowding out effect, as traditional sectors are deprived of financial resources to ensure their steady growth.

Over the past 10 years, it is possible to identify periods of subsidence linked to the 2008 crisis (we talk about the deep depression suffered by venture capital in Europe) and a boom (in the case of France, news outlets report that "French start-ups are celebrating"). During this last phase, we might note an open and not very selective access to capital, provided that the innovative project is part of the digital economy? In reality, history does not repeat itself [GUI 18b].

A recent work [ALO 17] analyzes the relationship between the change in the productive fabric and the increase in labor productivity in the United States. Despite the introduction of new digital technologies, productivity growth dropped by more than half between 1995 and 2015 (from 2.8% to 1.3%).

Young firms[1] contribute quickly and significantly to productivity growth. But the difference compared to firms that are already established and more mature (20 years and older) is rapidly decreasing. Two-thirds of the effect disappears after five years, and the effect completely disappears after 10 years. Productivity gains are also affected by the entry/exit process of firms. However, the entry rate of new firms has been declining since the mid-1990s, resulting in a decrease in the number of firms in all sectors, including ICT. More specifically, the exit rate significantly exceeded the entry rate between 2008 and 2011, and the net creation rate remained slightly positive until 2015. Many studies highlight the decline in entrepreneurial dynamism and note that the share of employment attributed to new firms has fallen by 30% over the past 30 years.

The authors cited above have determined two distinct periods: 1996–2004 (high productivity), and 2005–2016 (low productivity), and make two observations. The first is that the innovations implemented within firms have a much weaker influence on productivity than market forces exerted on young firms through the effects of the selection and reallocation of economic activity (inefficient newcomers lose market share and exit very quickly). The decline in entrepreneurial dynamism is reflected by a deficit in the number of start-ups, and the lasting effect of this deficit that gains in productivity slowed by about 0.5%. It also reflects a strengthening of the concentration and market power of the most dynamic and productive firms described by Autor *et al.* as "*Superstar*" *firms* [AUT 17].

This is a complete departure from Schumpeterian dynamics, since the effects obtained on the market have a greater influence on productivity than the innovations made within firms. The second observation is that the most productive firms already established have not gained market share at the expense of the least productive firms. In the case of established firms, it is widely accepted that as one firm increases its productivity, another firm will see its productivity decrease. This blocking of the reallocation of added value between mature firms more than compensates for the modest productivity gains achieved within firms.

1 Young firms are those between 0 and 19 years old. This does not generally match up to the firms selected to be used as samples in this work.

Artus [ART 18] explains how Schumpeterian dynamics are blocked by two factors. First, very low interest rates significantly reduce companies' interest charges, and have artificially allowed inefficient companies to continue their operations. Second, wage stagnation and the distortion of income sharing to favor profits have increased profitability and helped to keep low-productivity firms in business, despite a marked development of digital technologies in OECD countries.

While overall productivity growth is slowing, productivity gains are nevertheless dispersed among firms due to the slowdown in the spread of new technology. Research conducted in 40 countries and across many sectors indicates the existence of a U-shaped curve, a kind of "productivity trap" whose edges are made up of young firms with low initial productivity but rapid growth, and large firms with high productivity. The companies caught in this trap are no different in size than the large companies located at the top of the distribution. On the other hand, they suffer from a low efficiency of their intangible inputs, particularly in knowledge- and technology-intensive activities.

This can be explained by the strategies of Superstar firms that block the spread of digital knowledge and technologies, by capturing growing market shares and protecting their intellectual assets (a practice evidenced by the decrease in the speed of patent citations). The slowdown in the spread of technology maintains the dispersion of gains in productivity. A command of Big Data and the best tools to use this data allow the most dynamic firms to provide better services and reinforce their advantages. They are part of a virtuous circle, since this strategy makes it possible to consolidate their markets, make their products and services essential to consumers, and lead to quasi-monopolistic situations (by using their market power to erect barriers to entry and protect their dominant position – particularly by buying up start-ups financed by venture capital). This runs contrary to what was theorized by Schumpeter, which reduced monopolistic practices to the objective of restricting production by increasing selling prices.

The transition to a new technological regime involves a principle of selection in that some organizations have shown themselves capable of creating their own environment, and therefore of escaping from a situation in which they would be forced to adapt by learning to organize a fully completed whole that they can appreciate and modify under the benevolent

guidance of the authorities of competition[2]. The result of this is a very significant increase in the costs of adopting technology for a large number of companies, which leaves them caught in the productivity trap. Indeed, digital technologies take a considerable amount of time to operate effectively, most likely several years. Threshold effects must be achieved, and additional investments are needed, such as the redesign of processes, training expenses, changes in the company's organizational structure, etc. [BRY 17]. Thus, maintaining national and international competition in this field requires increasing both the stock of tangible and intangible capital available to companies.

*Schumpeterian dynamics are disrupted in the United States for several reasons*. First, innovation is not effective in rebuilding the productive system, including the start-up deficit, decline in entrepreneurial dynamism, increased concentration on activities benefiting from high returns of scale and network effects, the maintenance of operations, and especially of old and unproductive companies.

Second, the difference in output growth rates between the most dynamic and less dynamic firms was 16% in the 1990s. It fell to 4% in 2008 and beyond. It even turned negative in 2011. This begs the question as to whether this can be interpreted as a slow movement toward the homogenization of the American economy, characterized by less dispersed output growth rates and minor differences between dynamic and less dynamic firms. This observation, if proven true, is not insignificant nor the most pleasant for economists addressing another question: how can they reconcile the logic of the digital economy based on the principle of "winner take all" (increasing returns and decoupling of the market space from production) and the strategy of massive data appropriation and control by some firms with the assumption that the models of economic dynamism of the different sectors are becoming more and more similar? This remains a mystery: "Something has happened to the incentives or the ability to be a high-growth firm in the high tech sector" [DEC 15, p. 22].

2 "Some American business leaders have found ingenious ways of creating barriers to the market to prevent any form of serious competition, helped by lax enforcement of existing competition laws and the lack of updating of these laws for the 21st Century economy. As a result, the share of new businesses in the United States is declining" [STI 19].

Third, the start-up deficit is troubling. These companies are the most productive and profitable, and are the most likely to make major innovations, thanks in particular to high spending on R&D. They are not run by "subsistence entrepreneurs", but by "transformational entrepreneurs" [SCH 10] who run these companies with high growth potential in high-tech sectors. This is particularly true in knowledge-intensive services (software, Internet service provision, web portals, etc.) and in certain industrial sectors (IT, peripherals, etc.), that is in activities with the highest percentage of STEM workers.

Fourth, it is possible to analyze these trends as a challenge to the logic of venture capital. The statistics available to us clearly indicate an increased weight of the unlisted to the detriment of listing and initial public offering (IPO). As Artus recently pointed out, there were more than 8,000 companies listed in the United States 20 years ago, while today there are only 3,800[3]. This context means there are less runaway and speculative bubbles for venture capital, but also more exits done through a sale to other companies, which can increase the concentration and market power of large companies.

Finally, could we be witnessing a reversal of the mechanisms? Creative destruction means that the new replaces the old (which means that it is low-producing companies that disappear, and not traditional activities) and this brings productivity gains that are essential for improving living standards. Since 2005 and ever since then, innovation has tended to make existing structures more rigid. New elements appear without making any significant progress ("Gordon's thesis"), unproductive firms are maintained thanks to monetary policies compatible with their needs, technological diffusion slows down, and concentration increases and promotes the creation of monopoly rents.

3 "There are several fundamental reasons for this movement. The trend towards mergers and acquisitions over the past two years has obviously contributed to the downgrading of this rating. Companies have become larger and more dominant, as have the GAFAs, which buy up many start-ups, or even kill their competitors" [MAU 19].

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**Coordinated by Bernard Guilhon and Sandra Montchaud**

The funding of innovative projects that are fundamentally ambiguous often leads to situations where decision-making is difficult. However, decision-making can be improved by practices such as syndication and step-by-step funding. The dynamic of this industry requires us to consider the economic and institutional variables that make this system coherent in English-speaking countries, but conversely reduce it to a privileged niche by the leading authorities in Europe and France.

This book proposes two guiding ideas. The first idea presents innovation as a very uncertain process. This modifies the decision-making in the entrepreneurial ecosystem, with intervention upstream in regards to stronger foundations, evaluations and selection of projects. The second idea is that the actors hold onto partial knowledge in a context where their attention span is limited. These cognitive limitations need the formation of networks, and lead to mutual and complementary dependency relations.

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