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Financing innovation in Italy: an analysis of venture capital
and private equity investments

by Valerio Vacca

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FINANCING INNOVATION IN ITALY: AN ANALYSIS OF VENTURE CAPITAL AND PRIVATE EQUITY INVESTMENTS

by Valerio Vacca*

Abstract

Using a unique dataset, this paper describes the main features of the industry of venture capital funds in Italy. Operations by Italian specialised venture capitalists are only in part devoted to young, small firms from advanced industries, have a rather short duration and are weakly focused on a few firms or sectors. Furthermore, young innovative firms receiving private equity capital – from both ‘venture capital’ funds and other private equity funds – are usually also financed by banks, both at the start and the end of the investment, and the fund’s commitment tends to only weakly reduce the cost of credit. Overall, an ‘equity-then-credit’ sequence does not clearly emerge in the financing strategies of young and high-tech Italian firms, suggesting that funds play a weak signalling or scouting task towards the banking system.

JEL Classification: G21, G23 G24.

Keywords: venture capital, SMEs, innovation financing.

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1 Introduction¹

Venture capital (VC) is acknowledged to be a key factor for the competitiveness of a country's entrepreneurial system as it affects the growth of its most dynamic firms. VC funds are private-equity (PE) funds which receive capital contributions from investors and supply them to small, young, high-tech companies with high growth potential. They are specialised investors that monitor target firms' management and participate in strategic decision-making. VC funds should provide external finance to firms that are normally excluded from the credit market, owing to the characteristics of their business, especially the relatively high risk and the lack of a credit history; at the same time, the support provided by venture capitalists should facilitate firms' access to other sources of financing, primarily bank credit, for subsequent expansion.

In spite of the importance of the topic, evidence on the role played by the VC industry is still insufficient. This is especially true for the Italian market.

This paper sets out to fill informative gaps about the Italian VC-fund industry by describing its main features. In carrying out this stock-taking exercise, we ask whether Italian VC funds actually provide financial support to a crucial segment of firms – i.e. small companies recently established in innovative and technological sectors – which cannot easily be assisted by banks. Furthermore, we are interested in disentangling what happens to the financial structure of young innovative firms targeted by VC funds. The first issue entails examining the features of fund investments, also according to the ownership of the fund (independent, public, or bank-affiliated). The second topic – dealing with the relationship between bank and non-bank financing of innovation – is tackled by assessing how frequently funds introduce target firms to the credit market.

The main contribution of the paper is to use previously unexploited fund- and firm-level data to describe the VC industry, namely the mandatory reports sent to the Bank of Italy by the financial firms managing Italian private-equity funds (including VC funds) and credit data from the Central Credit Register.² These data provide an accurate picture of the financial operations undertaken with young innovative Italian firms. Previous studies in the field, by contrast, relied on information obtained from questionnaires submitted to market players or hand-collected data sets.

The rest of the paper is organised as follows. Section 2 briefly surveys the related literature; after a description of the main features of the data employed in Section 3, Section 4 describes stylized facts about VC funds' investments. Section 5 looks at the

¹ The opinions are those of the author and do not involve the Bank of Italy. I am greatly indebted to Maria Lucia Stefani, Andrea Bonaccorsi, Roberto del Giudice, Francesco Franceschi, Giovanni Fusaro, Silvia Magri, Vincenza Marzovillo, Damiano Bruno Silipo, an anonymous referee and participants in workshops at the Bank of Italy (September and December 2012) and at the University of Calabria (March 2013) for useful comments, while remaining responsible for any residual errors.

² Mandatory reports to the Bank of Italy do not explicitly distinguish the funds devoted to venture capital from among the wider category of private-equity funds; therefore, the former have been identified through information derived from their industry association (see below).

financial structure of young and innovative firms funded by private equity and the relationships between banks and innovative firms that receive external equity in their early stages. Section 6 concludes and suggests future research.

2 Related literature

Venture capital and private equity in general have been extensively studied in recent years, within the wider framework of the financing of innovative ventures: small innovative firms show a persistent lack of external finance and high funding costs, even in financial systems endowed with well-developed venture capital operations (Hall, 2010).

The literature dealing with the features of VC fund investments has tackled two main issues, the degree of specialisation/diversification of their portfolios, and the impact of the ownership of funds on their operations.

As regards the first aspect, funds' specialisation on a few sectors or industries apparently enhances the success rate of target firms, and therefore improves the funds' own performance (Cressy et al., 2012; Gompers et al., 2009); excessively diversified funds may be unable to monitor target firms effectively due to limited attention. However, Knill (2009) shows that a pure specialisation strategy is not necessarily superior to a pure diversification one, as the ability to diversify risk is crucial to venture capital's effectiveness. Within this framework, Section 4 of the paper deals with the degree of specialisation of Italian funds' portfolios by sector and their concentration on a few target firms.

Heterogeneities among funds also stem from their institutional set-up, i.e. either independent funds or funds which belong to larger organisations ('captive' funds, having a corporate, public or banking ownership). Funds' ownership can affect the type of firms targeted and the duration and size of the investment. Tykvová (2006) looks at almost 200 PE operations on the German market and finds that, compared to captive ones, independent managers are more activist in providing target companies with managerial advice. Bottazzi et al. (2008) also show that independent funds manage their investments more actively and that their firms perform better. This leads private funds to focus on just a few industries or firms (Cumming, 2006). According to Andrieu and Groh (2012) entrepreneurs decide to have recourse to an independent rather than a bank-owned VC fund by trading the former's greater expertise off against the larger financial capacity of bank-affiliated vehicles, which allows such funds to support the expansion of the firm through several rounds of staged financing and to avoid premature divestment imposed by the fund's need to raise fresh money.

Funds' ownership, in other words, can affect investment duration, which can also be driven by firms' stage of life at the time of the first investment (Cumming and MacIntosh, 2001). Private funds are likely to have incentives to exit their investments rapidly, both to pursue a grandstanding strategy (i.e. to signal a high success rate to the market) and to recover liquidity, since they rely exclusively on funds provided by private investors. Their holding periods are therefore likely to be shorter than for other funds (Gompers, 1995).

Section 4 will contribute to this literature by singling out the features of portfolios held by differently owned funds.

The link between equity provision to start-up firms (venture capital) and bank financing, which is crucial to this paper, is still an underexplored topic. The focus has traditionally been on the pros and cons of the two forms of financing *within the single stage* of firm development. Bank credit might not be consistent with the risk/return profile of investment in start-up firms, especially those operating in high-tech sectors. The typical hindrances to bank-borrower relationships (information asymmetries, agency costs, moral hazard) are exacerbated for these firms, which are consequently often financially constrained (Freel, 2007). These issues are of paramount importance in Italy, where innovation reportedly suffers from more severe constraints than in other countries, and where the banking system plays a pivotal role in firm financing (Bugamelli et al., 2012). Micucci and Rossi (2012) show that innovation in Italy is fostered by a stable bank-firm relationship, which of course is out of reach for recently set-up firms.

Based on data about Italian, German and British SMEs, Berger and Schaeck (2011) show that firms turn to venture capitalists rather than engaging in multiple banking relationships in order to take advantage of VC managers' expertise and perhaps to avoid rent extraction by the main bank. By contrast, according to Ueda (2004), there is the risk that venture capitalists will expropriate innovative entrepreneurs, who are obliged to disclose their projects during the screening phases.

Recent studies investigate the links between credit and venture capital *in subsequent stages* of firms' growth. A strand of the literature explicitly addresses the exploitation of a sequence of financing sources, whereby investors' incentives can lead to strategic behaviour. Hellman et al. (2008) is a pivotal paper in this field: their 'relationship hypothesis' states that bank-affiliated VC funds might finance small innovative firms with a view to building up early relationships. The latter will be exploited by group banks granting credit in later stages of firms' lives. The signalling effect produced by VC funds in relation to the banking system would therefore be mainly in favour of banks within the same financial group. This relationship hypothesis fosters a strategic rationalization of the pecking order in the sources of financing which is often found in firms' life stages.

Summing up, venture capitalism and banks can coexist within each phase of firms' development, be mutually exclusive, or build a natural sequence which supports the young innovative firm during its growth (first equity, then bank credit). Section 5 tries to shed light on the issue, looking at the frequency of these three alternatives in the Italian case, with specific attention paid to intra-group strategies, following – although within a mainly descriptive framework – the work of Hellman et al. (2008).

The literature on venture capitalism, which is rich for the US market, is growing for the European market. European VC funds seem to be rather conservative in their investment strategies (Revest and Sapio, 2008). The reports from the VICO project have investigated the impact of venture capitalism on the innovation rate, employment creation, and growth and competitiveness of innovative firms (VICO, 2011). VICO studies consider funds' institutional setting and address endogeneity issues, as is required in this kind of

quantitative analysis (see e.g. Puri and Zarutskie, 2010): firms having recourse to VC financing might have ex ante features which make them different from other firms and affect their subsequent performance (Bertoni et al., 2011). Bertoni et al. (2008) point to the positive effects of funds' intervention on target firms' investment activity, but show that firms targeted by a corporate VC fund continue to be financially constrained by a lack of internally generated resources.

This study focuses on the Italian market. Bank of Italy (2009) provides a picture of the Italian private-equity industry using a questionnaire submitted to target firms and financial intermediaries, jointly with AIFI (the Italian private equity and venture capital association): while expansion and buy-out operations are found to be frequent, genuine venture capitalism seems to be relatively underdeveloped in Italy; compared with other markets, contracts are less sophisticated, in particular in addressing the profit-sharing agreements between the investor and the target company, and investors' technical expertise in target firms' sectors is weaker than in other countries. Granturco and Miele (2011) also focus on Italian PE, exploiting a questionnaire submitted to fund managers, and gauge the financial fragility of target firms using balance sheet and Central Credit Register data.

3 The data

The data employed in this study are primarily retrieved from reports that firms managing Italian closed-end funds must submit to the supervisory authority (the Bank of Italy) on a half-yearly basis (see the methodological appendix for details). The advantage of using this database is that it records all the stakes in a firm held by Italian PE funds (including VC funds). In other words, the available data should generally cover, in a fully comparable framework, the whole set of operations initiated by closed-end funds established in Italy. The database suffers from the shortcomings that it disregards non-fund investors and investors not established in Italy, and that the data are primarily collected for administrative, not research-related, purposes. Moreover, in matching the portfolio reports from fund managers with official securities registers, about one tenth of the funds' portfolio could not be matched. Although nothing suggests that these non-matched operations are not randomly drawn from the complete data set, some sample selection bias might in principle be caused by this imperfect match.

Supervisory reports from fund managers can be jointly analysed with other firm-level information on target firms, namely that from the Italian central balance sheet register (Cerved/Cebi), and data on the quantity and cost of credit extended to firms by banks and other financial institutions (from the Central Credit Register and the Bank of Italy's survey data on interest rates). The latter sources make it possible to assess, for the first time for the Italian market, the effects of a VC operation on the subsequent credit history of the target firm.

During the reference period (December 2003 to June 2012),³ supervisory data refer to operations by almost 150 funds, of which about one tenth can be considered venture

³ Reports after June 2012 are not homogeneous with previous data, due to changed reporting guidelines.

capital funds. In the next section the focus will be on the features of the investments made by these ‘venture capital funds’, compared with investments by ‘other private-equity funds’.

Classification of funds is necessarily partial and incomplete: some PE funds not labelled as VC funds make VC-type investments, albeit on a non-systematic basis. By contrast, as will become apparent in the next section, VC-labelled funds devote part of their portfolios to non-VC operations, holding stakes in non-high-tech, non-small or non-young companies. In Section 5, therefore, attention will switch to the financing of innovative firms in their early stages (with seed or start-up capital) by Italian closed-end funds. These operations can be considered as essentially ‘venture capital investments’, regardless of the investor involved (i.e. a VC-labelled or a non-VC-labelled private-equity fund).

4 The features of the investments by venture capital funds

This section aims at sketching the main features of the operations carried out by Italian closed-end funds, which are commonly considered to be venture capital specialised investors. Within the current analysis, specific attention will be devoted to a key question in assessing the effectiveness of the role played by venture capitalists in promoting the development of the entrepreneurial system, i.e. whether they actually address a segment of firms (young, innovative SMEs) which are weakly supported by banks.

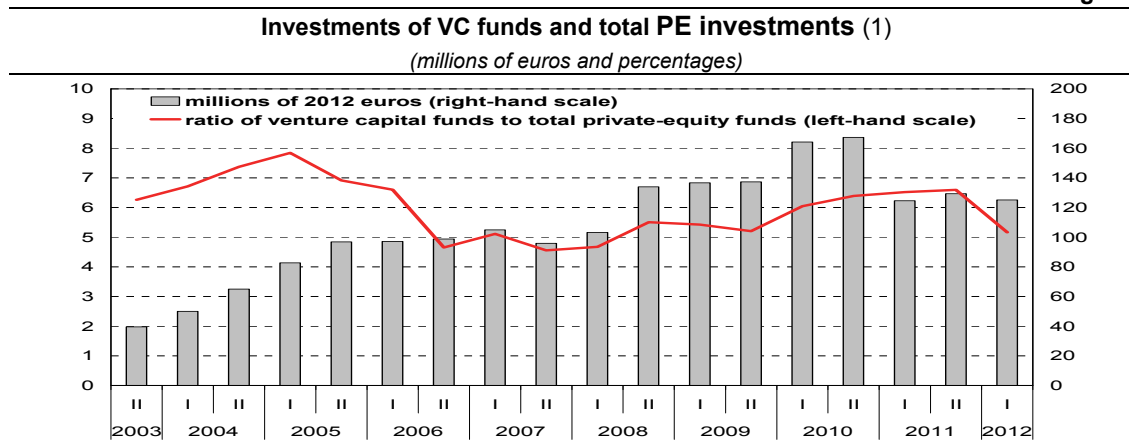
Based on AIFI reports, in particular on the yearly *Venture Capital Monitor* (see VEM, various years), it has been possible to identify funds specifically devoted to venture capital. These VC-labelled funds and the other PE funds have been sorted into sub-groups according to the ownership of the capital of their managing firm.⁴

The value of the portfolio held by VC-labelled funds peaked in the second half of 2010 and shrank afterwards; in mid-2012, the portfolio was worth more than €125 million (Figure 1). These funds’ holdings showed a cyclical pattern compared with the total holdings of Italian closed-end funds; in the first half 2012, their share was 5.2 per cent. Therefore, VC funds seem to account for a rather small share of the Italian PE market and it has not grown over time.⁵ The financial crisis that started in 2007-08 apparently affected the value of investments by venture capital funds later than the value of those by other private-equity funds.

⁴ The classification of funds has been refined through contacts with AIFI and other sources. The categories established for all the private-equity funds, both venture-capital and non-venture-capital labelled, are the following: (i) *banking-finance* if the fund’s managing firm belongs to a banking or financial group, (ii) *private* if it belongs to a non-financial company, (iii) *public* if it is backed by a public body, (iv) *mixed* if it is owned partly by a banking or financial firm and partly by a private non-financial firm, (v) *syndicated banking* if it belongs to a group of banks, (vi) *industrial/real estate* if it belongs to a group working in these sectors, and (vii) *insurance* if it is embedded in an insurance group. The groups are defined according to the ownership of the capital of the company managing the fund.

⁵ EVCA (2012) provides a comparison of venture capital market size in European countries. According to Eurostat (2012) the Italian venture capital market accounted for 0.003 per cent of GDP in 2010, compared with an EU-15 average of 0.029 per cent. Moreover, at the end of 2012 the overall portfolio of Italian private-equity funds was estimated to be about 0.44 per cent of the bank credit extended to Italian companies.

Figure 1

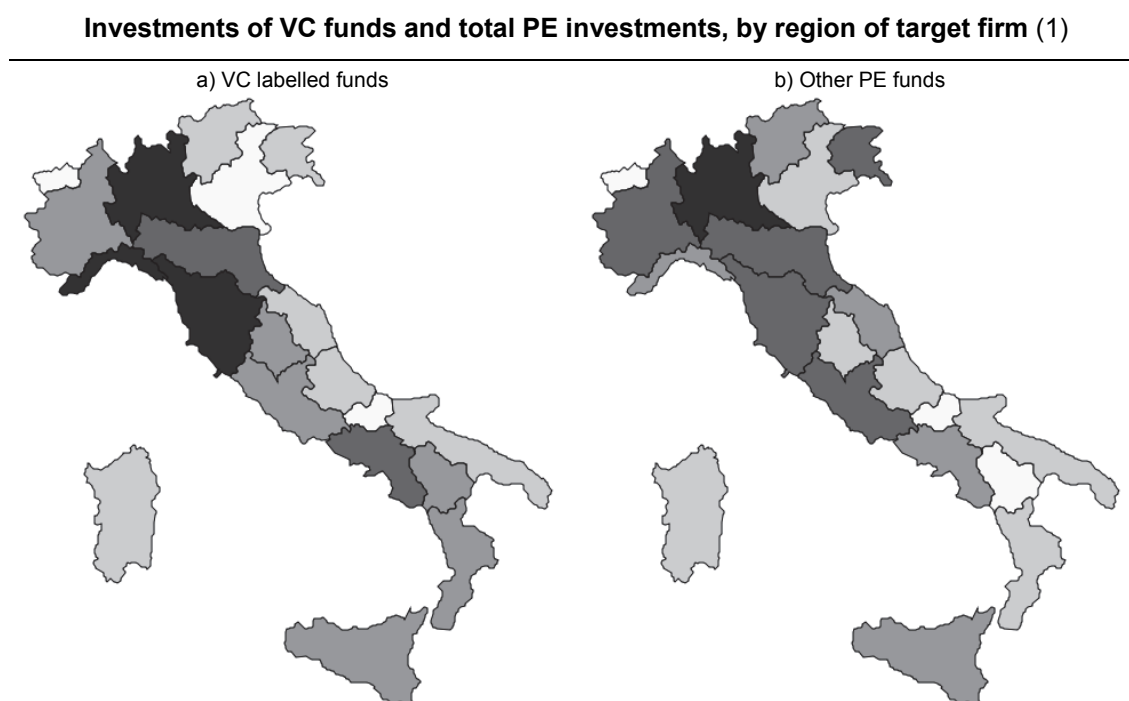


Source: Bank of Italy supervisory reports.

(1) Total portfolio of venture capital funds at the end of the reference period in millions of euros and as a percentage ratio to the total portfolio of Italian private-equity closed-end funds. The portfolio figures are reported in millions of June 2012 euros.

On average each fund invests in 2 or 3 provinces. The highest proportions of VC funds' investments were in firms in Lombardy, Tuscany and Friuli-Venezia Giulia (Figure 2). Firms in southern regions received about 12 per cent of VC funds' total investments and 4.7 per cent of the total investments of other PE funds.

Figure 2



Source: Bank of Italy supervisory reports.

(1) Ratio of the venture capital investments in each region to the total investments of Italian VC-labelled funds (panel a) and other PE funds (panel b) by region of the target firm, average December 2003 – June 2012. Darker colours correspond to higher proportions of the overall portfolio invested in firms in that region, according to the following five ranges: 0; 0 to 1 per cent; 1 to 5 per cent; 5 to 10 per cent; over 10 per cent.

4.1 Number, amount and duration of the operations

Table a1 in the appendix shows the main differences between investments by VC funds and other Italian PE funds.

Investments by VC funds have a duration of about 2.4 years on average, slightly lower than other funds. Differences are larger and significant for single fund categories, being shorter than the average for private funds. By contrast, public funds hold their stakes for longer than other VC funds and other public PE funds. Public funds display the longest duration and private ones the shortest, thus confirming a feature of the Italian VC market (VICO, 2011).

The shorter duration of VC funds' investments with respect to ordinary PE operations is to a certain extent an unexpected result, since the financial support should in principle be longer the younger the target venture, in order to gradually overcome the information asymmetries between the firm and the finance provider (Cumming and MacIntosh, 2001). Our data set in part confirms this hypothesis: the duration of the investment seems to be negatively correlated to the age of the firm at the time of the fund's intervention (with a -0.44 correlation coefficient, significant at the 1 per cent confidence level).

A first finding, therefore, concerns the investment duration, which is apparently much shorter than the minimum usually deemed necessary to support a firm in its early stages.⁶ This evidence for Italy can be compared with findings in studies based on different markets: Cumming and MacIntosh (2001) gauge the investment duration at the time of the first (partial or full) exit of the fund from the firm at 4.7 years for the United States and 5.3 years for Canada. On the same markets, Cumming and Johan (2010) record shorter investment durations (about 3 years in the United States and 2.4 years in Canada); to explain this finding they argue that, for an early-stage firm, investment has a longer expected duration if the firm succeeds, whereas in the event of failure (write-off) the duration could be shorter than for other investments.⁷ With reference to Europe, Tykvová (2006) finds similar durations for operations in the German market.

In order to shed light on the reasons for the short duration of operations in Italy, and on the apparent under-development of the VC market (and the PE market in general), it would be useful to analyse funds' investment exit. In this respect, the data set employed in this study breaks up funds' divestments into the following categories: 'stock market offering' (e.g. IPO), 'sale to other partners of the company', 'sale to other firms', and 'other'. Unfortunately, however, Italian venture capital funds do not disclose their exit strategies in accordance with the proposed categories, as for their divestments it is systematically reported that the standard exit patterns categories cannot be applied.⁸

As regards the size of operations, VC funds invest about €2.7 million on average, less than half the figure for PE operations. Private funds have the smallest holdings, while mixed and bank-affiliated funds make the largest investments, consistently with the greater financial resources these funds usually have. Public VC funds' operations are below the sector average.

⁶ As a reference, the regulation of the Italian Investment Fund (FII), a private-equity vehicle with (partly) public ownership, envisages a 5-7 year period for the Fund's intervention in target firms.

⁷ The data set used in this study records all investments, including those with a rapid adverse outcome.

⁸ For the sake of comparison, other private-equity funds report a stock market sale for about one third of their operations, a sale to other partners of the company in 6.0 per cent of cases, and a sale to other firms in 29.4 per cent of cases (weighted by the operation's amount; see Table a6).

Summing up, private funds' operations are shorter and smaller than the average, in line with the stylised facts found in other markets: privately owned funds do not have a captive capital market to rely on, and are therefore likely to divest more rapidly, with a view to restoring their financing capability and showing the market a high success rate for their investments (Tykvová, 2006). Banking/finance funds engage in larger-than-average ventures, as expected, but their commitment is not longer than the average, contrary to what is found in other markets.

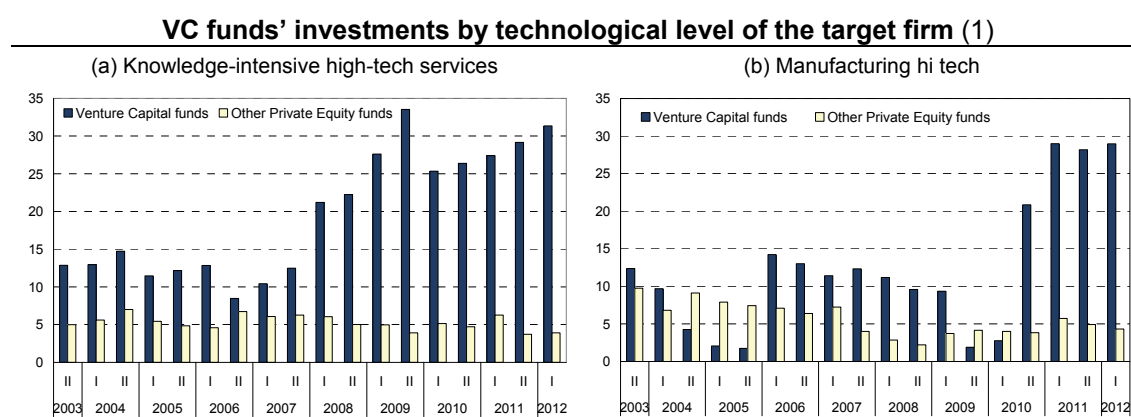
4.2 Investing in high-tech industries and start-up firms

In order to assess the extent to which VC funds' portfolios are actually devoted to advanced manufacturing or services, investments have been sorted according to the technological level of the industry to which the target firm belongs, using the OECD taxonomy (see the methodological appendix).

Table a2 shows a greater focus of VC funds (with respect to other PE funds) on more advanced and technological sectors, for both high-tech manufacturing and service firms. However, less knowledge-intensive services rank second among VC funds' holdings (17.4 per cent). The relatively low presence of VC funds in advanced manufacturing, compared with services, is consistent with anecdotal evidence provided by Italian industry players such as start-up incubators, science parks and business angels.

The focus of VC funds on innovative and technological sectors changed over time (Figure 3). Only in the second half of 2009 did investments in high-tech services rise above one third of the overall portfolio; in mid-2012 they accounted for just over 30 per cent. The share directed to high-tech manufacturing became significant only after mid-2010.

Figure 3



According to aggregate evidence, Italian VC funds invest in younger firms than other closed-end funds, but the average firm age at the start of investment is 7.4 years, which is rather high for seed and start-up firms (Table a3). The age of firms at the time of funds' entry is also higher than in other markets: Cumming and Johan (2010) report an average of 5.7 years in their Canadian sample and of 5.4 years in the United States. The Italian target firms analyzed in VEM (2010) had about one year of activity at the time the VC investment

was made. The fund's ownership plays a major role in this respect: the target firm's age is high for banking and mixed-ownership funds (banking/non-financial), whereas for other funds it matches the conventional range for VC action. The low age of public funds' targets (around 3 years) confirms VICO's (2011) findings.

As far as firm size is concerned, VC funds invest in companies with lower net equity, assets and turnover than those targeted by other closed-end funds (Table a4).⁹ However, in less knowledge-intensive sectors and for some types of funds, the size frequently exceeds the EU definition of a small enterprise;¹⁰ therefore, part of the portfolio of VC funds is apparently directed to investments that are not consistent with the mission of such investors.

According to the taxonomy reported directly by the fund manager, seed and start-up operations account for about a quarter of VC funds' portfolios, while almost half are committed to expanding operations (Table a5). Moreover, almost all the VC operations consist in the purchase of a minority stake in the firm, whereas other PE funds acquire the majority in about one third of their interventions.

4.3 Funds' concentration and specialisation

The degree of investor concentration by firm and specialisation by sector can affect target firms' performance and thus funds' performance (see Section 2).

In the Italian case, the degree of concentration of VC funds' investments is not different from the average of closed-end funds (Table a6). In spite of a smaller portfolio, the number of target firms and the share devoted by VC funds to the main target in relation to the total portfolio are not very different from those of the average PE fund: the VC funds usually have less than 5 investments running at any given time, a value which is in the lower bound of the range found in some studies on venture capital markets in other countries (Kanniainen and Keuschnigg, 2004). The main target accounts for 57 per cent of the portfolio for VC funds, much the same value as for the other PE funds. The largest portfolios are run by mixed-ownership managing firms, which, on average, also hold the largest stakes in individual firms; banking/finance affiliated funds, whose portfolios are committed for about two thirds to their main investment, are more concentrated, whereas in other countries a higher concentration is found at independent funds (Cumming, 2006).

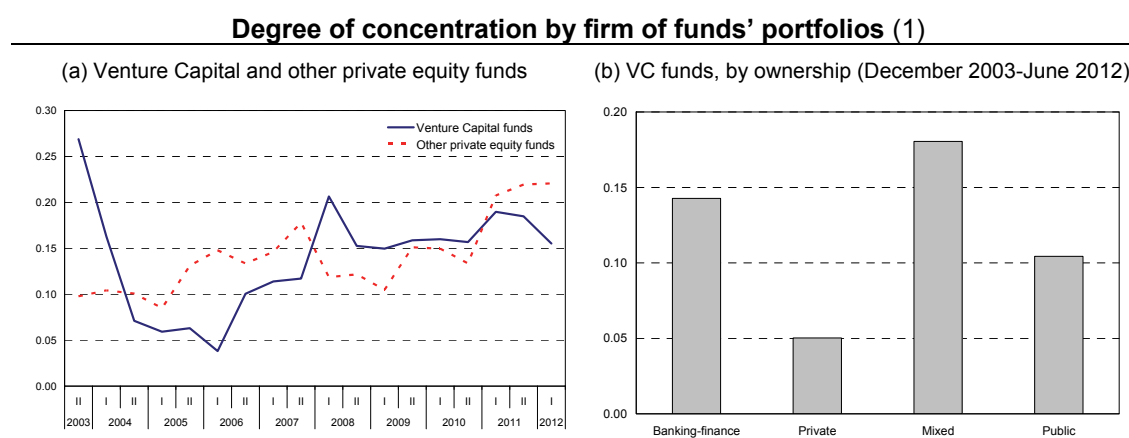
Looking at the whole portfolio distribution by firm, a Herfindahl-Hirschman concentration index can be computed. This analysis substantially confirms the findings obtained above for the largest shares in individual firms. As can be seen in Figure 4a, the concentration of VC funds' investments was not systematically above the corresponding value for other 'generalist' PE funds, apart from a steady increase in the period before the economic downturn of 2008-09. The banking/finance and mixed funds score the highest

⁹ For total assets, the average size of VC funds' targets is smaller than the corresponding values for other private equity funds' targets with a confidence level of 1 per cent.

¹⁰ According to the European Commission, enterprises are defined medium (small) if they have up to 250 (50) workers, €50 (€10) million turnover, and €43 (€10) million total assets.

values of the index, whereas private funds display the lowest and public fund managers are in the middle (Figure 4b).

Figure 4



Source: Bank of Italy supervisory reports.

(1) Herfindahl-Hirschman concentration index for funds' investments in individual firms at the end of the reference period; the index is normalised to range between 0 and 1 (maximum concentration). Averages are weighted by the total amounts of funds' portfolios.

As far as the target firm's industry is concerned, each fund invests on average in 2-3 sectors, and the main sector accounts for about 55 per cent of the total portfolio (Table a6). The most specialised funds are again those affiliated with banking/finance groups, for which the main sector accounts for two thirds of the total portfolio.

The degree of specialisation is generally low, but there are some notable exceptions: a higher-than-average degree of specialisation at some funds stems both from the smaller overall size of their portfolios and from their larger investments in individual firms or sectors.¹¹ Highly specialised funds are active almost exclusively in advanced sectors, with two thirds of their portfolios invested in knowledge-intensive high-tech services and one third in high-tech manufacturing.

For Italian funds there is thus an apparent trade-off between specialisation and fund size, which has been widely discussed in the literature (Section 2). There seems to be a clear distinction between small VC funds, highly specialised in advanced sectors, and larger and more diversified funds, with a relatively small proportion of investment in advanced sectors. A lower-than-expected degree of specialisation would in principle require fund managers to possess diversified managerial and technical skills (Bank of Italy, 2009); from another point of view, this might affect target firms' performance, since these skills are fundamental in promoting entrepreneurial projects and fostering growth (Cressy et al., 2012; Gompers et al., 2009).

* * *

¹¹ Italian funds can be sorted into 'concentrated/specialised funds' and 'other funds'. Specialisation has been defined on the basis of the share of funds' portfolios committed to the main target firm or the main target sector. A fund is 'concentrated/specialised' if it belongs to the first quartile. The quartiles are separately identified for VC funds and other PE funds. The analysis has not been replicated with reference to the value of the Herfindahl-Hirschman index, which provides results very similar to the share of the main investment.

The above analysis showed, as expected, that VC funds display a degree of specialisation in advanced sectors, which only in recent years has grown, albeit irregularly, and spread to manufacturing, whereas it was previously limited to services. At the same time these funds commit a part of their portfolios to goals unrelated to the real venture capital mission: non-technologically advanced sectors account for a non-negligible share of their holdings (about half their total investments) and some investments are in large or mature firms (Tables a2-a4). The next section therefore focuses on ‘true’ venture capital investments, not fully coinciding with the investments of VC-labelled funds, which were the subject of this section.

5 Firms’ financial structure after fund intervention

The previous section suggested that Italian VC-labelled funds invest only part of their portfolios in young innovative firms. A further issue involves the financial structure of such companies and their relationships with the banking system. In this section we address the question whether the financial structure of young and innovative firms that receive private-equity capital is substantially improved by the involvement of funds, whether these firms are actually excluded from the credit market, and, if so, whether fund intervention introduces them to the banking system.

The following analysis, which is essentially descriptive in nature, is based on a definition of venture capital that disregards the identity of the investor fund, while referring instead to the features of the investment, *per se*. A ‘VC investment’ is defined as an investment made by an Italian closed-end fund and having both the following features: it targets a firm that is (i) less than 5 years old and (ii) active in a ‘high-tech manufacturing sector’, a ‘knowledge-intensive high-tech service sector’ or a ‘knowledge-intensive service sector’. Applying these firm-related criteria, 118 operations in the database were classified as ‘venture capital investments’.¹² In order to assess the balance sheet performance and credit record of VC-backed firms during the investment, a benchmark sample of firms was retrieved. These firms have features very close to those of the target firms (i.e. they are all firms found in the balance sheet database in the same years having the same age and size range, and working in the same industry and region as the relevant target firm; see the methodological appendix for the selection criteria).

¹² A fund investment is defined as a pair ‘target firm - closed-end fund’; if a firm has been targeted by more than one fund during the reference period (from end-2003 to end-2011), each pair is treated as a separate investment. A firm may therefore be included in more than one investment. The overlap between these operations and those selected according to the nature of the investor (previous section) was not very great: barely above one third (35.2 per cent) of the investments of the ‘VC-labelled funds’ belonged to this category, and about 60 per cent of ‘VC investments’ were actually made by funds which were not labelled as specifically devoted to venture capital.

5.1. *The financial structure of target firms during fund intervention*

First, changes in the balance sheet situation of target firms *during the period* a fund held shares are described, in order to assess the impact of the investor's presence on the firm's financial situation, growth and profitability.

Target firms' balance sheet ratios can be driven, among other factors, by funds' investment strategies: in principle, funds should exit firms' capital when the value of their stake has been enhanced and made attractive to the market, thus when firms achieve a more balanced financial structure and are close to breaking even. However, funds' will sometimes exit before these conditions are realised, in case of failure (write off or write down). Granturco and Miele (2011) show that a large proportion (about 40 per cent) of the target firms of Italian closed-end funds have a fragile financial situation. Furthermore, the comparison of balance sheet indicators between the initial and final investment year is influenced by the severe economic downturn after 2008, which may have affected individual firms in different ways, also due to the different time span of each investment.

Table a7 summarizes some balance sheet ratios of firms which received VC-type financing during the period in which a closed-end fund was present in their capital.¹³

Growth indicators display an average turnover increase of 25.7 per cent, compared with less than 10 per cent for the average benchmark firm. In the period of fund commitment, target companies carried out yearly investments equal to about 6.7 per cent of their turnover, which entailed rapid growth in fixed assets (both tangible and intangible). Even though these ratios also reflect the initial turnover of the target firms, presumably low in the first stages, they are higher than the corresponding ratios of similar non-VC-backed firms, suggesting less severe financial constraints for VC-backed firms.

The profitability of the average firm (operating profit and ebitda over total assets) was negative in both the initial year and the final year. For non-VC-backed firms, the performance was more negative during the same period; however, differently from benchmark firms, VC-backed companies failed to display a significant improvement in their profitability ratios between the initial and final years of the fund's investment. As a consequence, in the exit year or in the last fiscal year for which the balance sheet was available, VC-backed firms were far, on average, from breaking even: the percentage of firms which recorded a positive RoA barely grew during the investment period, rising from 17.2 to 20.8 per cent.

Firms' financial structure changed only to a limited extent during the time a fund was present in their capital. The leverage (financial debt over the sum of financial debt and shareholders' equity) grew from 21.8 at the time of funds' entry to 25.9 per cent in the last fiscal year. At the end of the period the leverage of VC-backed firms was about half the average value for similar non-VC-backed firms; the latter also had five times more non-bank financial debt. This suggests that to some extent funds' equity replaces other forms of

¹³ The last balance sheet used for these statistics is in any case not later than that for 2010 (the last full fiscal year available in the Cerved/Cebi database at the time of this analysis), regardless of whether the investment was still in place after 2010.

non-bank finance, e.g. debt finance provided by firms' owners, rather than supplying additional funds.

The rather low leverage of VC-backed firms is consistent with their being more highly capitalized. On the other hand, it encourages investigation of the effect, if any, of funds' involvement in the relationship between target firms and other finance providers, among which banks play a key role.

5.2 The relationship between target firms and the banking system: the availability of credit

In most cases, young and innovative targets of closed-end funds are not excluded from the credit market. About two thirds of firms backed by closed-end funds are in the Central Credit Register (79 cases out of 118; Table a8, column a).¹⁴ These companies had a credit relationship at the start or the end of the fund's venture capital investment, or at both dates.

In a few cases (less than one in six) firms were granted credit after a fund's intervention, whereas before they had not received credit. However, more often than not firms already had a credit relationship before a fund intervened. Therefore, there is no clear evidence that VC investors introduce firms to the credit market, playing a signalling or scouting role. By contrast, the fact that firms had usually already been granted credit before a fund's entry supports the hypothesis of 'inverse signalling', from the bank to the fund (Drucker and Puri, 2006).

Table a8 displays comparable statistics for the benchmark sample of similar non-VC-backed firms (column b), and for other PE investment targets (column c). In particular, in the benchmark non-VC-backed sample, over half the firms were actually excluded from the credit market, both at the start and at the end of the VC investment in the corresponding target firms, a higher percentage than for the VC-backed companies.

The intensity of banking relationships does not change significantly during the venture capital commitment. When target firms had credit relationships, the number of financing banks was relatively stable (rising from 2 to 3 for the median firm; Table a8); as a consequence, the main bank's share of the total credit granted declined from 74.8 to 69.5 per cent. The main bank's share was higher for similar non-VC-backed firms, thus indirectly supporting suggestions that VC-backed firms seek to escape hold-up situations (Berger and Schaeck, 2011). The amount of credit granted rose from €4.3 million to €8.0 million, more rapidly than for comparable companies over the same period. During the time funds were present, the bank credit granted was 3.2 times the value of the fund's stake on average, whereas the actual use of credit lines – a percentage which proxies the financial constraints on firms – stayed at around 80 per cent.

¹⁴ Firms are found in the Central Credit Register database if they have been granted or used credit above the recording threshold; the threshold for recording a single debtor in the Register was lowered from €75,000 to €30,000 on 1st January 2009.

According to the above evidence, fund intervention in the capital of a recently established firm operating in an advanced industry has a weak certification effect vis-à-vis the banking system, although this effect has been suggested by other studies (Bertoni et al., 2008): in spite of growing credit lines, target firms' access to credit does not markedly improve from the start to the end of the investment, as regards the number of financing banks or the role of the main bank. The leverage ratio in these firms' balance sheets increases only slightly (see above). This finding would not confirm – as far as the Italian market is concerned – a clear-cut pecking order in the use of sources of external finance whereby bank credit is granted relatively late in the growth of a new entrepreneurial venture, and is partly consistent with some findings by Berger and Schaeck (2011).

Following the relationship hypothesis put forward by Hellmann et al. (2008), bank-affiliated venture capitalists might use the supply of capital within a strategic framework, with a view to establishing early partnerships with innovative firms and exploiting them through subsequent bank credit relationships (see Section 2).

In this respect, in 25 VC-type operations (that is, about 1/3 of those in which the firm was entered in the Central Credit Register at the time of the fund's entry or exit) the target firms turned out to be financed by a bank of the same group as the venture capital fund. The number of these operations is small, but the percentage of group-related finance relationships is not negligible. Therefore, joint intervention (capital and credit) within the same group emerges as not infrequent for such of investments.¹⁵

The funds and the banks that provided this type of joint credit and capital support to firms belonged to five of the main Italian banking groups. For almost all the groups (with just one exception), the firms targeted by the VC fund already had credit lines granted by group banks at the time of the fund's entry; for these groups the supply of capital seemingly takes place at the same time as or subsequent to the granting of bank credit. Therefore, these findings do not lend support to the hypothesis that – for Italian banking groups – the start of a credit partnership is the continuation of a customer relationship established through the supply of equity at an earlier stage of the firm.

5.3 The relationship between target firms and the banking system: the cost of credit

In addition to the amount of credit granted, the data set allows us to appraise its costs. To this end, interest rates paid by firms which benefited from venture capital involvement have been compared with the average rates on similar credit lines paid by comparable firms (same industry, geographical location, range of turnover and age; Table a9).¹⁶

¹⁵ Hellmann et al. (2008) conclude, on the basis of a probit analysis, that the likelihood of a VC-backed firm subsequently obtaining credit from a bank belonging to the same group as the VC fund is more frequent than suggested by a purely theoretical model that assigns the same ex ante probability to all the possible bank-firm pairs.

¹⁶ The comparison was made with reference to short-term credit lines, which are easily comparable among firms; this is not the case for commercial operations-related credit lines (which display a lower variability across firms, regardless of their riskiness) and for medium-to-long term operations (which are affected by the duration and collateralisation of the bank financing).

According to descriptive statistics, VC-backed firms do seem to benefit from fund investment, as far as credit costs are concerned, and this benefit spills over to the period following the fund's presence in the capital. The spread with respect to the cost paid by similar firms during the investment period becomes negative and the negative difference widens after the exit of the fund.

Again, the fund's institutional setup matters. For almost every type of fund, a decrease in the rate paid by the firm is apparent from the period before the investment, with respect to comparable firms. However, only for bank-owned and private funds is the spread significantly negative after the fund's exit. The banking-affiliated funds invest in firms that paid high rates before the investment, and manage to substantially improve the situation, consistent with the findings of Hellman et al. (2008). Public funds also leave their targets better off with respect to the *ex ante* situation, but still with a positive spread. For mixed funds (jointly owned by banks and non-financial groups) the effects on rates are negligible.

This comparison should be assessed against the idiosyncratic riskiness of firms receiving bank credit, although the benchmark sample has been selected according to features which to a large extent proxy the debtor's creditworthiness. The perceived riskiness of the target firm might be affected by the fund's participation in its capital. The next sub-section performs a more formal analysis of this issue.

5.4 Bank credit and its cost. An econometric analysis

A simple econometric analysis substantially confirms that mutual funds have a weak signalling effect vis-à-vis the banking system. The regressions compare target firms to counterparties that are similar in many respects, and therefore the possible selection bias has been taken into account in part. However, the endogeneity problem has not been tackled directly. Therefore, the results from this exercise must be interpreted carefully as correlations between the receipt of private equity and the likelihood of receiving credit or its cost, rather than as a causal link.

First, a probit model allows us to disentangle the effect of the fund's intervention on the likelihood of a firm being present in the Central Credit Register, while controlling for the firm features (size class, industry, location, incorporation technique, credit history length) and time dummies. The estimated model is as follows.

$$P(CR_{i,t}) = \Phi(\alpha + \theta T_t + \beta X_i + \gamma_1 FB_{i,t} + \gamma_2 FD_{i,t} + \gamma_3 FA_{i,t}) \quad (1)$$

In equation (1), the probability of a firm i being present in the Central Credit Register at time t , i.e. $P(CR_{i,t})$, is a function Φ of time dummies (T), the features of the firm (X , e.g. institutional set-up, age, sector of activity, size, geographical location), and the fact that t is a period before, during or after the entry of a PE fund into the firm's capital (the FB , FD and FA dummies, in that order).¹⁷ In order to spot possible ownership-linked heterogeneities, an extended version of equation (1) jointly considers the interaction of the

¹⁷ For the benchmark sample, i.e. firms which are similar to the target firms but did not receive private-equity investments, the FB , FD and FA dummies are set to zero.

three dummies FB , FD and FA with the ownership of the fund (bank-owned, private-owned, etc.).

The likelihood of a VC-backed firm being granted credit during the fund's holding period is higher than for other benchmark firms, especially in the case of private and bank-owned funds (Table a10). However, the same likelihood turns out to be lower than for similar firms when the private fund has already exited. Bank-affiliated funds usually support firms already present in the Central Credit Register. These estimates are not directly comparable to the descriptive evidence in Table a8: the latter refers to firms that have been granted credit at the date of the fund's entry or exit, whereas econometric estimates take into account all the dates in the reference period.

Turning to the cost of credit, in a panel analysis the interest rate paid by target and benchmark companies is related to the firm features referred to above. The panel is unbalanced, as the data on credit costs (interest rates) are only available for the periods in which firms were granted credit, and has been estimated through a random effects model, i.e. the most general form of model based on panel data. The estimated relationship is as follows.

$$IR_{i,j,t} = \alpha + \theta T_t + \beta X_i + \gamma_1 FB_{i,t} + \gamma_2 FD_{i,t} + \gamma_3 FA_{i,t} \quad (2)$$

In equation (2), $IR_{i,j,t}$ is the interest rate on short-term credit charged by bank j to firm i at time t , and the other symbols are as for equation (1). The econometric analysis suggests that the impact of funds' presence on the bank rates paid by target firms is weak (Table a11). Overall, VC-backed firms pay a lower rate both during and after the intervention of the fund. However, these differences turn out to be negligible, after controlling for observable firm features. Looking at fund ownership, private funds tend to invest in firms which paid relatively high interest rates, and make the spread nil upon intervention. The opposite is true for funds with mixed ownership. Only funds owned by several banks achieve a significant rate advantage for their targets during their participation in their capital, though this does not spill over into the subsequent period.

6 Conclusions and further research

Using fund-level and firm-level data about Italian venture capital and private equity funds, this paper provides new evidence on the Italian market for venture capital funds. It is a key topic for the potential development of an industrial system to understand whether VC funds actually provide financial support to young and innovative small enterprises which cannot easily be assisted by banks. Moreover, the relationships between non-bank and bank financing also matters: in principle, when closed-end funds provide private equity to young innovative firms, they might play a signalling or scouting role vis-à-vis the banking system.

The main findings are that the portfolio of VC funds – which is still small compared with the total portfolio of Italian private-equity funds – is only in part devoted to young and innovative small firms. The investment duration is less than three years, and is inversely correlated with the age of the firm at the time of the fund's entry (as younger firms need to be financially supported for longer periods). Contrary to what one would

expect owing to the intense managerial support needed by target firms, VC-labelled funds do not seem to be more concentrated on just a few firms or specialised in just a few sectors than other closed-end funds. A few small funds that are strongly focused on selected high-tech sectors are an exception in this respect.

Turning to the second issue, young and innovative companies targeted by PE funds are present in the credit market more often than their non PE-backed counterparts. However, they usually already had a bank relationship *before* the fund intervention, so that a clear sequence venture capital – bank credit does not emerge from the financing strategies of young innovative Italian firms. This is also the case when credit is provided by a bank belonging to the same group as the investor fund; this lends weak support to the hypothesis of a multi-period group strategy built on the overall relationship with the customer firm, both through equity and through credit. Finally, only some funds (private and banking/finance funds) manage to reduce the cost of credit for the target firm, with respect to comparable firms.

Further research will use the same database in order to investigate more deeply the effect of venture capital on firms' subsequent credit history, in particular by explicitly testing for Italy the relationship hypothesis put forward by Hellmann et al. (2008); the effects of fund intervention on firm performance could be disentangled through a sample matching analysis (e.g. via propensity score matching); finally, the database makes it possible to assess which features of the funds (e.g. specialisation) lead to a better fund performance.

7 References

Andrieu G., Groh A.P. (2012), "Entrepreneurs' financing choice between independent and bank-affiliated venture capital firms", *Journal of Corporate Finance*, Vol. 18 (2012) 1143–1167.

Bank of Italy (2009), "Private equity and venture capital in Italy", *Occasional Papers*, 41, February 2009.

Berger A.N., Schaeck K. (2011), "Small and medium-sized enterprises, bank-relationship strength, and the use of venture capital", *Journal of Money, Credit and Banking*, Vol. 43, No. 2–3 (March–April 2011).

Bertoni B., Colombo M.G., Croce A. (2008), "Venture capital financing and firm's investments", <http://ssrn.com/abstract=1102069>.

Bertoni F., Colombo M.G., Grilli L. (2011), "Venture capital financing and the growth of high-tech start-ups: Disentangling treatment from selection effects", *Research Policy*, 40 (2011) 1028–1043.

Bottazzi L., Da Rin M., Hellmann T. (2008), "Who are the active investors? Evidence from venture capital", *Journal of Financial Economics*, 89, 2008, 488–512.

Bugamelli M., Cannari L., Lotti F., Magri S. (2012), "The innovation gap of Italy's production system: roots and possible solutions", Bank of Italy, *Occasional Papers*, 121, April 2012.

Cressy R., Malipiero A., Munari F. (2012), “Does VC fund diversification pay off? An empirical investigation of the effects of VC portfolio diversification on fund performance”, *International Entrepreneurship and Management Journal*, 2012.

Cumming D. (2006), “The determinants of venture capital portfolio size: Empirical evidence”, *The Journal of Business*, 79(3) (May 2006), 1083–1126.

Cumming D., Johan S. (2010), “Venture capital investment duration”, *Journal of Small Business Management*, (2010) 48(2), 228–257.

Cumming D.J., MacIntosh J.G. (2001), “Venture capital investment duration in Canada and the United States”, *Journal of Multinational Financial Management*, 11 (2001) 445–463.

Drucker S. and, Puri M. (2006), “Banks in capital markets: A survey”, May 2006, in Eckbo B.E. (ed), *Handbook in Corporate Finance: Empirical Corporate Finance* (Elsevier/North-Holland).

Eurostat (2005), “Statistics in focus – Science and technology – R&D statistics”, (August Götzfried), 4/2005.

Eurostat (2012), “High-tech statistics”, http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/High-tech_statistics.

EVCA (2012), “EVCA Yearbook 2012, Activity data on fundraising, investments and divestments by private equity and venture capital firms in Europe”, May 2012.

Freel M.S. (2007), “Are small innovators credit rationed?”, *Small Business Economics* (2007) 28:23–35.

Gompers P.A. (1995), “Optimal investment, monitoring, and the staging of venture capital”, *The Journal of Finance*, 50(5), Dec. 1995, 1461-1489.

Gompers P.A., Kovner A., Lerner J. (2009), “Specialization and success: Evidence from venture capital”, *Journal of Economics & Management Strategy*, 18(3), Fall 2009, 817–844.

Granturco M., Miele M.G. (2011), “The Italian private equity funds: an analysis of the portfolio companies’ economic and financial conditions”, Bank of Italy, *Occasional Papers*, 98, July 2011.

Hall, B. H. (2010), “The financing of innovative firms”, *Review of Economics and Institutions*, 1(1), Spring 2010, Article 4.

Hellmann T., Lindsey L., Puri M. (2008), “Building relationships early: Banks in venture capital”, *The Review of Financial Studies*, 21(2), 2008.

Kanniainen V., Keuschnigg C. (2004), “Start-up investment with scarce venture capital support”, *Journal of Banking & Finance*, 28 (2004) 1935–1959.

Knill A. (2009), “Should venture capitalists put all their eggs in one basket? Diversification versus pure-play strategies in venture capital”, *Financial Management*, Autumn 2009, 441–486.

Micucci G., Rossi P. (2012), “Financing R&D investments: Relationship lending or financial markets?”, paper presented to the workshop *The transformation of local production systems*, Bank of Italy and Department of Economic Sciences, University of Bologna, 31 January - 1 February 2012.

OECD (2003), “OECD science, technology and industry scoreboard”.

Puri M., Zarutskie R. (2010), “On the lifecycle dynamics of venture-capital- and non-venture-capital-financed firms”, *NBER Working Paper Series*, 14250.

Revest V., Sapio S. (2008), “Financing technology-based small firms in Europe: A review of the empirical evidence”, LEM Working Paper Series, Laboratory of Economics and Management Sant’Anna School of Advanced Studies.

Tykvová T. (2006), “How do investment patterns of independent and captive private equity funds differ? Evidence from Germany”, *Financial Markets Portfolio Management*, 2006, 20, 399–418.

Ueda M. (2004), “Banks versus Venture Capital: Project Evaluation, Screening, and Expropriation”, *The Journal of Finance*, Vol. LIX, No. 2, April 2004.

VEM (various years), “Venture capital monitor – Italy yearly reports”.

VICO (2011), “Venture capital. Policy lessons from the VICO project”, 30 September 2011, VICO-Financing Entrepreneurial Ventures in Europe, 7th Framework Program.

8 Methodological appendix

Supervisory reports by closed-end funds

Supervisory reports to the Bank of Italy by closed-end funds are regulated by a regulation on supervisory returns (*Manuale delle Segnalazioni Statistiche e di Vigilanza per gli Organismi di Investimento Collettivo del Risparmio*; http://www.bancaditalia.it/vigilanza/normativa/norm_bi/circ-reg/stat_oicr).

According to the regulation, a closed-end fund is a mutual fund whose participants' right to the reimbursement of the shares may be exercised only at pre-defined maturities. Managing firms must comply with reporting requirements for each managed fund from the inception of the fund's operations.

Under the item "holdings" the fund must report the value of the stakes held in listed and unlisted companies. Holdings in listed companies are to be reported at market value. Other holdings, lacking a reference market price, are to be valued – taking into account the economic and financial situation of the firm – according to the general regulatory criteria laid down by the Bank of Italy.

In the supervisory half-yearly reports on funds' portfolios, financial instruments are identified using the international codification standard (ISIN code). Through the Italian securities register, the ISIN code makes it possible to single out the majority of Italian target firms (accounting for about 90 per cent of the total value of funds' portfolio of Italian target firms' equity), and therefore to know their structural features. For unidentified firms, it is not possible to match data on these investments with those of other databases (central balance sheet register, Central Credit Register, etc.). Consequently, there are a different number of observations for some exhibits in the paper.

Grouping investments by technological level of the target firm

Target firms are grouped according to the technological level of their activity, consistently with the taxonomy employed by the OECD and Eurostat (OECD, 2003; Eurostat, 2005, 2012).

On the basis of the ATECO 2007 classification "high-tech manufacturing" encompasses sectors C21, C26; "medium-high-tech manufacturing" includes sectors C20 and C27 to C30; "medium-low-tech manufacturing" includes sectors C19 and C22 to C25; "low-tech manufacturing" includes sectors C10 to C18, C31 and C32. "Knowledge-intensive services" encompass sectors H50, H51, H53, J58 to J63, K64 to K66, M69 to M75, N77 to N80, N82, O84, P85, Q86 to Q88 and R90 to R93. Among the latter, "knowledge-intensive high-tech services" are sectors H50, H53, J58, J61, J62, J63, M72. All services between J45 and T98 (included) and not mentioned among "knowledge-intensive services" are defined as "less knowledge-intensive services".

Based upon the ATECO 2002, 2 digit classification, "high-tech manufacturing" encompasses sectors DL30, DL32, DL33; the "medium-high tech manufacturing" encompasses sectors DG24, DK29, DL31, DM34, DM35; the "medium-low-tech manufacturing" encompasses sectors DF23, DH25, DI26, DJ27, DJ28; the "low-tech manufacturing" encompasses sectors DA15, DA16, DB17, DB18, DC19, DD20, DE21, DE22, DN36, DN37. The "knowledge-intensive services" include sectors ATECO2002: I61, I62, I64, J65 to J67, K70 to K74, M80, N85, 092: among these sectors, I64, K72 and K73 are defined as "knowledge-intensive high-tech services".

In the grouping used in this paper, moreover, investments in banks of fund managing firms are grouped separately ("Finance and banking").

The benchmark sample

The benchmark sample matching VC-backed firms consists of about 2,800 firms having simultaneously the following characteristics: they (i) are within the same region, (ii) are within the same sector (ATECO 2007 four-digit classification), (iii) have a turnover in the range of the turnover of the target firm in the initial year of the investment (turnover benchmark = $[0.25 \mid 4]$ turnover target), and (iv) have about the same age (age benchmark = age target ± 3 years).

The Central Credit Register and the Bank of Italy survey data on bank interest rates

The Central Credit Register records all the credit lines granted by banks and other financial intermediaries to borrowers whose granted or used credit at the reporting institution exceeds a given threshold (€30,000 as from 1 January 2009, previously €75,000). See http://www.bancaditalia.it/statistiche/racc_datser/intermediari/centrarisk for reference. The Bank of Italy

survey on bank interest rates gathers data from about 200 banks on interest rates applied to credit lines referred to borrowers whose total credit received from the reporting bank exceeds a given threshold (€75,000). See the Glossary to the Bank of Italy's annual report.

9 Statistical appendix

Table a1

Features of investments of VC and other PE funds (1)								
Fund type	Venture capital				Other private equity			
	Number of funds	Number of operations (2)	Average duration (years) (3)	Average amounts (mln) (3)	Number of funds	Number of operations (2)	Average duration (years) (3)	Average amounts (mln) (3)
Banking/finance	13	99	2.4***	4.1	40	402	2.5	4.1
Private	1	8	1.5***	0.6***	63	833	3.0	8.4
Mixed	5	60	2.3***	1.8***	11	113	1.3	10.9
Public	4	33	3.2***	1.4	1	4	1.3	1.7
Syndicated bank					2	21	3.4	5.6
Insurance					4	72	3.3	4.2
Industrial/real estate					4	44	2.9	4.4
Total	23	200	2.4*	2.7***	125	1,489	2.6	6.9

Source: Bank of Italy supervisory reports.

(1) Data refer to Italian target firms and to total or average values for the period December 2003 – June 2012 (half-yearly data). – (2) Total number of operations in the reference period. – (3) Averages weighted by the amounts of the investment. Values with stars indicate whether the difference between the values for VC funds and other PE funds is statistically significant (* = confidence interval 10%, ** = 5%, *** = 1%).

Table a2

Technological level of the sector (2)	Fund category	
	Venture capital-labelled funds	Other private-equity funds
High-tech manufacturing	13.2	4.9
High- and medium-tech manufacturing	7.7	14.1
Medium- and low-tech manufacturing	10.0	5.8
Low-tech manufacturing	6.0	8.0
Knowledge-intensive high-tech services	21.7	5.2
Knowledge-intensive services	16.7	36.8
Less knowledge-intensive services	17.4	10.9
Finance and banking	0.6	0.2
Other	6.7	14.0
Total	100.0	100.0

Source: Bank of Italy supervisory reports.

(1) Data refer to Italian target firms and to total or average values for the period December 2003 – June 2012 (half-yearly data). – (2) The industry classification is based on the OECD taxonomy. See the methodological appendix.

Table a3

Age of target firm (1)
(average number of years)

	VC-labelled funds	Other private-equity funds
(a) Firm age at start of the investment (years)	7.4 ***	15.6
<i>(a.1) By fund type:</i>		
<i>Banking/finance</i>	7.2 *	12.5
<i>Private</i>	0.9 ***	8.1
<i>Mixed</i>	9.7 **	52.1
<i>Public</i>	3.2	19.5
<i>(a.2) By technological sector:</i>		
<i>High-tech manufacturing</i>	3.9	14.8
<i>High- and medium-tech manufacturing</i>	14.2	9.1
<i>Medium- and low-tech manufacturing</i>	3.5	12.8
<i>Low-tech manufacturing</i>	6.2	10.9
<i>Knowledge-intensive high-tech services</i>	7.6	7.7
<i>Knowledge-intensive services</i>	18.0	29.2
<i>Less knowledge-intensive services</i>	3.6	13.0
<i>Finance and banking</i>	...	1.0
<i>Other</i>	11.8	12.7

Sources: Bank of Italy supervisory reports and the Italian central balance sheet register (Cerved).

(1) Data refer to Italian target firms. Averages are weighted by the investment amounts. For the overall average and the averages by fund type (panels a and b) the t-test of the differences between VC funds and other PE funds are reported. Stars denote significance of the t-test (* = 10 per cent, ** = 5 per cent and *** = 1 per cent, respectively).

Table a4

VC-labelled funds: size of target firm (1)
(millions of euro)

	VC-labelled funds	Other private-equity funds
(a) Total assets	198.4	405.2
<i>(a.1) By fund type:</i>		
<i>Banking/finance</i>	246.0	147.9
<i>Private</i>	1.1	350.6
<i>Mixed</i>	77.3	1097.8
<i>Public</i>	8.3	9.9
<i>(a.2) By technological sector:</i>		
<i>High-tech manufacturing</i>	293.7	130.9
<i>High- and medium-tech manufacturing</i>	35.3	102.7
<i>Medium- and low-tech manufacturing</i>	75.0	1536.3
<i>Low-tech manufacturing</i>	78.9	90.7
<i>Knowledge-intensive high-tech services</i>	47.2	120.2
<i>Knowledge-intensive services</i>	67.6	636.1
<i>Less knowledge-intensive services</i>	510.0	347.6
<i>Finance and banking</i>	0.0	8.9
<i>Other</i>	49.8	97.1
(b) Net equity	65.0	127.7
(c) Yearly turnover	142.7	224.7

Sources: Supervisory reports and the Italian central balance sheet register (Cerved).

(1) Data refer to Italian target firms. Balance sheet values are averages of the balance sheet values 2002-2010 where available for the relevant firms, weighted by the investment amounts.

Table a5

Investments by operation type, stake-holding type and exit patterns (1)

(millions of euros; averages December 2003 – June 2012)

	VC-labelled funds	Other private-equity funds
<i>By operation type:</i>		
Early stage (seed, start-up)	23.5	3.0
Expansion	51.5	32.4
IPO directed	0.0	7.9
Leveraged buy-out	0.0	33.1
Turnaround	0.0	0.0
Other	25.0	23.1
Not applicable	0.0	0.6
Total	100.0	100.0
<i>By stake-holding type:</i>		
Minority	79.5	37.9
Majority	6.2	49.8
Syndicated majority	0.0	3.8
Not applicable	14.3	8.6
Total	100.0	100.0
<i>By exit pattern:</i>		
Stock market sale	0.0	30.3
Sale to other partners of the company	0.0	6.0
Sale to other firms	0.0	29.4
Other exit patterns	2.2	17.7
Not applicable	97.8	16.5
Total	100.0	100.0

Source: Bank of Italy supervisory reports.

(1) Averages weighted by the investment (divestment) amounts.

Table a6

Funds' portfolio specialisation by target firm and industry sector (1)

Fund type	a) Total portfolio (millions of euros)	b) Concentration by firm		c) Specialisation by sector	
		Number of firms	Share of the main investment	Number of sectors	Share of the main investment
VC-labelled funds					
Banking/finance	14.0	3.9	62.8	2.2	67.2
Private	3.4	5.8	35.1	2.8	41.6
Mixed	12.3	6.8	48.4	2.5	28.3
Public	5.8	4.1	55.9	2.6	49.1
Total	11.7	4.7	57.3	2.4	54.7
Other private-equity funds					
Banking/finance	25.5	5.2	60.7	2.6	58.9
Private	53.0	7.1	53.4	4.6	54.8
Mixed	81.0	6.4	61.3	3.4	46.1
Public	6.4	3.8	51.8	2.0	57.5
Syndicated bank	27.7	5.1	74.2	1.9	74.5
Insurance	74.7	10.6	44.3	10.6	15.5
Industrial/real estate	29.8	6.8	40.0	4.3	53.1
Total	45.2	6.4	56.2	3.9	54.9

Source: Bank of Italy supervisory reports.

(1) Data refer to Italian target firms. Average shares and values for the period December 2003 – June 2012. Sectors are classified according to the ATECO 2007 2-digit taxonomy.

Table a7

Balance sheet ratios of VC investment target firms (1)
(average values)

Balance sheet ratio	Venture capital investments			Benchmark sample		
	During the investment period	Entry year	Exit/last year	During the investment period	Entry year	Exit/last year
(a) Growth and accumulation						
- Turnover growth	25.7			9.4		
- Investments / turnover	6.7			-0.6		
- Accumulation rate (2)	69.8			0.3		
(b) Profitability						
- RoA		-16.5	-17.5	-40.1	-36.9	
- % of firms with RoA>0		17.2	20.8	19.9	23.5	
- Ebitda / assets		-7.5	-6.1	-49.0	-45.8	
(c) Financial structure						
- Leverage (3)		21.8	25.9	39.9	45.8	
- Non-bank financial debt / net equity		6.2	6.5	24.6	29.3	

Sources: The Italian central balance sheet register (Cerved/Cebi).

(1) Data refer to Italian target firms. Ratios are averages weighted by the investment amounts. For the way the benchmark sample has been selected, see the methodological appendix. – (2) Yearly rate of growth of fixed assets. – (3) Ratio of financial debt to the sum of financial debt and net equity.

Table a8

VC target firms in the Central Credit Register (1)

(units, millions of euros and percentage values)

	Venture capital investments		Benchmark sample	Memo items: Other private-equity investments
	(a)	(b)	(b)	(c)
Number of investments (supervisory reports)	100%	(118)	100%	100%
(a) Firms in the Central Credit Register:				
- only at the start of the fund's investment	5.9%	(7)	4.8%	6.2%
- only at the end of the fund's investment	16.1%	(19)	15.2%	6.6%
- both at the start and at the end of the fund's investment	44.9%	(53)	28.3%	81.8%
- neither at the start nor at the end of the fund's investment	33.1%	(39)	51.7%	5.5%
(b) Average values				
Number of banks				
– at the start of the fund's investment	2		2	5
– at the end of the fund's investment	3		2	7
Share of main bank (2)				
– at the start of the fund's investment	74.8		84.5	49.3
– at the end of the fund's investment	69.5		80.2	38.1
Extended credit (mln)				
– at the start of the fund's investment	4.3		0.8	15.6
– at the end of the fund's investment	8.0		1.6	19.0
% of extended credit used				
– at the start of the fund's investment	80.1		55.8	73.8
– at the end of the fund's investment	77.4		73.7	77.6

Source: Bank of Italy supervisory reports and the Central Credit Register.

(1) Data refer to Italian target firms. The values refer to the investments of closed-end funds. Each investment is defined as a firm-fund pair, and therefore a firm can be included in more than one record if it was targeted by more than one fund during the reference period. – (2) Percentage of the total credit extended to the firm.

Table a9

VC target firms vs benchmark sample firms: the cost of credit (1)

(interest rate spreads; percentage points)

Item	Venture capital investments							
	Before the investment		During the investment		After the investment		Overall	
Total	1.11	***	-0.82	***	-2.11	***	-0.69	***
Of which:								
Banking/finance funds	5.84	***	0.50		-1.96	***	-0.24	***
Private	-0.05		-1.64	***	-2.83	***	-1.71	***
Mixed funds	0.79	***	0.20		0.52		0.59	***
Public funds	1.33	***	1.58	**	0.15		1.35	***

Sources: Bank of Italy's survey data on bank interest rates and Bank of Italy supervisory reports.

(1) Data refer to Italian target firms. Reported values refer to the spread between the interest rate on short-term loans to VC-backed firms and the average rates on loans – at the same dates – to firms active in the same industry (ATECO 2007, four-digit classification), in the same geographical area (at NUTS2 level) and belonging to the same size and age class. See the methodological appendix. Averages are weighted with the credit amounts on which the interest payments were computed. The stars refer to the confidence intervals for the t-test, at 1 (***), 5 (**) or 10 (*) per cent.

Table a10

Econometric analysis (probit).
Probability of being in the Central Credit Register for VC targets and benchmark
sample firms (1)

	Before the investment	During the investment	After the investment
a) Overall			
VC-fund presence	0.00 [0.03]	0.15 *** [0.03]	-0.21 *** [0.03]
<i>Pseudo R-squared (Chi-squared)</i>	0.29	(6,759)	
<i>Number of observations</i>	22,481		
b) Account for fund's ownership			
Banking/finance funds	0.16 *** [0.07]	0.39 *** [0.05]	0.00 [0.06]
Private	-0.08 [0.06]	0.33 *** [0.06]	-0.16 *** [0.05]
Mixed funds	0.01 [0.04]	0.05 [0.06]	-0.16 [0.10]
Public funds	-0.03 [0.08]	-0.12 [0.07]	-0.18 [0.11]
Syndicated banks		-0.59 *** [0.17]	
<i>Pseudo R-squared (Chi-squared)</i>	0.29	(8,614)	
<i>Number of observations</i>	22,480		

Controls: Time dummies, Firm features (credit history length, size class, industry sector, incorporation technique, province of location) (2)

Sources: Bank of Italy's survey data on bank interest rates and Bank of Italy supervisory reports.

(1) Data refer to Italian target firms. Reported values refer to the estimated marginal effect of the intervention of a fund in a firm's capital on the likelihood of the firm being granted credit, with respect to the same likelihood for similar firms (see the methodological appendix). The stars refer to the confidence intervals for the t-test of the estimated coefficient, at 1 (***) , 5 (**) or 10 (*) per cent, based on robust standard errors (between brackets). – (2) The controls used in the analysis are dummy variables as follows: credit history length is the time of the first entry of the firm in the Central Credit Register; size class is retrieved from the CCR classification of the firm; industry sector is the Ateco 2007 four-digit classification; incorporation technique is the type of limited company; province of location is the province in which the firm's head office is located. The reported estimates refer to a subsample of firms present in the Bank of Italy register; enlarging the subsample to firms not present in the Bank of Italy register yields similar estimates (36,685 observations).

Table a11

**Econometric analysis (random effects panel).
Cost of credit for VC targets and benchmark sample firms (1)**

	Before the investment	During the investment	After the investment
a) Overall			
VC-fund presence	0.55 [0.52]	-0.77 [0.33]	-0.10 [0.49]
<i>R-squared (overall)</i>	0.23		
<i>Number of observations</i>	6,098		
b) Account for fund's ownership			
Banking/finance funds	0.91 [0.93]	0.12 [0.53]	-0.88 [0.62]
Private	3.32 *** [0.96]	-0.03 [0.60]	0.15 [0.77]
Mixed funds	-0.55 ** [0.24]	0.58 [0.42]	0.75 *** [0.11]
Public funds	-1.24 [1.33]	-0.86 [1.58]	
Syndicated banks		-1.01 *** [0.34]	
<i>R-squared (overall)</i>	0.23		
<i>Number of observations</i>	6,098		

Controls: Time dummies, firm features (credit history length, size class, industry sector, incorporation technique, province of location) (2)

Sources: Bank of Italy's survey data on bank interest rates and Bank of Italy supervisory reports.

(1) Data refer to Italian target firms. Reported values refer to the panel (random effect) estimated impact of the intervention of a fund in a firm's capital on interest rates on short-term credit, with respect to the interest rate paid by similar firms (see the methodological appendix). The stars refer to the confidence intervals for the t-test of the estimated coefficient, at 1 (***) , 5 (**) or 10 (*) per cent, based on robust standard errors (between brackets). – (2) The controls used in the analysis are dummy variables as follows: credit history length is the time of the first entry of the firm in the Central Credit Register; size class is retrieved from the CCR classification of the firm; industry sector is the Ateco 2007 four-digit classification; incorporation technique is the type of limited company; province of location is the province in which the firm's head office is located.