The Risk Profiles of Private Equity

Private equity is a risky asset, but private equity investments are not necessarily so.

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Disclaimer:

This paper represents the personal opinion of the authors and does not necessarily reflect the views of the European Investment Fund (EIF). The EIF works under the mandate of the European Union to act as a catalyst for venture capital. It is Europe's largest venture capital investor with more than €2 billion committed and close to 200 funds, supporting indirectly more than 2000 companies.

The authors have taken great care to give proper acknowledgment to data sources and articles. Most data comes from the Thomson Venture Economics database.

Executive Summary

- Private equity is a risky asset, but private equity investments are not necessarily so.
- Every type of private equity investment vehicle has a different risk profile.
- Diversification is of utmost importance in private equity, because it significantly reduces risk:
  - A direct investment has a 30% probability of total loss.
  - A fund (or a portfolio of direct investments) has a very small probability of total loss.
  - A fund-of-funds (or a portfolio of funds) has a small probability of any loss.
- Most investors invest in less risky investment vehicles, mainly due to capacity or legal constraints.
- Due to the lack of an efficient private equity market, it is not possible to measure risk as the volatility of a time series, and therefore the standard deviation around the average return is used.
- **Figure 1**, **Table 1**, **Figure 2** and **Table 2** summarise the study.

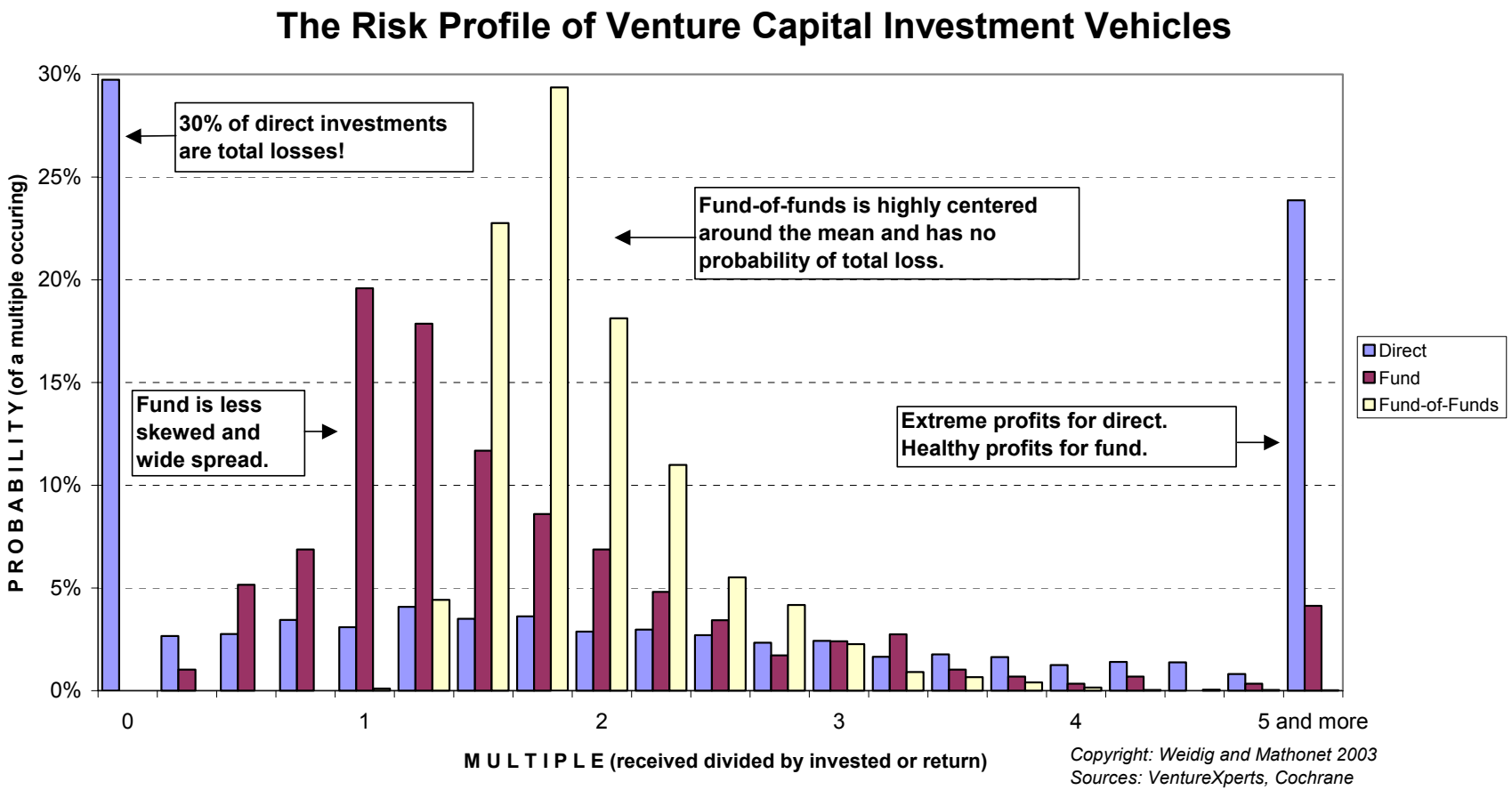

Figure 1: Comparing the risk profile of venture capital investment vehicles: Multiple distribution. (Data contains about 5000 direct investments (US data – no European data available), about 300 European funds, and 50,000 simulated European funds-of-funds.)

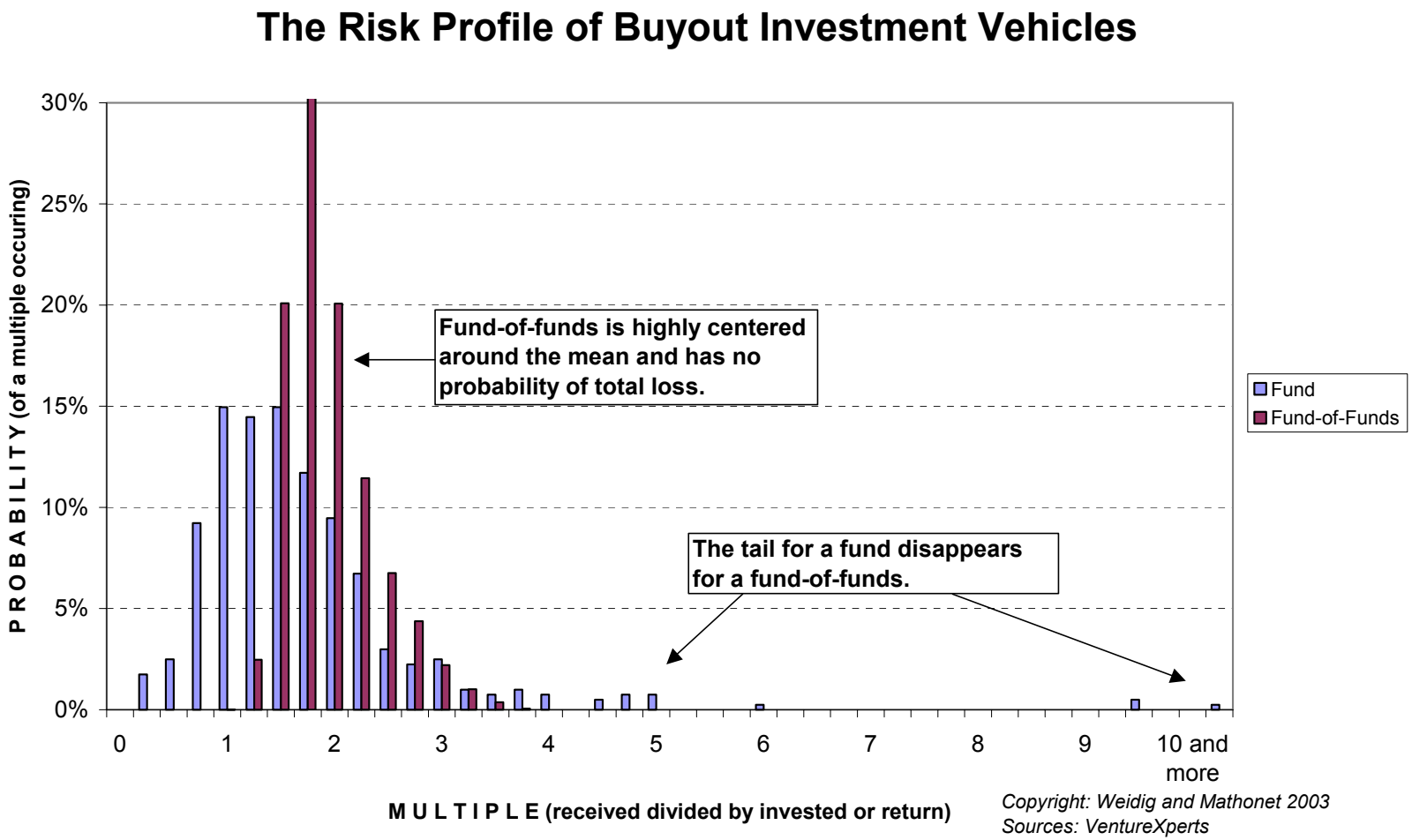

Figure 2: Comparing the risk profile of European buyout funds and funds-of-funds: Multiple distribution. (Data contains about 200 funds, and 50,000 simulated funds-of-funds.)

Comparing The Risk Profile of Venture Capital Investment Vehicles

	Direct	Fund	Fund-of-Funds
Average multiple	6.2	1.7	1.8
Median multiple	1.5	1.3	1.7
Standard deviation	53.8	1.9	0.5
Worst 99th percentile	-100%	-74%	12%
Worst 95th percentile	-100%	-55%	26%
Probability of a loss	42%	30%	1%
Average loss given a loss	-85%	-29%	-4%
Probability of total loss	30%	1%	0%
Risk-return ratio	0.1	0.4	1.7

Sources: VentueXperts, Cochrane

Table 1:

Comparing the risk profile of venture capital investment vehicles (Please note that the risk numbers are over the total investment period, and cannot be directly compared to risk numbers derived from a time series of market prices over a given period, like quarterly value-at-risk or annual probability of default, as typically used for risk management or capital allocation for public equity.) (Data contains about 5000 direct investments (US data – no European data available), about 300 funds, and 50,000 simulated funds-of-funds.) The risk-return ratio used in this study is the return, i.e. the average multiple minus one, divided by the standard deviation to find the return per unit risk.

Comparing The Risk Profile of European Buyout Fund and Fund-of-Funds

	Fund	Fund-of-Funds
Average Multiple	1.6	1.7
Median Multiple	1.5	1.7
Standard Deviation	0.8	0.2
Worst 99th percentile	-75%	25%
Worst 95th percentile	-32%	37%
Probability of a Loss	21%	0%
Average Loss Given a Loss	-23%	-1%
Probability of total loss	1%	0%
Risk-Return ratio	0.8	3.1

Sources: VentureXperts, Cochrane

Table 2:

Comparing the risk profile of European buyout funds and funds-of-funds (Please note that the risk numbers are over the total investment period, and cannot be directly compared to risk numbers derived from a time series of market prices over a given period, like quarterly value-at-risk or annual probability of default, as typically used for risk management or capital allocation for public equity.) (Data contains about 200 funds, and 50,000 simulated funds-of-funds.)

With respect to tables 1 and 2, we conclude that there is a clear diversification benefit for funds, funds-of-funds, and portfolios of funds and direct investments. For example, the probability of any loss is small for a VC fund-of-funds, whereas the probability of a total loss of capital in a direct VC investment is about 30%.

Introduction

Private Equity[1] (PE) can be defined as follows: "Private equity provides equity capital to enterprises not quoted on a stock market. Private equity can be used to develop new products and technologies, to expand working capital, to make acquisitions, or to strengthen a company's balance sheet. It can also resolve ownership and management issues. A succession in family-owned companies, or the buyout and buyin of a business by experienced managers may be achieved using private equity funding. Venture capital is, strictly speaking, a subset of private equity and refers to equity investments made for the launch, early development, or expansion of a business."

Investors often perceive private equity as a risky asset class. This is especially true for venture capital (VC), which is also known as risk capital. Venture capitalists mainly invest into small and medium sized companies to allow rapid growth, and sell their shares a few years later. The rewards can be high, and so the pitfalls. For example, the University of Boston invested an important part of its endowment fund in one such company called Seragen Inc., and lost most of its capital.[2] On the other hand, Tiscali, a very successful Italian communications company, has given to its venture capitalists handsome profits with a more than hundred-fold return!

However, most investments into private equity are far less risky, because most investors either cannot directly invest into companies or they hold several such positions. Their investment strategies are limited by know-how, statutory, legal, and volume constraints. A private equity investment involves one of four investment vehicles: direct investments, funds, funds-of-funds, and more exotic products like collateralised fund obligations (CFOs), publicly quoted entities or mixed portfolios. Furthermore, they all have different risk profiles, which can be very different from a direct investment.

Research has been undertaken into direct investments and funds, but funds-of-funds and more exotic alternatives are largely unexplored, at least in published research. All research is made difficult by the lack of transparency and efficient market pricing. Information has to be painstakingly collected[3] relying on goodwill and could therefore be biased. It is not possible to measure risk as volatility of a time series of a market price, because there is no public and efficient market to price the product. Therefore, the risk is usually taken as the standard deviation around the average return.[4] The return is expressed as a measure, typically the internal rate of return[5] or the multiple[6], that summarises all cashflows over the lifetime of the investment, and unavoidably information on the timing and amount of the cashflows is lost. The

[1] Source: EVCA. In this study, private equity means buyout and venture capital.

[2] "Boston University posted a loss of $17.2 million on its investment in Seragen Inc., a Hopkinton bio-technology start-up, in the fiscal year ended June 30. BU stated that the latest write off brings the $43.4 million the total amount the university has lost of Seragen since it acquired a majority of the stock in August 1987." (Boston Globe, May 15, 1993)

[3] The worldwide largest databases are probably Thomson Venture Economics and Cambridge Associates. We estimate that VE captures about a third of the European market (see section 3).

[4] The riskier an investment, the more likely it is to deviate from an average return.

[5] The internal rate of return is the discount rate that makes the net present value of all cashflows of an investment equal to zero. It measures the efficiency of an investment.

[6] The multiple is the sum of all cashflows of an investment divided by the capital invested. It measures the efficacy of an investment.

uncertain cashflow pattern can be viewed as a source of liquidity risk unless the investment is held-to-maturity.

In this study, we introduce the different investment vehicles and mostly refer to VC, but also to buyout (BO) whenever possible. We use the multiple as our return measure, because it is the simplest and most intuitive one, and expresses how much money was received back as a multiple of the amount paid-in[7]. Our discussion is based on published research articles, our own research, and the Thomson Venture Economics (VE) database. We analyse the risk profiles in detail, also in terms of the risk-return ratios of each vehicle. We conclude that there is a clear diversification benefit for funds, funds-of-funds, and portfolios of funds and direct investments. For example, the probability of any loss is small for a VC fund-of-funds, whereas the probability of a total loss of capital in a direct VC investment is about 30%. We also mention allocation of economic capital to cover for unexpected losses, especially with respect to Basel II regulations.

[7] For a multiple of one, for example, 100 are paid-in, and 100 are received back. For a multiple of 1.5, 100 are paid-in, and 150 are received. For a multiple of 0.5, 100 are paid-in, and 50 are received. And, a total loss represents 0.

1 Direct Investments

Unlike in debt financing or public equity, the private equity practitioner provides not just capital, but also adds value notably with expertise in financing, management, strategy, human resources, and the industry sector. After a due diligence and a negotiation period, investors commit capital and, after some years, sell their shares either via a trade sale (sale to another industrial buyer), an IPO or a secondary transaction. VC funds and informal private equity investors, the so-called business angels, align interests with the founders or early-round investors to avoid adverse selection and opportunistic behaviour.

Valuations are notoriously difficult, and the entry and exit price also depends on offer and demand. Therefore, the only way to measure the return is to look at the entry and exit prices of an investment. The risk of a direct investment is measured as the variation of its potential return. We are only aware of reliable research and data on direct investments in the US market. In Europe, no such research seems to exist and it is likely that no satisfactory data exists so far. The EIF is a limited partner in close to two hundred VC funds with around two thousand European companies, but most direct investments have not been exited yet. This database will however provide a rich source of information in the future. There should be a difference between a US and European direct investment, because a US and a European fund exhibit different risk profiles: see section 3.3. However, we believe that the overall shape of the risk profile of a direct investment should be similar for both, namely highly skewed, with a considerable amount of total losses, and fat tails, with extraordinary multiples.

Cochrane (Cochrane 2003) used the VentureOne database, which includes over fifteen thousand valuations in over seven thousand companies where a new financing round or IPO occurred. The data has a survival bias, because exits for badly performing companies are typically delayed or never happen. Cochrane corrects for this bias by modelling the probabilities of exits.[8] Cochrane finds a highly skewed return distribution with an arithmetic annual mean of 59% and a high volatility. There are some multiples over ten or even over hundred, some modest returns, and a significant amount of losses or total loss. Das, Jagannathan, and Sarin (DJS 2002) analysed over fifty thousand financing rounds in over twenty-three thousand companies. They use VE data, which does not have a survival bias except a possible sample bias: see discussion in next chapter. They find an average multiple of 5.12 for early stage and 1.12 for late stage investments, but do not seem to state standard deviations. Peng (Peng 2001) creates a VC index using thirteen thousand financing rounds mainly from VentureOne. The index allows him to create a time series and he finds an overall geometric annual return of 55% and a high volatility. Quigley and Woodward from Sand Hill Econometrics also construct an index based on similar data sources: see (QW 2003) for more details. Moskowitz and Vissing-Jørgensen (MV 2002) consider all private equity i.e. stakes in companies of any size that are not publicly traded, and find that returns are no higher than for public equity.

Figure 3 and Figure 4 show the risk profile of a direct VC investment in terms of multiples using data obtained from Cochrane.[9] The distribution clearly shows that a VC direct investment is a risky investment. There might be statistically significant

[8] He uses a maximum likelihood estimation method: please refer to Cochrane (2003).
[9] We would like to thank John Cochrane for data and discussions.

differences between financing stage, sector, and market, but this is not the aim of this study. The main objective is to illustrate that a general direct investment is significantly riskier than a fund investment. The figures clearly show that the profile of a direct VC investment is highly skewed with around 30% being a total loss i.e. a zero multiple, and a fat slowly thinning tail of extremely high multiples, i.e. over multiple of 100. According to Cochrane, the annual return is well described by a lognormal distribution with a very high standard deviation. Table 3 shows the risk numbers of the distribution. Please note that the risk numbers are over the total investment period, and cannot be directly compared to risk numbers derived from a time series of market prices over a given period, like quarterly value-at-risk or annual probability of default, as typically used for risk management or capital allocation for public equity. The average and the median are very different, i.e. the distribution is skewed. The worst 99th respectively 95th percentiles are 100%, because more than 30% of all direct VC investments result in a total loss. The probability of a loss[10] on a direct investment is 42%, about half the investments. To cover 99% respectively 95% of all possible scenarios, 100% of capital need to be set aside. This shows how risky directs are. The risk-return ratio used in this study is the return, i.e. the average multiple minus one, divided by the standard deviation to find the return per unit risk. However, we have to point out that, due to the extreme skewness, the standard deviation is very high.

To summarise, a VC direct investment is highly risky. Therefore, investors should only commit all their capital in one direct investment, if they want to gamble that their selection skills and added value is "a sure bet". If investors believe that their selection skills and added value is only superior, they should invest in several direct investments to achieve a better risk-return ratio. Their superior skills would generate a higher average and the diversification effects reduce their downside (and upside) risk. If investors are not sure whether they have the necessary skills, they will be far better off investing into funds, funds-of-funds, or more exotic products (see next chapters).

[10] We neglect inflation and risk-free return. An adjusted target multiple can be approximated by (1+rate)^period, and the cumulative probability shows in Figure 4.

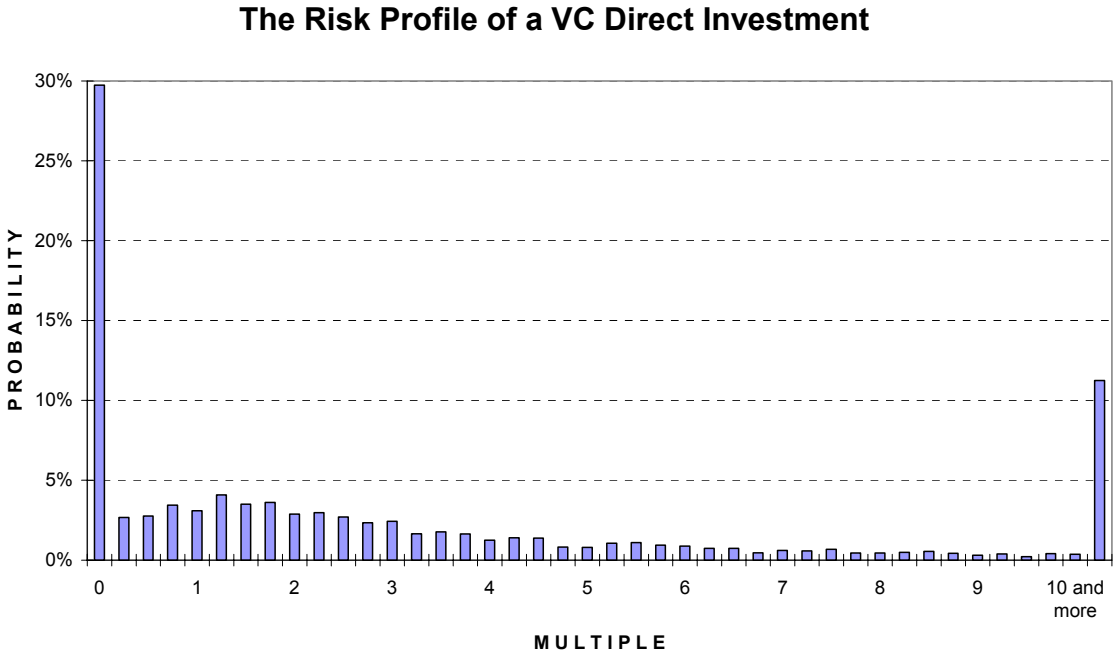

Figure 3: The risk profile of a US venture capital direct investment: Multiple Distribution. (Source: Cochrane)

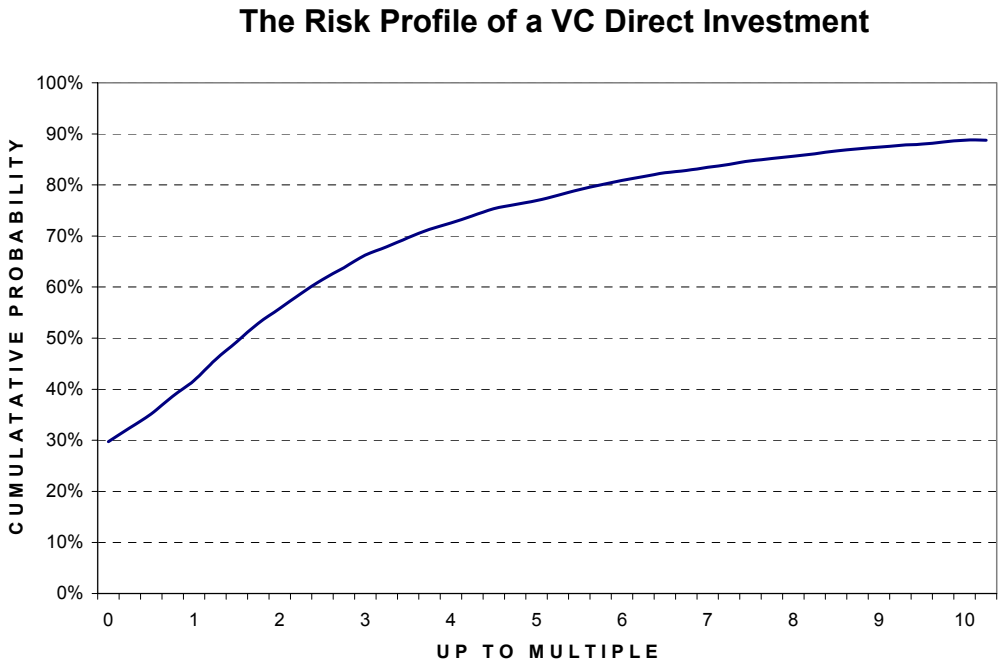

Figure 4: The risk profile of a US venture capital direct investment: Cumulative Probability (Source: Cochrane)

The Risk Profile of a US Venture Capital Direct Investment

	Direct
Average Multiple	6.2
Median Multiple	1.5
Standard Deviation	53.8
Worst 99th percentile	-100%
Worst 95th percentile	-100%
Probability of a loss	42%
Average loss given a loss	-85%
Probability of total loss	30%
Risk-return ratio	0.1

Table 3: The risk profile of a US venture capital direct investment (Source: Cochrane)

2 Private Equity Funds

Private Equity investment is carried out indirectly via funds, funds-of-funds or more exotic private equity products, with the fund being the most common investment vehicle. A fund collects capital from investors (limited partners, LPs) to choose and manage about 10 to 20 direct investments on their behalf. Investors in such funds in Europe are typically banks (25% of all capital committed), pension funds (25%), insurers (10%), funds-of-funds (10%), and corporate investors (10%).[11] The fund manager (called general partner, GP) is a team with complementary background and skills such as technical experts, VC experts, and financial specialists. LPs decide to invest in the fund as a blind pool based on a thorough due diligence, including the quality of the management team, its track record, investment strategy and fund structure. Capital is drawn down as needed in order to pay set-up costs (typically 1%) and management fees (typically 2.5% per annum), and to invest into about 10 to 20 companies over a period of four to five years, called investment period. Over the following years, the companies in the portfolio are further financed and managed for exit via trade sales, public offerings, or secondary markets. The proceeds are distributed among LPs and the GP according to agreed allocation rules. LPs are mainly protected through a long-term alignment of interests with the GP. The GP typically gets a 20% share of the profits after the total invested capital plus a hurdle return has been paid back to the LPs. And the GP's team members often need to invest a substantial share of their personal wealth (typically 1% of fund size). Their main interest is therefore the generation of an above average return. A fund is unlike a public equity mutual fund, because GPs have direct influence on the well being of its investments.

Several studies exist on the returns of funds. The data comes from a data provider or from private funds-of-funds that researchers had access to. Notably, the EIF has around 200 VC funds without survival bias, but most of them are not liquidated yet. Ljungqvist and Richardson (LR 2003) had access to a private dataset of all the cashflows of 73 funds. They find excess return of 4% - 8% per annum relative to the aggregate public equity market, and betas higher than one. Chen, Baierl and Kaplan (CBK 2002) have used the VE database, and conclude that VC has higher risks and higher return, and a very low correlation with S&P 500. Burgel (Burgel 1999) looks at 134 funds and finds an internal rate of return of 14% with a high standard deviation. Burgel's data is most likely a subset of the VE database.

We use the VE database, and drop all funds that are younger than five years, because their interim return still has a considerable amount of uncertainty and a systematic underestimation of the final return. These funds are either not even partially liquidated or their valuation is at cost. We first present a reliability and consistency check. As already mentioned, the private equity industry is opaque and not even the exact numbers of funds per vintage year are known. The VE database contains a table with basic information on all funds known to them, and a table that only contains those funds that communicate their return. We assume that the basic information on funds should cover the bigger part of the market and we consider these funds to reflect the total population. Unfortunately, not all funds report their return data. The table below shows the number of funds with return data versus all funds in the VE database. Most data is available for the US market (approx. three times more funds than Europe). The ratio of the funds with return data to all funds in

[11] Source: EVCA/PwC

the database from 1983 to 1998 is 38% in the US and 40% in Europe. A significant part of the European data comes from UK funds (about 40%). There are some differences between the groups of funds with return data and all funds. There are less small than mid-sized funds with return data versus all funds. We are not sure whether this difference creates some bias, namely that fewer small funds with low return report. We do not think that funds with a low return are less likely to report, because they agree to report before any return becomes apparent. However, this issue becomes important if VE actively tries to complete the data retrospectively. In the US, we do not believe that significant inconsistencies or biases exist. We are less sure about the European dataset.

	US	Europe
Funds with basic info	1969	702
Funds with return info	745	282
Coverage	38%	40%

Table 4: Representativeness of sample used: Thomson VentureXpert data for venture capital funds from vintage year 1983 to vintage year 1998.

Figure 5 and Figure 6 show the risk profile of a European VC fund from VE from 1980 to 1998. Figure 7 shows the risk profile of a European BO fund from VE from 1980 to 1998. The figures clearly show that the risk profile of a fund is a relatively symmetric distribution with less fat tails and virtually no total losses. The fund, as a managed portfolio of 10 to 20 companies, induces significant diversification effects as compared to a direct investment. Nevertheless, fund investments are not risk-free, which can be seen in the risk numbers of Table 5. For example, the probability of not getting back the total capital invested is around 30%. A complete loss is highly unlikely (versus 30% for a direct investment), except maybe when including legal risk or funds with leverage. The average and the median[12] are closer to each other, i.e. less skewed than for directs. To cover 99% respectively 95% of all possible scenarios, 74% respectively 55% of the capital need to be set aside. The risk-return ratio is 0.4, which is four times as high as the ratio for a direct investment.

To summarise, a fund investment is not as risky as a direct investment, but the risks are not negligible. If investors have not superior selection, monitoring, and management skills as related to a direct investment, but are able to take risks i.e. potential losses, they should invest in funds. However, if investors are averse to a potential capital loss and do not possess the necessary skills to manage limited partnerships, they should invest into several funds, a fund-of-funds, or more exotic products.

[12] The average or mean is the sum of all returns divided by the number of returns. The median is the return below and above which 50% of all returns are.

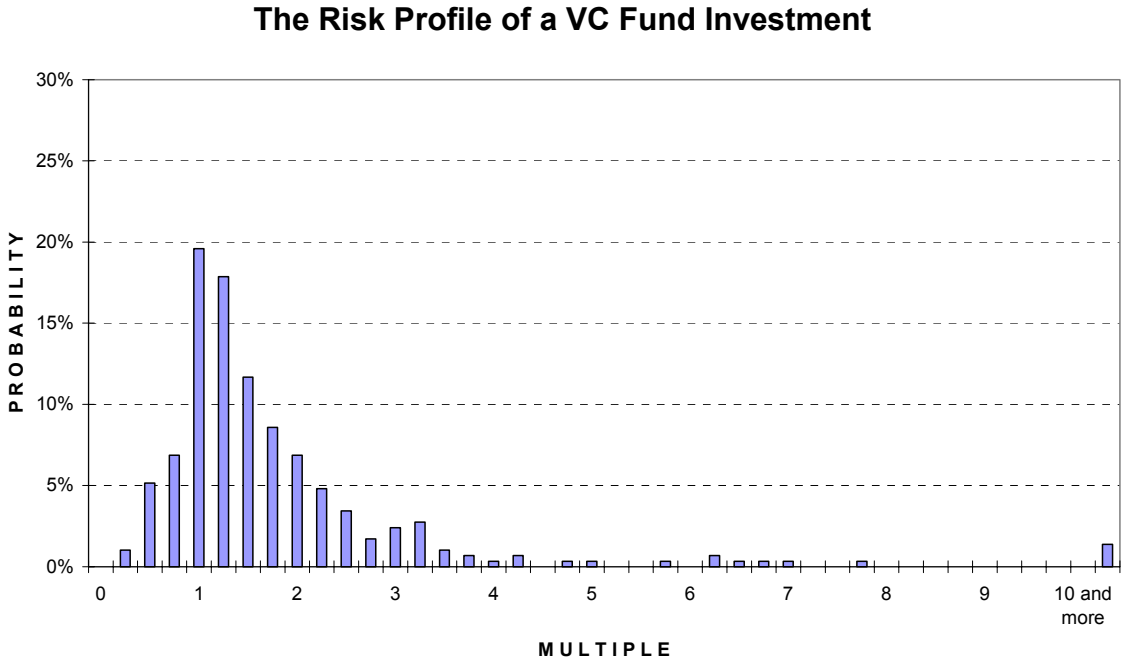

Figure 5: The risk profile of a European venture capital fund: Multiple Distribution (Source: VentureXperts)

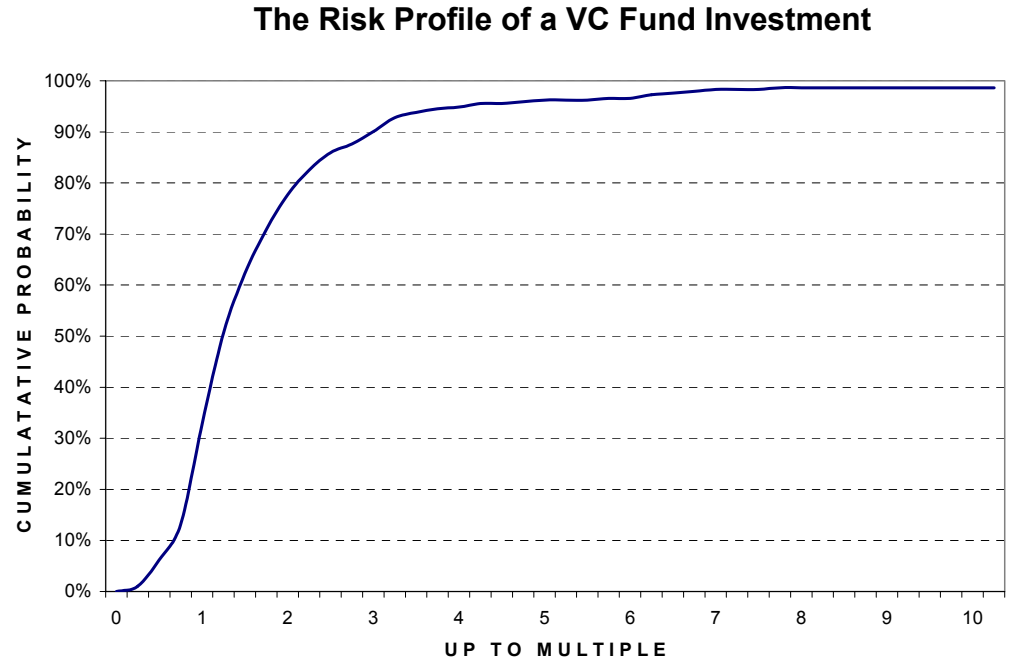

Figure 6: The risk profile of a European venture capital fund: Multiple Distribution (Source: VentureXperts)

The Risk Profile of a European Venture Capital Fund

	Fund
Average Multiple	1.7
Median Multiple	1.3
Standard Deviation	1.9
Worst 99th percentile	-74%
Worst 95th percentile	-55%
Probability of a loss	30%
Average loss given a loss	-29%
Probability of total loss	1%
Risk-return ratio	0.4

Table 5: The risk profile of a European venture capital fund (Source: VentureXperts)

The Risk Profile of a BO Fund Investment

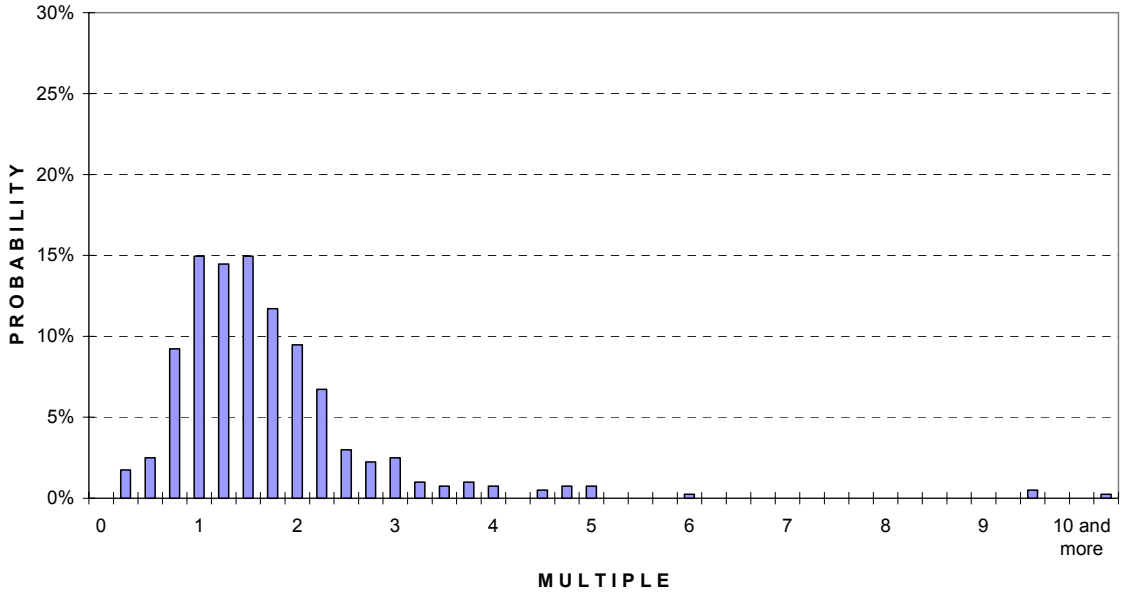

Figure 7: The risk profile of a European buyout fund: Multiple Distribution (Source: VentureXperts)

3 Private Equity Funds-of-Funds

A fund-of-funds collects capital from investors to invest in about 20 or more funds on their behalf. Fund-of-funds investors are typically pension funds, banks, insurance companies, corporate investors, and other funds-of-funds. Funds-of-funds have increased their share considerably over the last years, and now provide around 10% of the capital of funds. Funds-of-funds allow investors to easily invest and diversify on a global basis. They typically charge a management fee of around 0.5% per year, and participate in the profits with 5% to 10%. Internal cost savings for the fund-of-funds investor and the fund-of-funds manager's added value partially or more than fully compensate these fees, which are often wrongly perceived as fees on fees.

It is difficult to find historical funds-of-funds return data. We only find four in the VE database. The EIF is also a fund-of-funds but with around 200 un-liquidated VC funds within the EU Member States and Candidate Countries, and financed by own resources and several mandates. Therefore, we choose to model historical funds-of-funds. We construct historical funds-of-funds by creating portfolios of historical funds that are randomly selected from the VE database while respecting the timeline. We create fifty thousand such portfolios, and obtain the historical multiple distribution of a fund-of-funds. For example, to create a set of historical funds-of-funds with two funds invested over two years, two funds would repeatedly be randomly selected from the historical funds for each of two consecutive vintage years. This method is effectively a Monte Carlo simulation: see Weidig and Born (WB 2004).

Using statistical tests like Mann-Whitney and Kruskal-Wallis, we find that the US and European return data come from two different underlying distributions, and the same is true for VC and BO. Therefore, it is important to distinguish between VC and BO, and between US and Europe. For example, for a European VC fund-of-funds, only VC funds in Europe should be used. We choose not to distinguish between funds of different sizes or stages[13], because we could not find clear statistically significant differences between the mean multiple of funds of different stages and sizes.[14] The case for vintage year dependence is less clear. There is a correlation in the US data, but not in the European dataset. We guess that the European market is a set of different smaller markets, and more exists are trade sales rather than IPOs.

Figure 8 and Figure 9 show the risk numbers of a fund-of-funds. We consider a VC fund-of-funds with twenty funds invested over four consecutive years as the most typical fund-of-funds. The figures clearly show that the risk profile of a fund-of-funds looks similar to an index of an efficient public market; it has a symmetric distribution, not too pronounced fat tails and no total losses. Table 6 shows the risk numbers of a fund-of-funds. The average is close but not equal to the average of the sample of historical funds, because we select the funds according to vintage year, and not randomly. Even, the probability to loose any capital seems small. No capital is required to cover 99% or 95% of all scenarios. The average and the median are very close to each other, which implies a symmetric distribution. The risk-return ratio is again higher than for the underlying investments, namely 1.7 as compared to 0.4 for a fund. Of course, the fund portfolios are net of fees, and the fund-of-funds managers need to be compensated with a management fee, set-up costs and carry[15]. The fees shift all our results to the left, but only by a multiple between 0.05 and 0.1

[13] Early stage versus late stage VC.
[14] There are indications that the size of a fund in the US matters.
[15] Carry is the percentage profit participation when a hurdle rate return is passed.

according to a back-of-the-envelope calculation. The carry will not change the downside risk of our distribution. We conclude that a fund-of-funds, as a managed portfolio of twenty funds over four years, induces significant diversification effects as compared to a fund. This diversification depends on the number of funds in the portfolio and the period over which funds are invested into, as we show below.

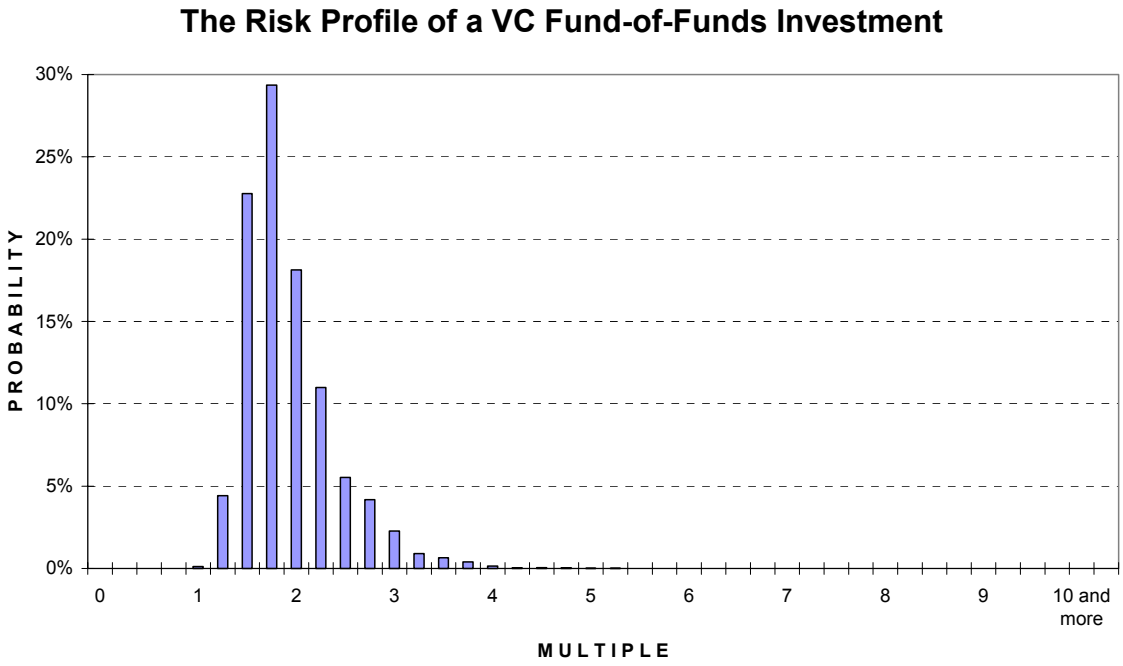

Figure 8: The risk profile of a European venture capital fund-of-funds: Multiple Distribution

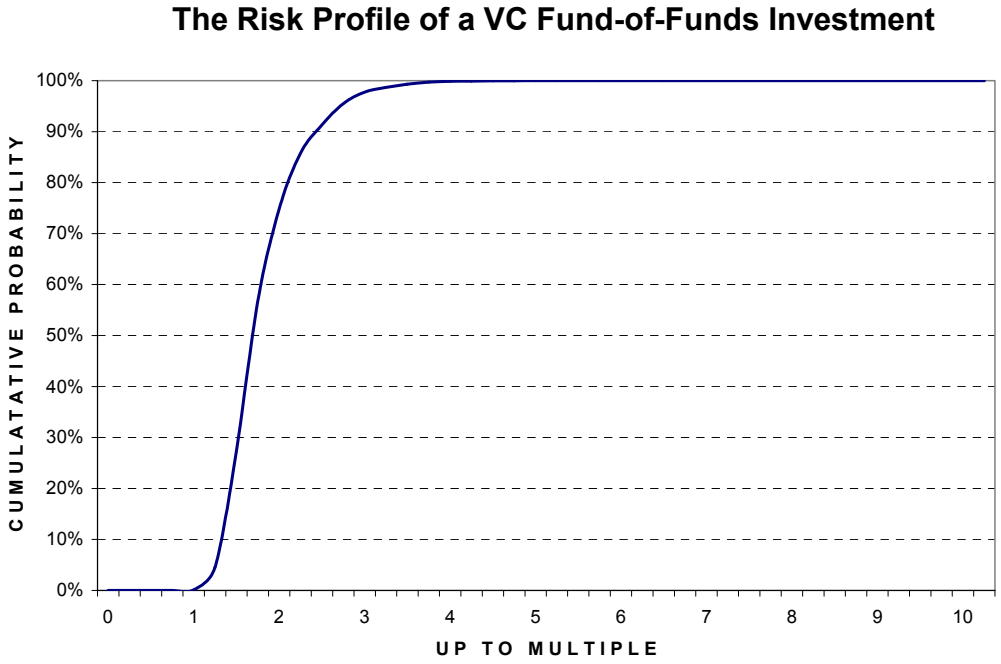

Figure 9: The risk profile of a European venture capital fund-of-funds: Cumulative Probabilities

The Risk Profile of a European Venture Capital Fund-of-Funds

	Fund-of-Funds
Average Multiple	1.8
Median Multiple	1.7
Standard Deviation	0.5
Worst 99th percentile	12%
Worst 95th percentile	26%
Probability of a loss	1%
Average loss given a loss	-4%
Probability of total loss	0%
Risk-return ratio	1.7

Table 6: The risk profile of a European venture capital fund-of-funds

3.1 The diversification by number

We run our simulation for funds-of-funds with different numbers of funds included in our portfolio, with an investment period of four years. Figure 10 shows how the curves get closer and closer to the best possible localisation of the distribution of multiples. The probability to achieve a multiple of one or less (probability of capital loss) is about 30 % for a fund investment. This loss probability will be very small if we build a realistic fund-of-funds of European VC funds of 20 funds over 4 years. Figure 11 shows the convergence of the standard deviation, our measure of risk, of the multiple by plotting standard deviation against the number of funds in a portfolio. The standard deviation asymptotically approaches a non-zero value, around 0.4, and the convergence follows a similar curve as the inverse of the square root of the

number of funds.[16] This non-zero value of the standard deviation represents the best possible diversification. The standard deviation does not go to zero, because only the idiosyncratic risk of the funds is diversified away. A zero value would imply a zero correlation between funds and therefore no common influence from general market factors. The maximum diversification benefit is already sufficiently reached with a portfolio of twenty to thirty funds.

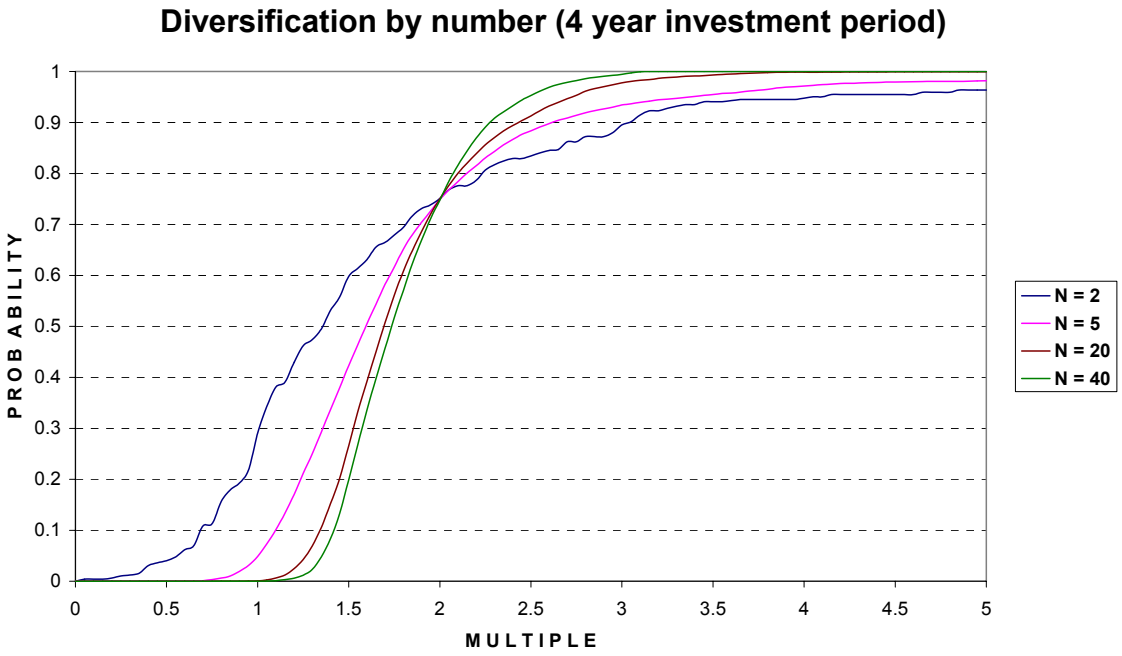

Figure 10: Diversification by number: Cumulative probability curves. (N is the number of funds in a portfolio)

[16] For a portfolio of N uncorrelated assets, the portfolio standard deviation is the asset standard deviation divided by the square root of N.

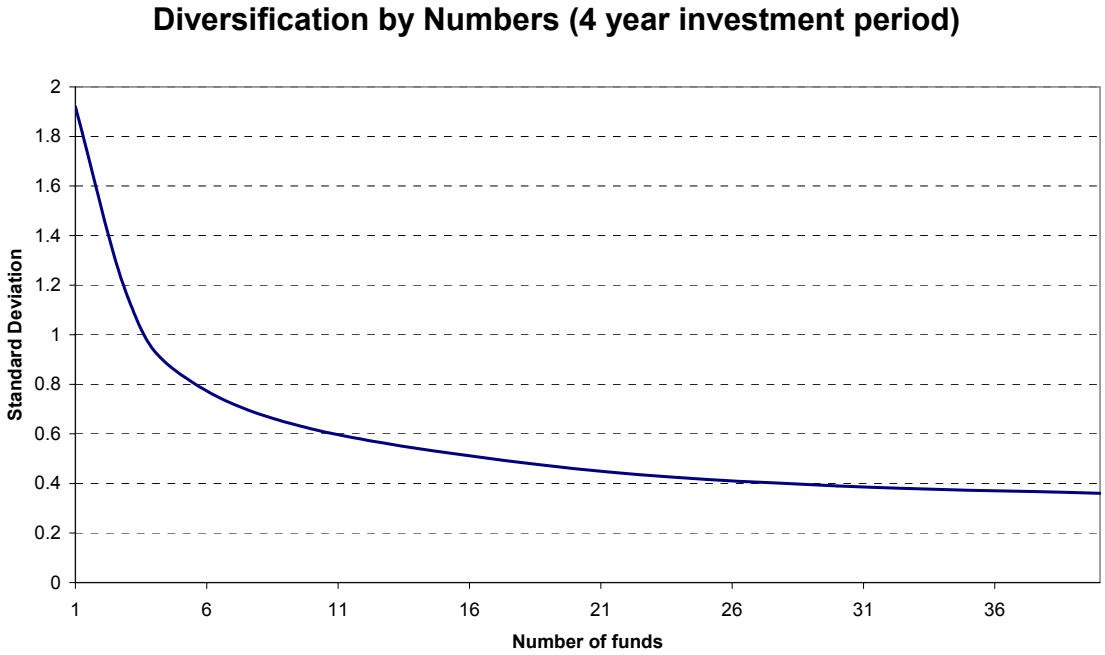

Figure 11: Diversification by number: Convergence of the portfolio standard deviation (in multiples)

3.2 The diversification over time

We run our simulation for funds-of-funds for different investment periods, with twenty funds. Of course, with twenty funds, the portfolio partially benefits from the diversification by numbers, but there is also a diversification by investment period. Figure 12 shows the convergence of the standard deviation, our measure of risk, of the multiple by plotting standard deviation against the investment period of a portfolio. The standard deviation asymptotically approaches a non-zero value. This non-zero value of the standard deviation represents the best possible diversification. The standard deviation does not go to zero, because only the idiosyncratic risk of the vintage year is diversified away. A zero value would imply a zero correlation between vintage years and therefore no dependence on vintage year. The convergence is clearly less strong than for the diversification by number. This is partially explained by the low dependence on vintage year within the European sample. The US sample has a clear dependence on vintage year as mentioned before.

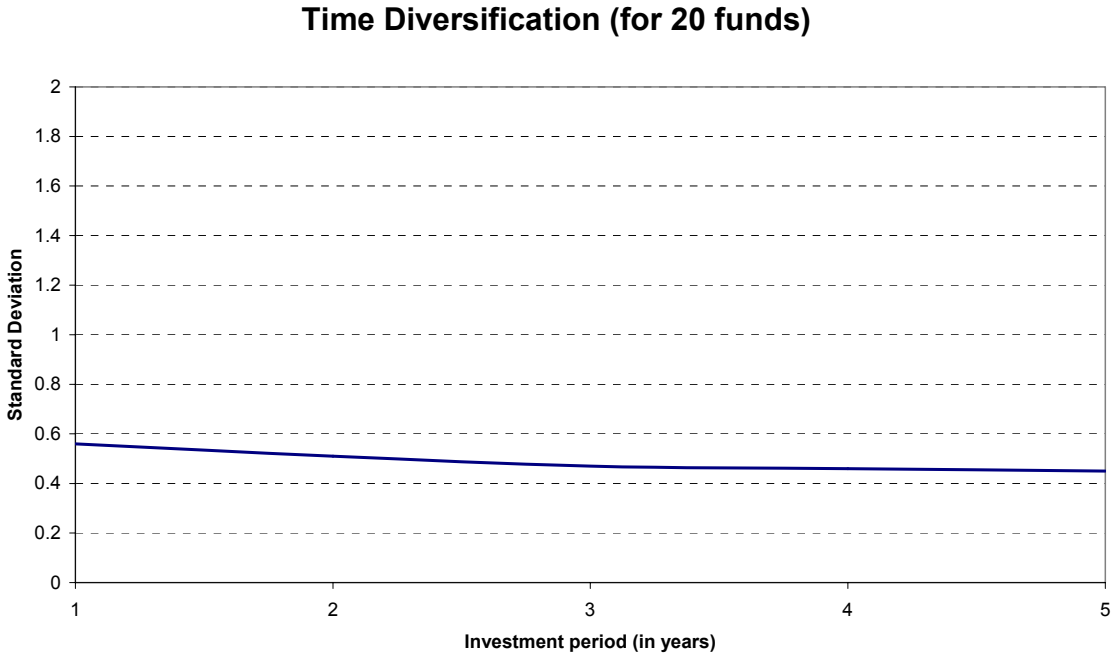

Figure 12: Diversification over time: Convergence of the portfolio standard deviation (in multiples)

3.3 The difference between US and European venture capital

We mention earlier that there are differences between Europe and US. Figure 13 demonstrates the differences between a European and a US fund-of-funds. We use funds-of-funds with twenty funds and an investment period of four years for both markets. For a fund-of-funds, the average multiple for Europe is 1.8 with a standard deviation of 0.5, and the average multiple for the US is 2.3 with a standard deviation of 0.8. For a fund, the average multiple of a European fund is 1.7 with a standard deviation of 1.9, and the average multiple for a US fund is 2.5 with a standard deviation of 2.6. But which market is best to invest in? US funds-of-funds have a higher return, but also a higher risk compared to a European fund-of-funds.

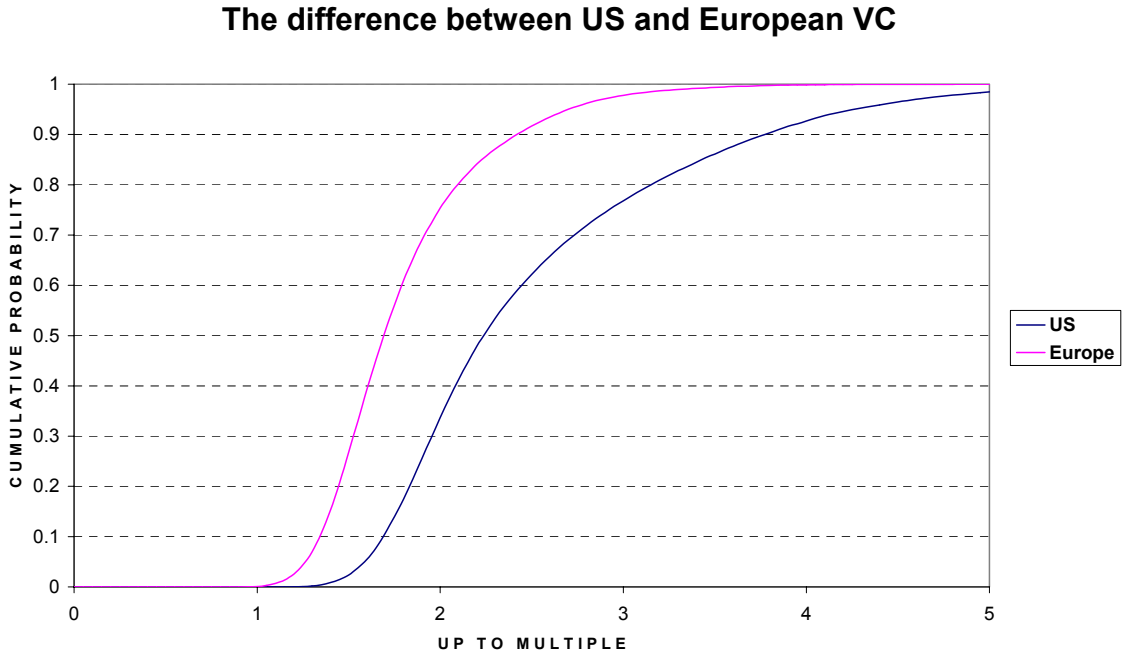

Figure 13: Difference between a US and a European venture capital fund-of-funds: Cumulative Probabilities

To compare the two markets, we use a risk-return ratio comparable to the Sharpe Ratio. This ratio (return, i.e. average minus one, divided by standard deviation) is a reasonable measure to compare markets with different mean and standard deviations. The ratio measures the return per unit of risk. The higher the ratio the more return is gained per unit of risk taken. Table 7 shows the ratios. The risk-return ratios for the US and Europe are surprisingly similar for a VC fund-of-funds, which is interesting. Thus investors would get similar returns for the same risk in both markets. However, looking at the fund level, the ratio is better for US funds while European funds have a lower correlation between each others, which reduces the standard deviation more for a European fund-of-funds.

	Europe		US	
	Fund	Fund-of-Funds	Fund	Fund-of-Funds
Average Multiple	1.7	1.8	2.5	2.3
Standard Deviation	1.9	0.5	2.6	0.8
Return-Risk Ratio	0.4	1.6	0.6	1.6
Maximum Fees	N.A.	0.6	N.A.	0.8
Return-Risk Ratio	0.4	0.4	0.6	0.6

Table 7: Risk-return ratio of venture capital funds and funds-of-funds in US and Europe

Table 7 also shows that the maximum cost of fees in terms of multiple for a fund-of-funds to have the same or smaller ratios than a fund is 0.6 for Europe and 0.8 for

the US.[17] This shows that an investor will have diversification benefits by portfolio generation if the annual fees of a fund-of-funds are less than 6% of committed capital in Europe and less than 8% in the US.[18] As realistic fees are below 1%, funds-of-funds still have diversification benefits even if fees are considered. The carry will decrease the mean and standard deviation slightly.

3.4 The difference between venture capital and buyout

We mention earlier that there are differences between a VC and BO fund. A US BO fund has lower returns and lower risk versus a US VC fund, but their risk-return ratios are similar. However, in Europe, the story is different. The European BO funds have been exceptional, with a risk-return ratio twice as high as for a European VC fund[19]. On the other hand, the risk-return ratio for a European VC fund is similar to a US VC or BO fund. The results are summarised in Table 8.

Figure 14 demonstrates the differences between a European VC and BO fund-of-funds. We use funds-of-funds with twenty funds and an investment period of four years for both markets. The average of a fund-of-funds is close but not equal to the average of the sample of historical funds, because we select the funds according to vintage year, and not randomly. The picture is similar to the one for the funds. In terms of risk-return ratios, an investment into a European BO fund-of-funds is best. The results are summarised in Table 8.

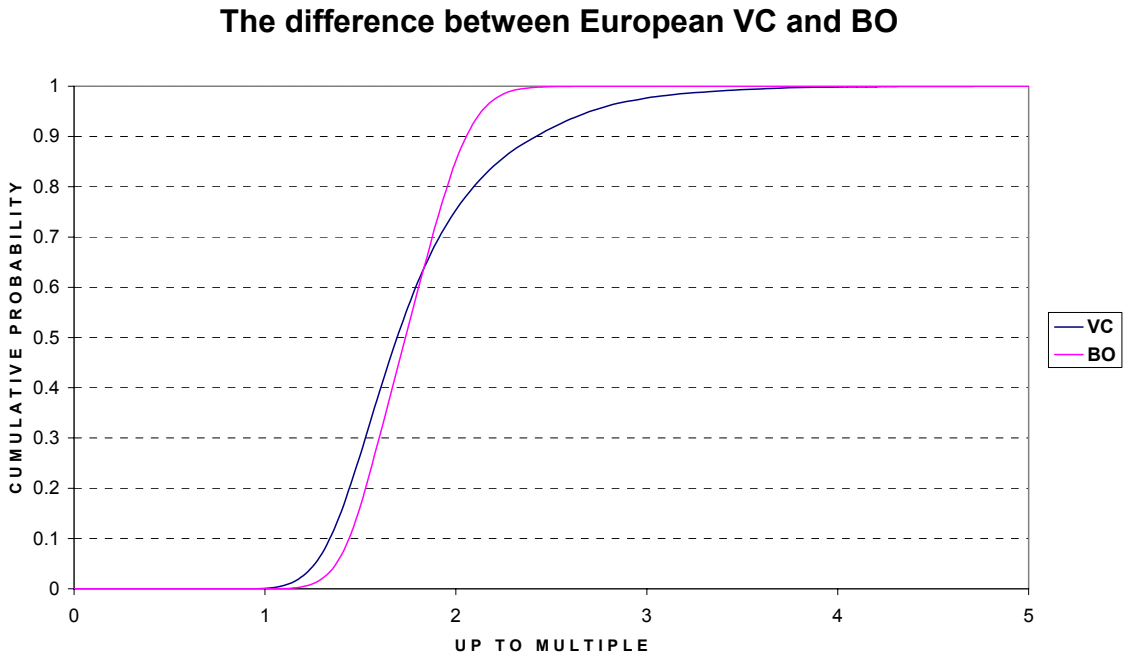

Figure 14: Difference between a venture capital and a buyout funds-of-funds in Europe

[17] We reduce the average return of a fund-of-funds until the risk-return ratio equals a fund's one. The difference is the maximum cost of fees. Fees do not affect the standard deviation.
[18] The annual fee is approximated by total cost of fees divided by a lifetime of 10 years.
[19] We are not sure of the reasons.

	VC Europe		VC US	
	Fund	**Fund-of-Funds**	**Fund**	**Fund-of-Funds**
Average Multiple	1.7	1.8	2.5	2.3
Standard Deviation	1.9	0.5	2.6	0.8
Return-Risk Ratio	0.4	1.6	0.6	1.6

	BO Europe		BO US	
	Fund	**Fund-of-Funds**	**Fund**	**Fund-of-Funds**
Average Multiple	1.6	1.8	1.7	2.0
Standard Deviation	0.8	0.2	1.6	0.7
Return-Risk Ratio	**0.8**	**3.1**	0.5	1.4

Table 8: Comparing venture capital and buyout for US and Europe for funds and funds-of-funds

4 Alternative Investment Vehicles

4.1 Collateralised Fund Obligations

Collateralised Fund Obligations (CFOs) are effectively securitisation of mainly private equity funds-of-funds, and have gained in popularity.[20] Examples of CFOs are the fund-of-funds manager Partners Group, which has sold two convertible notes, Princess in 1999 and Pearl in 2001, or Capital Dynamics, which recently sold its Prime Edge bonds. The main aim is either to raise capital for their private equity fund investments by offering to investors a product that suits their risk appetite and/or regulatory constraints, or to sell off a private equity portfolio. Deutsche Bank and JP Morgan Chase initiated similar deals. Instead of leaving private equity portfolios through costly sales in secondary markets, typically such transactions aim at capital release from their investments by selling the bond part while keeping the equity part, that is, the upside of private equity. Fitch Ratings, Standard & Poor's and Moody's Investors Service rated these CFO bonds, which forced them to consider modeling the private equity funds' cashflows.

It is impossible to give a risk profile for CFOs, because each deal is specific and modeling is very important and tricky. The securitisation allows stripping the total risk of a private equity fund-of-funds into various risk layers to meet the investor's risk appetite. To compute the default probability of a bond of such a risk layer, it is vital to model the cashflows of funds-of-funds. Standard & Poor's (S&P 2003) and Fitch Ratings (Fitch 2002) have undertaken efforts in this respect: see Weidig and Meyer (WM 2003) for a review.

4.2 Publicly Traded Products

The biggest obstacle to estimate the risk in private equity is the lack of an efficient market. Without a time series of a market price, we are unable to compute the volatility of the investment vehicle. Instead, we look at the standard deviation of final returns within a collected sample of investments. But, publicly traded private equity (PTPE) products exist. These entities are raising capital from the public market, and invest into private equity. As with mutual funds, their net asset value is published regularly, and the market price reflects the market's judgement on their fair value. Recently, Bauer, Bilo, and Zimmermann (BBZ 2001) researched PTPE. They classify PTPE into three groups: listed companies whose core business is private equity (e.g. 3i), quoted investment funds (e.g. Schroeder Ventures Trust), and specially structured investment vehicles (e.g. Castle Private Equity). They identify more than 200 PTPEs, and about 100 that were reliable for investigation. They claim to have found higher Sharpe ratio for PTPEs, but we are cautious as the data only represents the period of boom, and liquidity issues are important.

We undertook our own research. We look at the beta[21] of PTPE listed on stock exchanges, and only select PTPEs with some degree of liquidity and historical data.

[20] See articles by Primack in Buyouts (January 2003), Monga in Corporate Financing Week (January 2003) and Snow in PrivateEquityCentral (December 2002).

[21] The beta is the measure of systematic risk within the Capital Asset Pricing Model. Unlike the idiosyncratic risk i.e. the risk proper to the asset itself, the systematic risk is induced by the market, and cannot be diversified away with a portfolio of assets. Beta reflects the movement of the asset price with respect to the market index. For beta one, the price moves

Still, it becomes apparent that most PTPEs are illiquid, except 3i, which is a member of the FTSE 100. The two-year beta[22] of 3i is 1.59, with 15% of stocks of the FTSE having a higher beta. We compute the beta for several other PTPEs, and find a very low beta around zero. This is due to the illiquidity of the stocks. As they are rarely traded, their market prices do not move with the liquid market index. We try to correct for this bias by using a technique advocated by Ibbotson, Kaplan, and Peterson (IKP 1997). As a result, the betas are significantly higher, but on average no higher than the index. Figure 15 summarises the betas of FTSE 100 stocks, and the uncorrected and corrected betas for PTPE. To summarise, we are unable to make any definite statement. However, PTPE is probably not much different to public equity. More historical data and methodology work is needed.

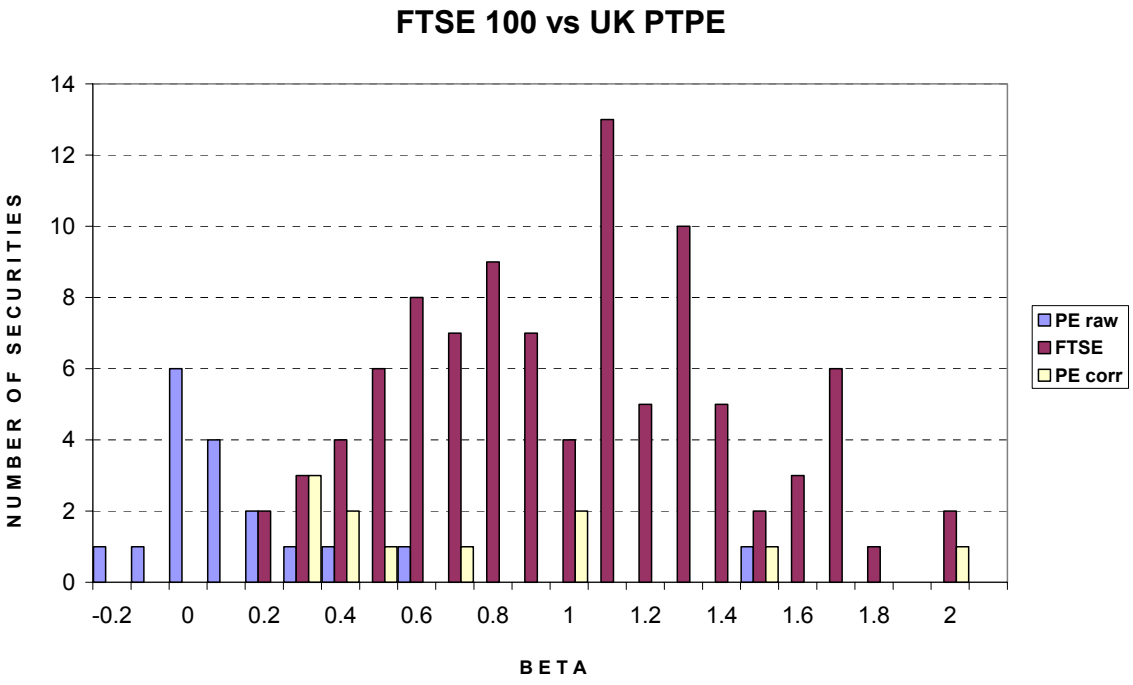

Figure 15: Beta of FTSE 100 stocks, PTPE raw, and PTPE corrected

up or down in the same way than the index, i.e. the asset has the same risk as the index. For beta higher than one, the price is moving higher or lower than the index movement, i.e. the asset has a higher risk.

[22] The betas are estimated against the main market index, and using two years weekly data.

4.3 Portfolios

An investor can also hold a portfolio of direct investments, funds, funds-of-funds or a mixture. We are unable to compute for example a portfolio of direct investments, because we do not know the correlation between direct investments, and are unable to use a database to construct them as we did for historical funds-of-funds. However, a portfolio of direct investments is effectively a selective fund portfolio without fees and carry, but with internal costs. And, we have seen that the risk profile of a fund is considerably lower. It would indeed be interesting to try to match microscopic (i.e. company level) data with macroscopic (i.e. fund level) data. This is in a sense what we have done in order to construct a risk profile of a historical fund-of-fund, because we assume that a portfolio of funds is effectively a fund-of-funds portfolio without fees and carry. Finally, another important aspect is to understand the internal cost structure of having such a portfolio as opposed to paying fees to a fund or fund-of-funds.

4.4 Others

There are niches in private equity with a few players offering exotic investment vehicles. Most of them are relatively recent, and no historical data is available. Thus, we are only able to describe the vehicles. But, they have very specific risk profiles different from all others described earlier.

A VC investment is a long-term investment, and fund investors enter into a limited partnership agreement. And, there is a market for secondary transactions, because some fund investors have decided to sell their part, for example to release capital. There exist secondary funds, which buy limited partnership shares of funds. Some secondary funds also purchase secondary directs. There also exist venture-leasing funds, which provide leasing to VC companies. These funds finance the core fixed assets, and obtain the ownership and the residual value of the assets, participate in some of the upside, and receive monthly payments to service the lease.

5 Summary

Figure 16 and Figure 17 summarise the risk profiles of a direct, a fund and a fund-of-funds investment. The diversification effects are clearly observable. The distribution of multiples of a direct investment is extremely skewed. 30% of all direct investments are a total failure, and all the capital invested is lost. However, the distributions have a very long, slowly decreasing and fat tail with extreme profits above a multiple of 100. The distribution of a fund's multiple is still skewed with a tail of healthy profits above a multiple of 10. The multiple distribution of a fund-of-funds is nearly normally distributed with rapidly decreasing tails, and looks like a stock in an efficient market.

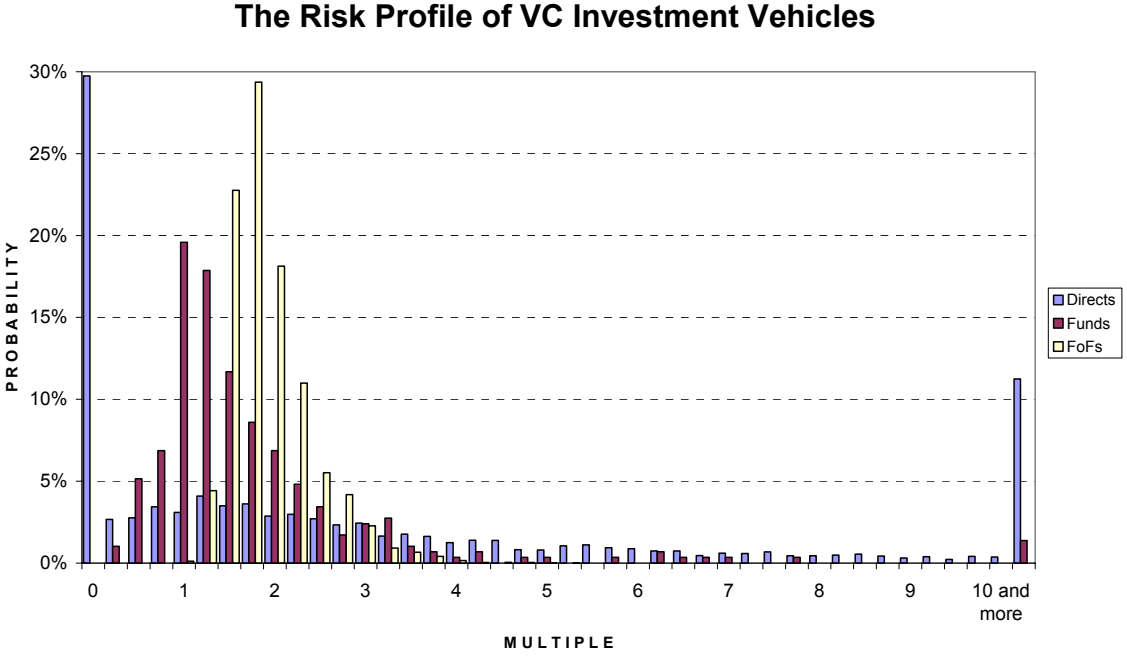

Figure 16: The risk profile of venture capital investment vehicles: Multiple Distribution (Data contains about 5000 direct investments (US data – no European data available), about 300 VC funds, and 50,000 simulated VC funds-of-funds.)

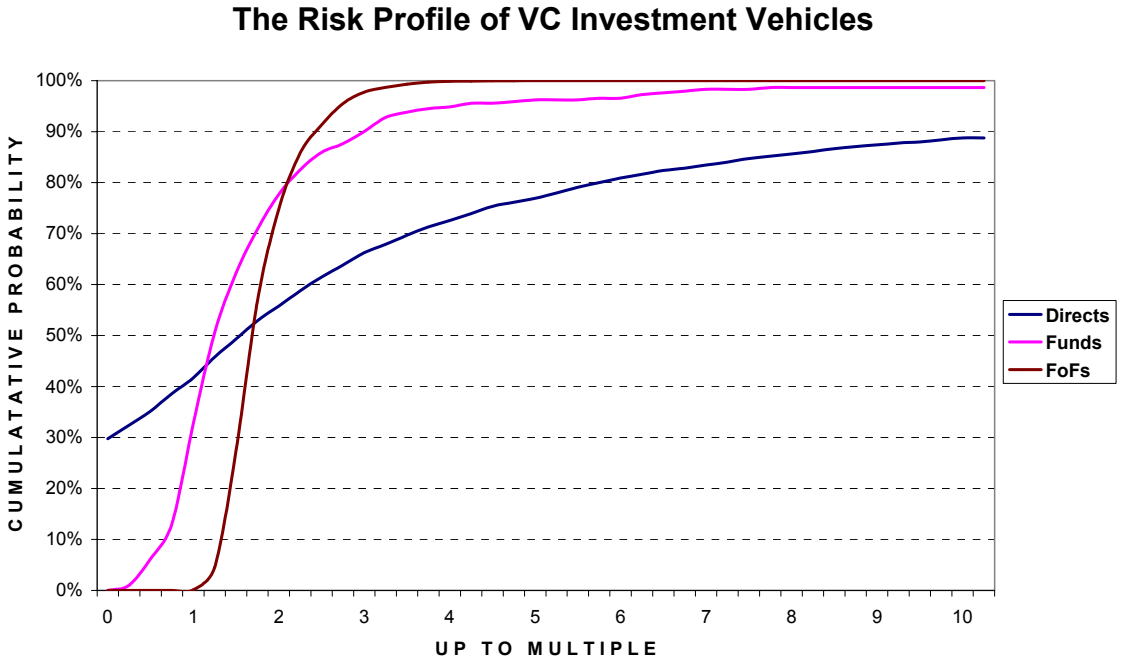

Figure 17: The risk profile of venture capital investment vehicles: Cumulative Probabilities in multiples. (Data contains about 5000 direct investments (US data – no European data available), about 300 VC funds, and 50,000 simulated VC funds-of-funds.)

Risk management of private equity investment vehicles is not an easy task, because the standard tools were developed for publicly traded products like market risk with value-at-risk or credit risk with ratings associated to probability-of-default and loss-given-default. Our study cannot directly link to economic capital or regulatory capital allocation under Basel. Unlike the Basel Committee's work, the study looks at the risk associated with the full private equity investment cycle (10 years), while the Basel Committee looks more at the value at risk on a quarterly or yearly basis. It is also important to stress that we do not look at the cashflow timing of a private equity investment. Nevertheless, we are confident to make reliable statements using the total return on private equity investment vehicles. First, diversification is of utmost importance, and any scheme of economic or regulatory capital allocation should distinguish between the very different risk profiles of the private equity investment vehicles. Secondly, we are able to quantify the overall potential loss for funds and funds-of-funds, and some results seem to be in conflict with the new Basel Accord rules. For example, in the PD/LGD approach for equity, the LGD is set to 90%.[23] Our study shows that a loss given any capital loss is around 30% for a fund, which is far lower. We can agree on a 90% LGD for a direct investment[24], but for a pool of direct investments or a fund, the LGD decreases very rapidly. Thirdly, we are unsure whether the calibration of the private equity risk weight floors is reliable using the small-cap stock index as a proxy for a private equity portfolio diversification, see working paper by the Basel Committee (Basel 2001). For example, is it relevant that, unlike a public index, a fund buys and sells direct investments at different times during its life? Ignoring the exit price, can the

[23] Section 321 on The New Basel Accord – Third Consultative Paper, April 2003.
[24] We find a loss given any capital loss is 85%.

purchase price of a fast-growing private company be linked to the small-cap index, too?

To conclude, we have proven the case of diversification on a fund and fund-of-funds level: a direct investment of €1m in one SME might result in a total loss, but when investing €1m in a fund-of-funds, the probability that all its underlying funds' direct investments, which are more than hundred, result in a total loss at the same time is next to zero. It is this mechanism that leads us to claim that private equity might be a risky asset, but a private equity investment is not necessarily so. The description of the different risk profiles cannot be as exact as for public equity products due to data and methodology constraints. However, we are convinced that the research and data on which we base our judgement is sufficiently reliable for general statements. Our study also highlights the need to distinguish between the various investment routes/portfolio levels when allocating capital to cover losses.

We would like to thank the EIF, and especially Thomas Meyer, Head of Risk Management and Monitoring, for their support. We also acknowledge the input provided by Björn Born who wrote his Diploma thesis on the risk profile of funds-of-funds under the supervision of one of us, Tom Weidig, and the University of Frankfurt. We welcome comments.

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