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Assessing the risk of private equity fund investments

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Introduction

The turmoil created by the credit crisis and the high volatility in the stock markets that persisted from the second half of 2007 to 2009 also raised some big questions about just how risky private equity investments are. What is the volatility of the asset class? Does the long-term horizon of the asset class also affect its risk parameters?

This chapter presents answers to these questions, shows different approaches of calculating risk in private equity and discusses their advantages and shortcomings. The chapter describes the difference of measuring risk in public markets and private equity markets, and it also presents various approaches of calculating risk measures: starting with an approach that calculates the standard deviation on the time-series of a private equity return which is very similar to public market approaches. In addition the authors focus on new methodologies that use simulation techniques to derive risk parameters of a private equity portfolio through resampling them.

Difference between calculating risk in public and private markets

Scientific literature has discussed various risk parameters in public equity markets for some decades. It starts with the calculation of the statistical variance or standard deviation on daily, weekly, monthly or annual returns of stock price changes. Some researchers have focused on the downside risk only and have created measures like the Value at Risk (VaR) or the Shortfall risk. As empirical studies show that the distribution of public market returns has a higher skewness than a Gaussian distribution, methods like the copula function have been developed in order to find distributions that match the profile of public markets better. All of these methods are based on daily changes of market prices.

As private equity assets are not traded that often there is lack of market price data. Private equity investors usually make commitments to a private equity partnership that draws the capital in the first years of the fund and sells the investments after three to seven years.[1] In the intervening period the investor receives information about the net asset value of all the underlying investments on a quarterly basis. The net asset value is an accounting value that the management team of the private equity fund assesses under various accounting rules. In order to align the valuation methodologies of private equity funds the European Private Equity and Venture Capital Association (EVCA), as well as other trans-national associations, developed and published accounting rules that have to be adapted by their members.[2] Even if common and standardised valuation methodologies are established, the net asset value (NAV) cannot reflect a market price similar to a stock price.

Empirical analysis shows that the difference of the net asset value of a company and the price of a company – reflected through the selling price a few months later – could largely differ. On the other hand an internal study by Capital Dynamics analysed that the ability to predict the correct value of the company and the performance of a private equity fund are positively correlated, i.e. good private equity managers have a good understanding of the value of their underlying portfolio companies. Even if the manager is able to predict the market price of a company very precisely, the available data points are still very limited. In addition, the management team tend to keep the changes of the valuation between different valuations periods very limited; e.g. during the investment period of a fund the value is usually kept at cost over a longer time period.

Due to the turmoil in the public markets the US accounting rules (US GAAP) were changed and private equity managers should also apply the mark-to-market valuation as described in FAS 157. Every private equity firm must 'fairly value' every single one of its investments, the criterion being a holding's likely current sale value. For those that do not trade publicly, buyout houses and their auditors must approximate the value as rigorously as they can, guided by the pricing of recent leveraged buyouts (LBOs) and valuations of 'comps' or comparable public companies. Auditors require a robust and well-documented determination of fair value by the private equity fund in order to agree to the valuation methodology. Whether this change in the accounting rules will also affect the volatility in the net asset value is currently open to debate and has to be analysed at a later point in time.

In summary, net asset values are accounting values and not market prices. Nevertheless, these accounting values have to be taken into account if someone wants to calculate the risk of private equity before the end of the fund's lifetime. But it is important to bear in mind what integrating net asset values actually mean and how great their influence is in different methodologies.

Risk calculation based on time-series private equity valuations

In the first approach the influence of the net asset value is large but the risk measure is easy to calculate and very similar to the public market.[3] This method defines the risk of private equity as the standard deviation or variance of the returns based on the changes of the net asset value from one quarter (i) to the next quarter ($i + 1$).

The net asset value of private equity funds is heavily influenced by the investments and divestments of the private equity funds. An investment (Take Down = TD_i) into a new company increases the net asset value while exiting a company decreases the NAV of the fund (Distribution = DI_i). Because of that the NAV has to be adjusted by the cash flows:

$$NAV_i = (NAV_{i-1}) * (1 + r) + TD_i - D_i$$

$$r = ((NAV_i - TD_i + D_i)/(NAV_{i-1})) - 1$$

The return r is based on the difference of the valuations between two quarters which is not affected by cash flows. This difference is based on downgrades or upgrades of company values by the manager of the private equity fund. This return r can be calculated for each quarter over the lifetime of a fund and can be used to calculate variance and standard deviation on this time-series.

The advantage of this approach is that it is very similar to the calculation on public markets and that the calculation can be easily performed. The shortcomings are that the calculations are based on changes of the net asset value only. As explained above, NAVs are accounting values that do not change to the same extent as market prices. Because of that real volatility of private equity fund returns are understated – this phenomenon is called 'stale pricing problem'.[4]

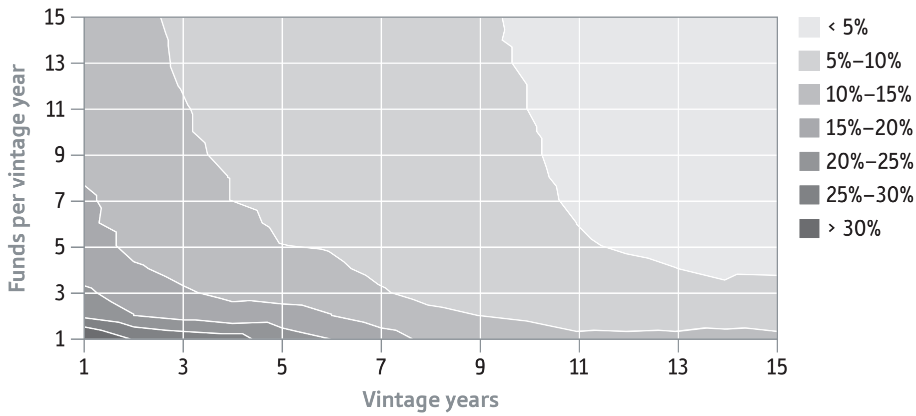
Due to this understatement some researchers developed approaches in order to circumvent the stale pricing problem. They are using theoretical models to adjust the derived variance by adding additional volatility, mainly through the connection to public market returns.

Risk calculation based on cross-section of private equity multiples

The second approach reduces the influence of the net asset value on the calculation of the risk measure. Instead of the pure NAV the TVPI (Total Value to Paid-In) multiple is taken into account. The TVPI sets the sum of all distributions plus the current NAV in relation to the paid-in capital. In order to derive the risk of private equity the authors perform a Monte Carlo simulation and simulate random portfolios out of the universe of private equity funds. This reflects the investment strategy of an investor who would randomly build a portfolio of private equity funds. At the end of the lifetime it would calculate the TVPI for each portfolio. Repeating this analysis 10,000 times results in a distribution of portfolio multiples on which it is possible to calculate the cross-sectional standard deviation.

This analysis uses performance data provided by Thomson Venture Economics. A total of 2,699 funds (1,015 buyout funds and 1,684 venture capital funds) were

Figure 3.1: **Standard deviation of a diversified private equity portfolio**



Source: Capital Dynamics analysis based on Venture Economics data up to 30 June 2007; well diversified portfolio allocated to European and US funds as well as to buyout and venture capital funds with vintage years from 1983 to 2003: data up to 30 June 2007.

included in the analysis. The funds have their investment focus either in Europe or the US, and have different strategies and vintage years between 1983 and 2003. Cash flows and reported NAV numbers are taken into account until 30 June 2007. In the following analysis the simulation is performed on a historical data, assuming that the return patterns in the future will have a probability distribution similar to the historic values.[5]

Running the Monte Carlo simulation for an investment in one single private equity partnership shows a variance of more than 30 percent. Compared to public markets this number seems to be high. However, diversifying over a number of funds decreases the span of the multiples of the randomly built portfolios. This is reflected in a lower variance of 18 percent for the cross-sectional variance of an investment in five funds of one vintage year. Increasing the commitments to 15 funds of one vintage year can reduce the risk further. If another level of diversification is added through vintage year investors can decrease their variance even further. A portfolio consisting of 30 funds over five vintage years has a variance of 10 percent. A comparison of the variance of such a diversified private equity with numbers for public markets show that the risk of private equity seems to be lower. Figure 3.1 shows the different levels of variance for randomly build portfolios.

Summarising the main results of this analysis shows that diversification could reduce the volatility in private equity multiples at the end of the lifetime of an investor. As an investor with a well diversified portfolio the risk of investing in private equity is very limited.

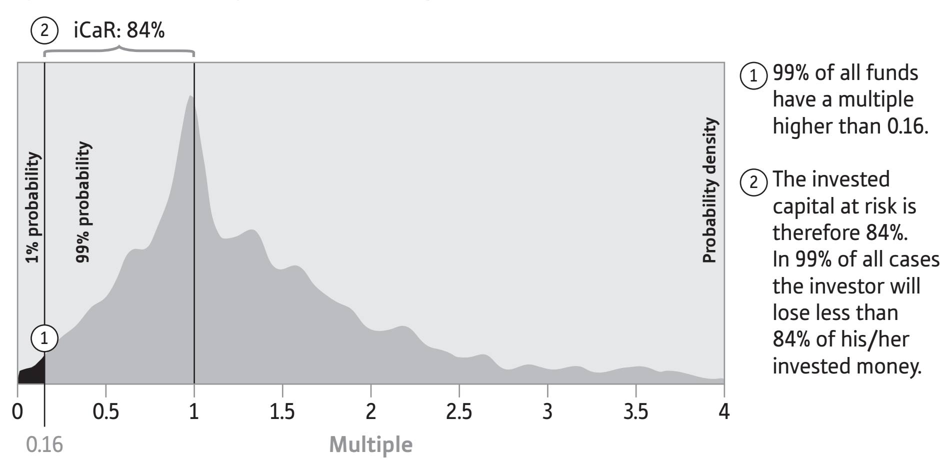
Invested capital at risk (iCaR)

The calculation of the variance takes into account the volatility on the negative as well as on the positive side of the distribution. As investors usually like positive outliers of performance the next approach should focus on the negative end of the distribution only. A risk measure is therefore introduced for private equity investments which is similar to the long-term historical Value at Risk (hVaR) approach of public markets and which takes into account the peculiarities of private equity investments.[6]

Similar to the VaR approach the authors calculate the amount of money such that there is a 99 percent probability (confidence level) of the portfolio losing less than that amount over a given period of time. As private equity is an illiquid asset class, in which market valuations are not regularly available, the entire life time of the private equity fund portfolio is used as the time period and the probability density function is calculated on a cross-section of different fund returns. The risk measure is based on the amount of money that investors have invested and assesses their 'invested capital at risk' (iCaR).

Figure 3.2 shows the probability density of the multiples of an investment in a randomly chosen private equity fund in a randomly chosen vintage year. The multiple used is TVPI. The highest probability (mode of the distribution) is located at a multiple of 1, i.e. the most probable outcome of a random investment into a single private equity fund is that the investor will get back the invested capital. However, there is a relatively strong probability of loss for the investor, and also of achieving substantial gains.

Figure 3.2: **Calculating the invested Capital at Risk (iCaR)**



Source: Capital Dynamics analysis based on Venture Economics data up to 30 June 2007 including European and US funds as well as VC and buyout funds with vintage years 1983 to 2003 (2,699 funds), Monte Carlo Simulation with random selection.

The first percentile of the historical distribution is located at a multiple of 0.16 which corresponds to an iCaR of 84 percent. This implies that the private equity investor has confidence level of 99 percent to lose less than 84 percent of his investments at the end of the fund's lifetime.

Diversification reduces risk

The example presented above shows that investing in a single private equity partnership can be risky and that the amount of money lost in bad cases is relatively high. In recent years the conclusion has been reached that diversification reduces risk and might even increases the return of a portfolio.[7] The right skewed distribution of private equity multiples is responsible for the risk reduction and the return enhancement.[8]

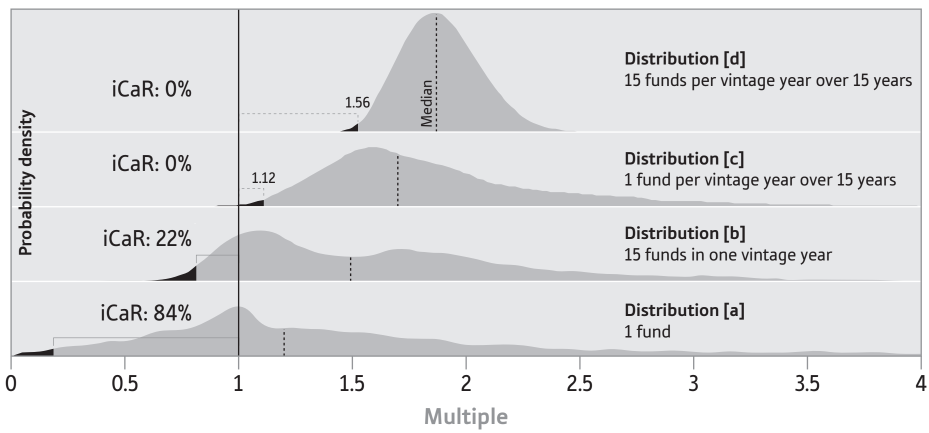
Diversification can be implemented in different dimensions. In the following, the analysis is concentrated on two dimensions of diversification: the number of fund commitments per vintage year and the number of vintage years. Spreading the commitments over a number of vintage years and over a number of funds per vintage year has a positive effect on the risk exposure of a private equity portfolio. However, the effect differs for both dimensions, i.e. spreading commitments into 15 funds over one vintage year has a different effect than committing to all 15 funds in the same vintage year.

For further analysis, Monte Carlo simulations are conducted to randomly construct portfolios out of the funds of the database and calculate their multiple. All portfolios invest globally and they are broadly diversified in terms of fund focus. It is of course also possible to show similar risk analyses for defined geographical regions and types of fund or adapted to the allocation of a specific client portfolio.

Figure 3.3 shows the empirical distributions of portfolio multiples of 10,000 randomly constructed portfolios using different selection criteria. Distribution [a] corresponds to an investment into a random fund, and it has already been described above. Distribution [b] reflects an investment strategy in which an investor allocates his money in 15 randomly chosen private equity funds in a single randomly selected vintage year. This strategy sharply reduces the risk. The left tail of the distribution has moved towards the right, and the probability of losing money is consequently reduced. This is also reflected in a lower iCaR of only 22 percent, i.e. an investor loses less than 22 percent of the invested capital in 99 percent of all cases.

Alternatively, the investor may chose to diversify across a number of consecutive vintage years. In order to run the simulation as realistically as possible, a calendar year is first chosen at random and then investments are made in a defined

Figure 3.3: **Diversification reduces risk and increases return**



Source: Capital Dynamics analysis based on Venture Economics data up to 30 June 2007 including European and US funds as well as VC and buyout funds with vintage years 1983 to 2003 (2,699 funds), Monte Carlo Simulation with random selection.

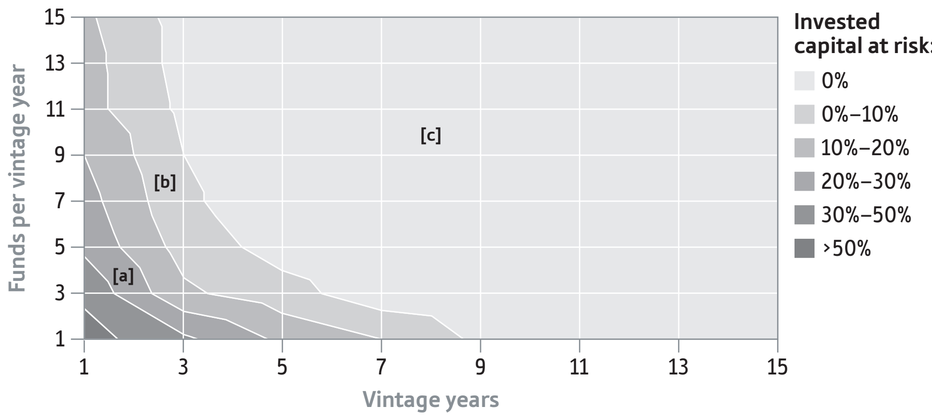
number of funds in that year and in the following years. The simulation gives rise to distribution [c]. Diversification over a number of vintage years therefore not only reduces the risk (iCaR of 0 percent) but also increases the average performance of the portfolio. It can also be seen that diversification by number of vintage years has a stronger effect on risk reduction than diversification over the number of funds.

Finally, distribution [d] shows the combination of both dimensions of diversification, namely an investment timeframe of 15 years and investments in 15 private equity funds per year. In addition to the substantial reduction of risk at the left-hand side of the distribution, a further shift of the entire distribution into the positive area can be seen. The investor has no risk of losing capital (iCaR = 0 percent) because the entire distribution lies in the positive multiple range. At the same time, the tails of the distribution are smoothed to a large degree and the highest probability is now located at a multiple of 1.75. The price for this enormous risk reduction is a decrease in the possibility of achieving an extraordinarily large multiple.

Mapping the risk of private equity

After presenting some specific examples of diversified investment strategies, the analysis now focuses on the risk of a variety of portfolios. With the aid of Monte Carlo simulations, risk combinations for an investment timeframe of between one and 15 years as well as for investments in one to 15 funds per vintage year are calculated. In order to demonstrate the changes in the portfolio risk, the iCaR measure is used.

Figure 3.4: **Risk of diversified private equity is very limited**



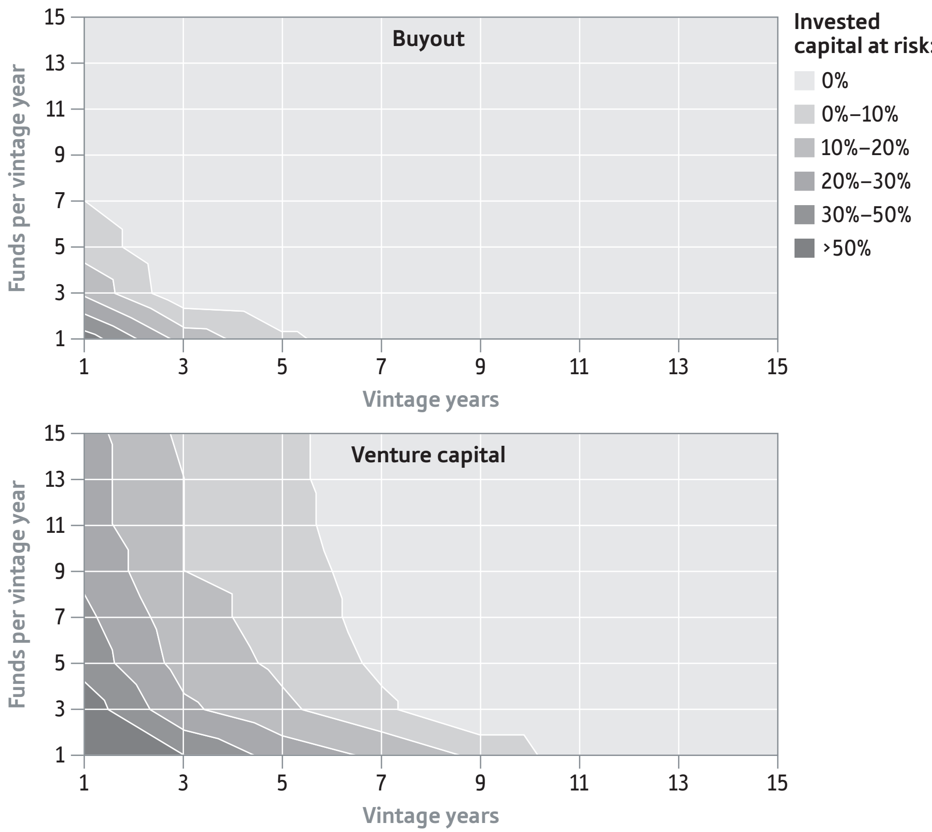
Source: Capital Dynamics analysis based on Venture Economics data up to 30 June 2007; well diversified portfolio allocated to European and US funds as well as to buyout and venture capital funds with vintage years from 1983 to 2003: data up to 30 June 2007.

Figure 3.4 presents the results of the risk analysis of diversified portfolios. The y-axis shows the number of fund investments per vintage year, while the x-axis shows the diversification over vintage years. The shaded areas represent the values of the risk measure iCaR. It is evident that the risk of an investment in a broadly diversified portfolio of private equity funds has historically been very low and can be reduced to almost zero in the 1 percent case.

The graph shows that with a minimum of diversification, the risk of a private equity investment is very limited. It is assumed that an investor begins with the development of a private equity programme and invests in five private equity funds in the first year. As Figure 3.4 shows, he bears a risk (iCaR) that in 99 percent of the cases will incur a loss of less than 20-to-30 percent (shaded area [a]) of his capital invested at the end of the fund's lifetime. If the investor keeps to his investment pace of five funds per year, he can reduce his risk after three years to less than 10 percent of capital invested (shaded area [b]). Note again that this loss has occurred historically with a probability of only 1 percent. After diversifying over only five vintage years, the investor, in 99 percent of all historic portfolio simulations, does not lose any capital at all which is reflected in an iCaR of zero (shaded area [c] – the combination of number of funds and vintage years).

These risk analyses are based on random selections of private equity funds across the global market for private equity; investments are therefore made in European and US funds and in venture capital as well as buyout funds. Funds operating in different geographies and investing in different types of companies have different risk characteristics, which can also be mapped. Figure 3.5 shows the risk map for buyout and venture capital funds.

Figure 3.5: **Buyout is less risky than venture capital**



Source: Capital Dynamics analysis based on Venture Economics data up to 30 June 2007; well diversified portfolio allocated to European and US funds as well as to buyout and venture capital funds with vintage years from 1983 to 2003: data up to 30 June 2007.

Implementing opportunity costs

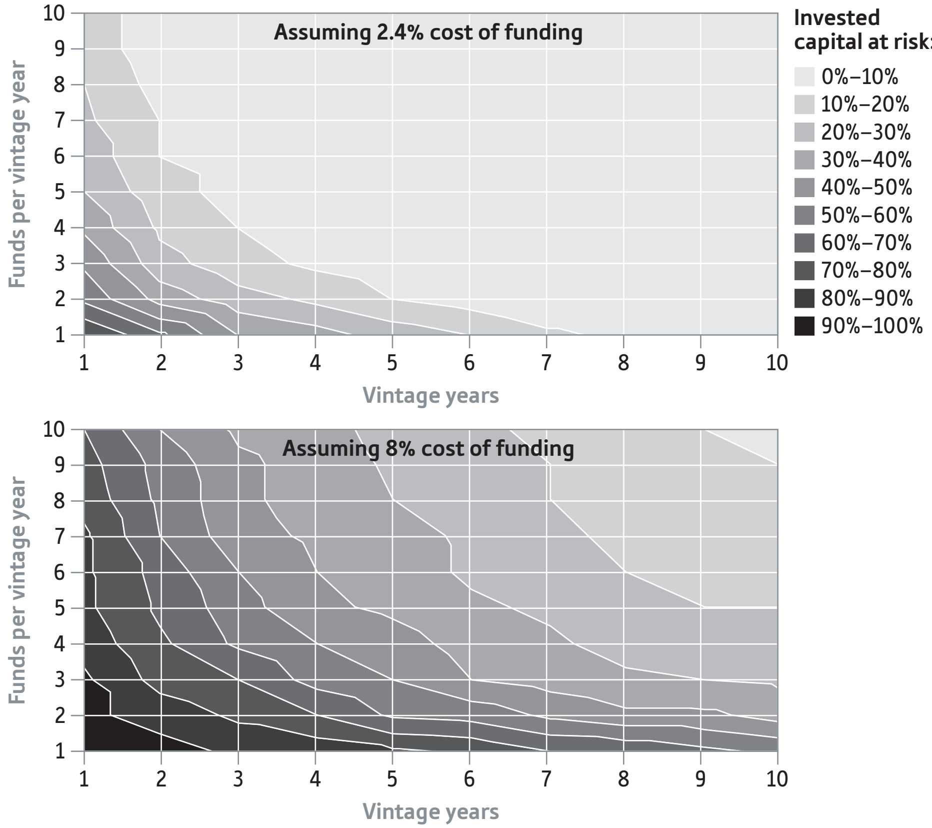
The current iCaR approach assumes that the risk of an investor is not to loose any capital over the entire lifetime of the fund. Because of that, a multiple of 1 is used as the reference for calculating the risk of a private equity fund, i.e. the approach does not take into account the different holding periods of different private equity funds. As known, a time value of money exists; the illustrated approach is further developed and includes the opportunity costs for an investment in private equity funds.

Opportunity costs can be viewed from two different perspectives. First, investors, like pension funds and asset managers, usually have the choice of investing into private equity or alternatively into other asset classes. Therefore the opportunity cost of investing in private equity is the expected return of other asset classes like bonds, stocks, real estate, hedge funds, etc. For such an investor, the risk of not achieving a return similar to that of other asset classes would be calculated. Therefore the yield of a 10-year treasury note could be used as comparison. In this case, the iCaR reflects the risk that private equity returns less than a 'risk-free' asset over the same holding period. A stock market index or any other return could be used to calculate the risk of not generating a similar return. For other investors, like insurance companies, banks or industrial enterprises, the cost of capital for their enterprise could be seen as opportunity costs. They need to have a fundamental question answered: Could we cover the cost of the company's finance? Therefore, their cost of financing is assumed as the opportunity cost and would calculate the risk of not achieving their cost of capital for a given confidence level.

In order to implement opportunity costs into the iCaR approach (presented above), it is necessary to take into account the holding period of each private equity portfolio. As the multiple and IRR of each fund is known, this information could be used to calculate an average holding period for all investments of the fund. This makes it possible to calculate the amount of opportunity cost for each individual private equity fund. The same methodology could be used to assess the average holding period and the amount of opportunity cost of a private equity portfolio over a longer time period. Building a portfolio of randomly selected private equity funds would mean incorporating this calculation in each Monte Carlo run, i.e. first randomly draw private equity funds, add their cash flows and calculate the IRR and multiple of the new created portfolio. On basis of this information the calculation of the average holding period of the portfolio is possible and the reference base for the risk calculation can be set. It is the invested capital of the portfolio compounded with the annual yield of the opportunity cost over the average holding period. Incorporating this method in each of the 10,000 Monte Carlo runs results in a new risk matrix for the iCaR.

Figure 3.6 shows that the iCaR for various portfolios and two different opportunity costs. The top section uses an annual interest rate of 2.4 percent (which was the current yield of an investment into US Treasuries as of 12 January, 2009) as opportunity cost while the bottom section is based on an interest rate of 8 percent per annum for the cost of capital. The two plots demonstrate that a larger degree of diversification is necessary to reach the same risk exposure in percentage terms than without opportunity costs. It is noteworthy that the new risk measure shows the risk of not achieving the defined cost of capital based on the invested capital of the private equity funds. As shown in Figure 3.6 an investor that invests in five funds (in one year) has the risk that 30 percent of his invested capital would generate a return of less than the cost of capital (2.4 percent) in 1 percent of all historical cases. If the investor regularly invests in private equity and keeps investing in five funds per vintage year over three years, the percentage of 'uncovered invested capital' could be reduced below 10 percent with the defined confidence levels.

Figure 3.6: **iCaR for various portfolios with two different opportunity costs**



Source: Capital Dynamics analysis based on Venture Economics data.

Conclusion

This chapter summarises various methodologies to assess the risk of a private equity portfolio. It describes risk measures which are typically used in the private equity market, discusses advantages and disadvantages and proposes a new innovative risk measure.

Discussion has primarily centred on risk measures that are mainly based on net asset values. Due to the stale pricing problem in private equity, the authors focus on figures that are mainly based on cash flow numbers that are not affected by accounting rules; the focus also encapsulated the cross-sectional iCaR method. As shown in the preceding analysis, the iCaR risk measure can be used to assess the risk of private equity investments in the cross section. The authors also calculated the 'invested capital at risk' for a number of different portfolios using historic performance data.

An investor who defines his risk as 'losing no capital at all' could create a risk-free private equity portfolio relatively easily; this chapter demonstrates that diversification over a number of funds committed in one vintage year reduces risk. A broader spread over a number of vintage years, however, reduces the risk even more and also increases the anticipated return of the portfolio. A combination of both diversification strategies and a globally diversified private equity portfolio result in zero 'invested capital at risk' at the 99 percent confidence level.

The authors also incorporated opportunity costs into the 'invested capital at risk' approach. Using this method, an investor could assess how much of his invested capital is expected to generate a return above the cost of capital and how much of the invested capital is 'at risk', i.e. not achieving the assumed cost of capital under the defined confidence level of 99 percent. This new approach is very helpful to investors as it gives them a useful tool to assess the risk of invested capital including their opportunity cost over the entire lifetime of private equity funds.

Both approaches are based on a cross sectional distribution of private equity funds over the entire lifetime of funds included in the portfolio. This tool is extremely valuable for investors who want to plan their private equity programme and want to construct their portfolio as the risk analysis can also be undertaken for any kind of portfolio allocation. The methodology can be used to assess the current long-term risk position of the portfolio and to adjust the future commitment programme in order to reach a risk-/return-optimised portfolio. □

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1 Gompers and Lerner (2004) on this specific topic and for a broad description of the private equity industry.
2 EVCA (2005) and EVCA (2006).
3 For other methodologies to calculate risk Groh and Gottschalg (2008) and Kaserer and Diller (2009) as well as Ljungqvist and Richardson (2003) for the risk characteristics of private equity.
4 Emery (2003) and Woodward and Hall (2003).
5 As the VaR does not give any information about the severity of loss by which it is exceeded the approach can also be extended and the expected shortfall of an investment in private equity can be calculated.
6 Duffie (1997), Hendricks (1996) and Dowd, Blake and Cairns (2004).
7 Rouvinez and Kubr (2003) and Weidig and Mathonet (2004).
8 Kaserer and Diller (2004) and Kaplan and Schoar (2005).

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