Risk in Private Equity

New insights into the risk of a portfolio
of private equity funds

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Christian is chairman of the EVCA risk management committee developing guidelines for risk management models in private equity and was involved in discussions with European regulators on regulation of private equity under Basel III and Solvency II. He regularly published in high-quality journals, co-authored a book on risk in illiquid assets and speaks at conferences.

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Many thanks:

Disclaimer:

1. Introduction

Due to the specific characteristics of private equity investments, the standard risk management tools that are used in other asset classes are unlikely to be applicable. Instead, there are specific risks in private equity that an institutional investor should be aware of. In this study, we assess and measure the most significant risks in private equity, and examine in detail how these risks can be reduced. We contend that the most significant risks in the asset class are those of market risk, funding risk, liquidity and capital risk, and our empirical analysis of three different private equity datasets finds that both funding and capital risk can be substantially reduced through diversification. In the study, we also measure "Realisation Risk", an analysis on losing value from the point of observation until the end of fund's life, for the first time in a study on risk analysis in private equity. Our results demonstrate that the risk for an investor of losing any capital over the entire holding period with a portfolio of 20 funds is only 1.4%, reducing to under 1% for an investor with a portfolio of 50 funds, adjusting for capital calls and distributions. These results demonstrate that private equity is not as risky as it is often perceived by some market participants, and that risk in the asset class should be conceptualised in a different way than it currently is.

Although private equity has become an increasingly established asset class for institutional investors over recent decades, the issue of risk within the industry remains relatively underexplored. Private equity is a long-term asset class which generates strong returns for investors, and given the current low interest rate environment, may be particularly attractive to institutional investors who are seeking sustainable returns.[1] Some of the largest pension funds have had positive experiences with private equity since the early 1970s and have current private equity allocations of around 25%.[2] Other long-term, non-regulated investors such as family offices sometimes have even higher allocations to the asset class with a private equity allocation comprising more than a third of their total assets.[3] While many of these sophisticated investors value the long-term risk-return characteristics of the asset class, regulators are often perceived as constraining banks and insurance companies from investing into the asset class or forcing them to divest their holdings as they perceive private equity as being too risky.

Due to its long-term investment horizon, its illiquidity and its unique structural characteristics, private equity has its own set of specific risks. These risks differ from those in public markets, and as such, can be more difficult to understand and capture in traditional risk models. As typical risk measures cannot be used and as the average performance is often considered to be higher than in public markets, risk in private equity is often perceived as being high. But how risky is private equity in reality? What are the risks for investors who invest in a portfolio of private equity funds? How can an investor mitigate these risks? Can an investor lose part or even all of an investment into a portfolio? How high is the risk that an investor does not get back the value that is generated during a fund's lifetime? What factors need to be taken into account when investing into the asset class, and what are the differences with public equities?

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1   See Cornelius (2011), Chapter 6.
2   See Diller/Wulff (2012), p.12 as well as webpages of Washington State Pension Fund (WSIB), CalPERS and OPERF (Oregon Public Employee Retirement Fund) for up-to-date information.
3   See survey from Montana Capital Partners and Private Equity International 2014 in PEI (2014).

This BVCA paper provides answers to these questions. It starts with a chapter describing the risks of private equity investments, which can be categorised into market risk, funding risk, liquidity risk and capital risk. Each risk factor will be defined and examined in detail and a demonstration will be provided on how that risk can be reduced.

The main section of the paper focuses on empirical risk analyses for a typical investor when investing into a portfolio of private equity funds. We run analyses to show the extent of the market risk, funding risk, liquidity risk and capital risk for an investor. As capital risk (the risk of losing any capital) is one of the most important, we focus on this risk and run various analyses. The results show evidence that an investor has a very low probability of losing any capital over the lifetime of the funds when investing in a diversified private equity portfolio with a number of funds. We then go a step further and run a risk analysis on the value generated over the lifetime of a portfolio. This research paper contains the first analysis of the risk of losing any (book) value from the point of observation until the end of a fund's lifetime,[4] which we call "Realisation Risk". Doing so reflects the typical situation of an investor who reports a value at the end of the year and needs to measure their risk of not getting back the current value of their portfolio in cash. As this is the typical situation for an investor and for regulators, this analysis provides crucial insight into the real risk of managing a private equity portfolio.

One of the major advantages of this study is the use of three different datasets which are widely used in the industry and are regarded as being accurate representations of the market in which a typical investor invests. All three datasets contain a large number of private equity funds with the following advantages:

Pevara dataset: Pevara, a subsidiary of e-front, tracks cash flows provided by limited partners which are subject to their rigorous data validation process.

BVCA dataset: This dataset has unique characteristics as it has no selection bias or survivorship bias in the data. The dataset has been collected by the BVCA directly from their membership and is one of the most accurate in the industry. When a fund enters the database it is tracked until the end of its lifetime. This is especially significant for regulators as it takes away most of their criticism towards typically used private equity data.

Preqin dataset: The dataset from Preqin is collected from various sources and is widely used in the industry. It has been collected from LPs and GPs and is checked by Preqin.

The results of the empirical analyses are robust for the three different datasets. In summary, we demonstrate that the risk for a diversified portfolio is extremely low for an investor who is able to hold their assets to maturity. Not only can capital calls and distributions be forecasted accurately, but the probability of losing the invested capital or the already accrued book value at any given time is very low. As such, these results indicate that the risks of private equity are manageable and that the asset class offers attractive returns, adding to the overall diversification across the whole portfolio for institutional investors.

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4   During the process of writing this study, we became aware of Barber / Yasuda (2014), who calculate the same measure, which they label Pseudo Value Multiples (PVM). However, they use this measure for a different research question: While we want to measure the risk of not getting back the current valuation in a portfolio of private equity funds, they use this measure to determine whether funds that are fundraising return reliably less than other funds, conditional on the current valuation. This result helps them in arguing that funds that are currently fundraising are inflating their valuations to attract more commitments. This is also why they do not show any summary statistics for their PVM, but only the final regression results, while we show in detail how this measure develops over time.

2. What are the main types of risks in private equity?

Risk management in private equity is different to public markets for several reasons due to the nature of private equity investments.

First, private equity is an equity investment into non-quoted companies. As the companies are not traded on a secondary market like the shares of publicly listed companies, there is no market price available on a regular basis. Only if the company is sold to another investor can true market values be observed, but this typically only happens after a number of years. Due to the lack of regular market prices, the typical and well-known risk measures of public markets, such as volatility, value-at-risk or shortfall-risk, cannot be used in private equity. Because of this lack of availability of market prices, fund managers derive a value for each company using one of the industry's standard valuation methods; e.g. market comparables, discounted cash flow methods or others.[5] These net asset values (NAV) are not market prices. Rather, they are similar to accounting values and are reported to investors on a quarterly basis to provide them with an indicative price for their investment based on valuations of the unrealised investments held. Even if these NAVs are sometimes used to calculate a risk measure, it is important to understand that they are not based on actual market transactions. Consequently, they can differ from true fair market values. This will be analysed in detail in further sections, but it is important to note from the outset that this characteristic of private equity makes it difficult to adequately measure market risk for the asset class.

Second, a typical pension fund, insurance company, bank or family office does not invest directly into a company. In the large majority of cases, a fund is used as the investment vehicle because the professional fund manager has both the experience and knowledge to source and select the investments, manage them actively, adjust the strategy of the company in order to create more value, monitor the company, and sell it after an average holding period of five years. The typical investment is done through a closed-end Limited Partnership structure. Here, investors are the Limited Partners (LP) who commit an amount of capital at the beginning of the life of the partnership with the legal obligation to pay this capital into the fund whenever the fund manager (General Partner; GP) calls for it.[6] When the fund manager has identified an attractive investment opportunity in a company, they will draw down the capital from the investor; usually this will be done during an investment period of five years. Thereafter the investment will be held and exited. In total, LP structures tend to be set-up for a long-term horizon of 10 years with no redemption rights for investors. They can only try to liquidate their stake at the secondary market for – depending on the market situation and external factors –a potentially large discount, due to the illiquidity and inefficiency of this market. In addition, sales negotiations can typically take several weeks to complete. As such, an investor in private equity can run a liquidity risk.

Lastly, an investor does not pay in all of their capital on the first day; rather, the money is drawn from the fund over time. This represents a specific risk for investors, which is of course a result of the typical fund structure discussed in the previous paragraph; i.e. funding risk. If the investor is not able to pay the capital call in accordance with the terms of the partnership agreement, they default on their payment. In such a case, the investor might lose the entire investment and all the capital which they already paid into the fund. Many fund managers have strict rules in their Limited Partnership Agreements in the case of a defaulting investor. Typically, the investor will lose their entire investment; in some cases they still hold the liabilities. This strict mechanism is important for the fund manager as they need to have the highest possible security to fund the investments they would like to acquire. In addition to the risk of not being able to fulfil their own undrawn commitment; each investor can be adversely impacted as a result of other

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5   For more details on valuations in private equity see: IPEV - International Valuation Guidelines for private equity 2012. Up-to-date information on: http://www.privateequityvaluation.com/
6   See for a more detailed description Cornelius et al. (2013) Chapter 4.

investors defaulting.[7] Hence, liquidity and funding risks arising through unfunded commitments are an important element and need to be reflected in sophisticated risk management systems.[8]

Liquidity Risk	Funding Risk
Market Risk – Interim NAV risk (short- and mid-term)	Capital Risk (mid- and long-term)

Figure 1: Key risks in private equity

In summary, the risks shown in Figure 1 can be identified and defined in private equity. The EVCA Risk Measurement Guidelines use the following categories and definitions:

- **Funding risk:** The unpredictable timing of cash flows poses funding risks to investors. Commitments are contractually binding and defaulting on payments results in the loss of private equity partnership interests. This risk is also commonly referred to as default risk.

- **Liquidity risk:** The illiquidity of private equity partnership interests exposes investors to asset liquidity risk associated with selling in the secondary market at a discount on the reported NAV.

- **Market risk:** The fluctuation of the market has an impact on the value of the investments held in the portfolio.

- **Capital risk:** The realisation value of private equity investments can be affected by numerous factors, including (but not limited to) the quality of the fund manager, equity market exposure, interest rates and foreign exchange.[9]

2.1   How does a private equity risk framework compare with the public market ones?

In this section, we outline a typical private equity risk framework as described above with the risk framework of an institutional investor in public markets. The public market risk framework is frequently used by regulators such as EIOPA, ESMA and EBA and we find its application in regulations for banks by the Basel Committee; for insurance companies under Solvency II or for pension funds under IORPD.

The typical risks are defined and categorised as:

- **Market risk:** Change in value of the underlying assets/price volatility

- **Credit risk**: Loss of assets due to issuer's credit events

- **Liquidity risk:** Redemption possibility of the investment at the moment when the investor chooses to get their money back

- **Funding Risk:** Ability to fund future liabilities

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7   Sometimes other LPs need to pick-up the defaulting LPs share or the fund size may have to be reduced, so leading to an increased concentration of the portfolio and explains why default provisions are so tough. However this risk is rather limited compared to the other factors as the stake can be sold on the secondary market.
8   See for a similar characterization: Buchner (2014), Cornelius et.al. (2013), EVCA Private Equity Fund Risk Measurement Guidelines (2012), and Kaserer / Wagner / Achleitner (2003), Diller / Kaserer (2009), Driessen, Lin, Phalippou (2007), Gottschalg (2007), and Mathonet / Meyer (2005).
9   EVCA Risk Measurement Guidelines (2013), p. 12-14.

It should be noted that credit risk is similar to capital risk in private equity, although there are several factors that make up capital risk, rather than the more narrow definition reflected in the term credit risk. One of the most important differences is that credit risk reflects no upside potential through positive outliers in its return distribution, while it plays an important role in capital risk as some transactions return a high multiple and are not limited to the return of capital as in a credit case. A more detailed comparison of the various risk factors can be found in the table below.

The following table compares the risks in public and private markets:

	PUBLIC MARKETS	PRIVATE MARKETS	
Market Risk	Change in value/price	Difficult as no market prices exist. The closest estimation might be "Interim NAV volatility"	Market/NAV Volatility Risk (short & mid-term)
Credit Risk	Loss of assets due to issuer's credit events	Credit risk is only part of risk in private equity and is more akin to any risks associated with the GP's abilities and the various "external" factors which can impact a PE investment. Credit risk models overestimate risks as they only reflect downside and not the large potential upside in private equity	Capital Risk (mid- & long term)
Liquidity Risk	Redemption possibility; liquidity when selling assets	No redemption possibility, but still relatively small and inefficient secondary market exists	Liquidity Risk
Funding Risk	Investors not able to finance future liabilities	Risk that the legal obligation to pay commitments cannot be funded by the investor	Funding Risk

Table 1: Matching table between risk definitions in public and private markets.

While it is easier to find a match between the liquidity and funding risks of private and public markets, it is more difficult to assess the market and credit risks. Private equity has elements of both credit risk and equity risk. While the focus of credit risk is that the investor does not lose any capital and has no upside potential, in private equity upside can be created through the "added value" of active ownership, which helps increase the value and improve the growth of the business.

However, the equity risk element is difficult to measure and observe due to the lack of market prices. An alternative to obtain an estimation of market risk is the calculation of the NAV volatility. But this statistic only covers parts of the underlying risk as NAVs are only quarterly valuations that may not entirely reflect the true underlying value of the assets.

The risk of investment loss cannot be measured through credit risk models because they "only reflect downside risk while the significant upside of fund investments is ignored. Aggregating just the probability of default (PD)/loss given default (LGD) figures for individual funds, even when factoring in diversification benefits resulting from correlations between individual funds defaulting, will produce overall risk weights for portfolios of funds that are excessive. Diversified portfolios of funds are significantly less risky than every individual fund as the upside of well performing funds compensate for the losses from "defaulting" funds."[10]

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10   EVCA Risk Measurement Guidelines (2013), p. 10.

Therefore, a combination of credit and equity models needs to be used to derive a similar risk for private equity. Many researchers and practitioners – ourselves included – use Monte Carlo simulation techniques to derive the capital risk of an investment. This is described in further detail in the empirical section of this study.

In summary, it can be seen that while the use of the same risk factors for both private equity and the public markets is difficult, it is still possible to measure and calculate similar risk measures. We will explore this further in the remainder of this paper.

2.2 Funding risk

Funding risk, also referred to as default risk within the private equity industry, is the risk that an investor is not able to pay their capital commitments to a private equity fund in accordance with the terms of their obligation to do so. If this risk materialises, an investor can lose their full investment (according to typical LPA rules) including all paid-in capital, which is why it is of paramount importance for investors to manage their cash flows to meet their funding obligations effectively.

The financial crisis in 2008 highlighted the importance of managing funding risk. Since then, regulators have focused more on funding risk and have issued principles for sound funding & liquidity risk management.[11] But how does funding risk occur when managing a private equity portfolio? In general, there are two reasons: (i) over-commitment and (ii) market distortion in capital calls and distributions.

The first possible reason for running into liquidity issues is an over-commitment strategy of some investors. As private equity funds typically do not draw all of their committed capital or as some companies have already been exited before all the commitment has to be paid in, the net liquidity need is typically smaller than the commitment size. Therefore, investors need to run an over-commitment strategy to avoid being permanently under-exposed to their strategic allocation to the asset class. In case of market turmoil, however, an over-commitment strategy may result in severe issues for an investor as they may be required to pay out more money to meet commitment obligations than they had anticipated or than is available.

Secondly, investors who have been running a private equity portfolio for some years typically use the distributions of mature private equity funds to finance the capital calls of young funds (self-funding strategy). Depending on the maturity of the existing portfolio, a private equity programme can be set-up and managed in a way that the capital calls and distributions are in a steady state and can be matched accordingly. As such, no additional capital needs to be put into the private equity programme as this is self-financing in normal market conditions. Indeed, it is common for mature private equity fund portfolios to have problems of how to ensure a desired level of exposure is maintained, as the level of distributions outstrips the level of new commitments being drawn, and so the overall level of exposure to private equity declines.

However, if a market distortion suddenly occurs and distributions are missing because exit activity on underlying companies dries up, investors may run into problems as they would require additional capital from external sources to meet their commitments. Other external sources could be: (i) regular capital inflow from a main business; e.g. insurance, pension funds, etc.; (ii) availability of cash; (iii) sale of liquid assets such as government bonds or company bonds; (iv) sale of listed stocks; or (v) sale of any other investment, potentially including their private equity funds, on the secondary market. If an investor has a regular and market independent source of capital inflow or only a small allocation to illiquid asset classes, this mismatch of distributions and capital calls will not have a big impact on its funding risk. As insurance companies, banks and pension funds typically have a regular source of income and often have a large allocation to liquid asset classes like bonds and listed equities, funding risk generally has less weight for them. However, this depends on the individual composition and situation of an investor.

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11 See BIS (2008).

For investors with limited flexibility on external cash sources or large allocations to private equity – namely listed private equity vehicles, fund of funds, university endowments and family offices – funding risk can be very important.

When reflecting on the last financial crisis, some investors faced severe funding issues. The most prominent case was from the university endowment of Harvard Management Corporation who issued a bond of more than USD 1bn to fund their future capital calls and considered selling a private equity portfolio of around USD 1.5bn, when the average discount on the secondary market was between 40% and 50%. Even CalPERS (the largest US pension fund) sold some of their listed stocks in order to be prepared for potentially paying future capital calls for private equity funds according to an article in the Wall Street Journal.[12] Listed private equity vehicles which ran an over-commitment strategy experienced similar issues. APEN, a Swiss listed vehicle had to go through significant restructuring, adding a new financial structure as well as selling on the secondary market so as not to lose any of its private equity assets.

It should be noted, however, that many pension funds and insurance companies investing in private equity did not have to take drastic measures during this time period and were able to cope with the change in cash flow profile because they managed their risks from the outset by limiting their allocation to private equity. Additional reasons for the limited allocation to private equity have been the possibility for them to match it with their incoming cash flows, the possibility to liquidate other liquid assets beforehand and having more diversified portfolios.

How can funding risk be measured and which solutions are possible?

Funding risk can be measured through a "funding test" or through cash flow models which take extreme cases into account. The funding test places the undrawn commitments in relation to the resources available for commitments.[13] Alternatively, a cash flow model provides the investor with a simulation of the expected capital calls and distributions in the future. It is very important that extreme scenarios are also considered in which capital calls are much higher than distributions and, hence, large amounts of outside capital are necessary.

How can funding risk be reduced?

Investors can reduce the risk by assessing their future commitment plan with cash flow simulations and cautious planning. Investors who have limited external capital available or large allocations to illiquid assets should be more cautious on the over-commitment and self-funding strategy. However, when deciding on such a strategy, investors should be aware of possible extreme scenarios and how much cash would be necessary and how this could be obtained from other sources. A strategic plan for these extreme cases as well as the portfolio construction plan is the key element.

2.3 Liquidity risk

Liquidity Risk is the risk that an investor is unable to redeem their investment at the time of their choosing. We have already noted that private equity fund structures are designed so that the investor remains in the fund for its full term without an opportunity to redeem their commitment. As a result of these structures, however, a secondary market for LP commitments (participations) has evolved. Consequently, liquidity risk may also be regarded as the risk that an investor wants to sell their private equity investment (in the form of a fund commitment) on the secondary market, but the market does not offer enough volume or efficiency for a fair trade.

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12   Karmin and Lublin, „Calpers sells stock amid rout to raise cash for obligations", Wall Street Journal, 25 October 2008.
13   See Cornelius et al. (2013) p.114ff.

While a secondary market for LP stakes in private equity has developed over the years, the secondary market for private equity investments is still relatively small when compared to the total size of the private equity fund market. It is also still somewhat inefficient, especially in trading smaller fund positions. The secondary market is not a liquid market efficiently setting "prices" as can be found in any listed market from quoted shares. Even though the secondary market volumes have increased over the last years and volumes have reached a record level of around USD 40 billion in 2014, it is still only 3% to 5% of the primary volume (see Figure 2).
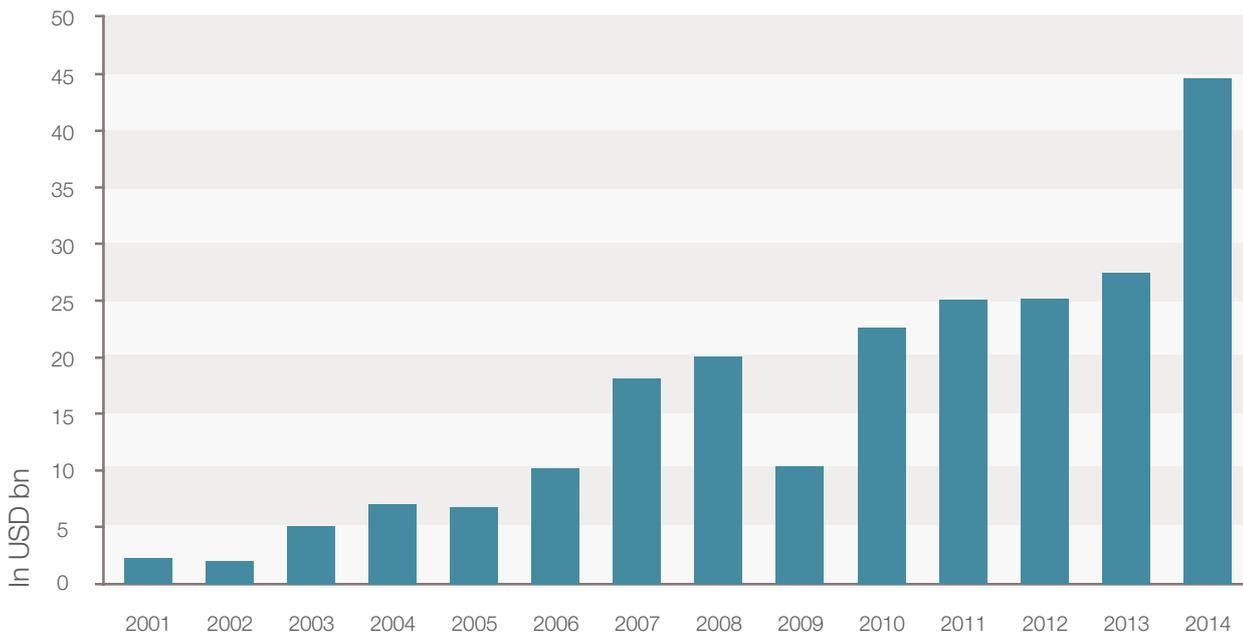
Figure 2: Global secondary transaction volume. Source: mcp analysis based on data provided by Cogent and Evercore.

Competition for larger transactions has increased as the market has become more efficient through the use of professional intermediaries. These intermediaries run auctions for the seller in order to optimise the price. Figure 3 shows market prices of a large intermediary and gives an indication of price levels since 2007.
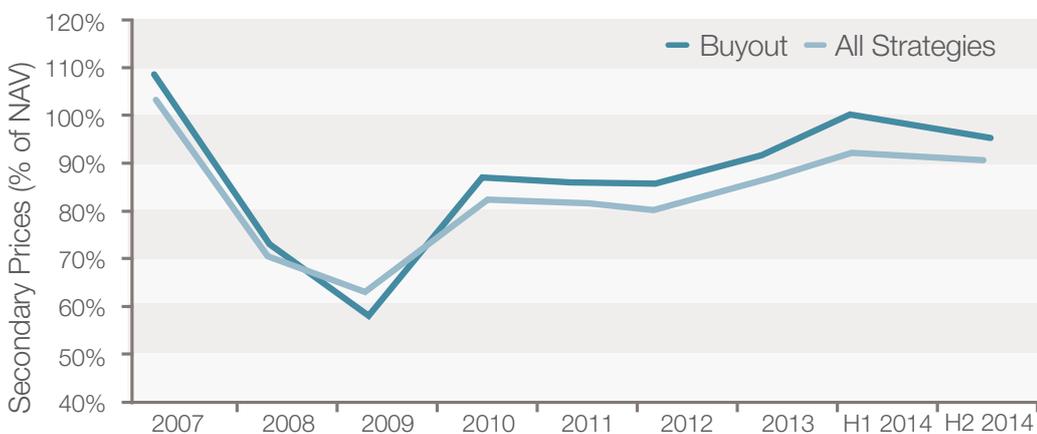
Figure 3: The chart depicts the average high first round bid as % of NAV for buyout funds and all strategies funds. Source: Cogent Partners (2015).

Moreover, secondary market prices are often significantly influenced by factors unrelated to the fair value of the partnership, which result in prices being discounted. For instance, investors selling from a distressed position often have to accept discounts to reported NAV.[14]

How can liquidity risk be measured and which solutions are possible?

Liquidity risk in private equity is difficult to measure. While the secondary market can be very active in a normal market environment and during boom phases, this level of activity is far from what one would see in even the most illiquid of listed markets. Moreover, the secondary market was shut down during the financial crisis in 2009 with very low trading volumes. As such, the liquidity risk for investors in private equity seems to be high due to inefficient secondary markets.

How can liquidity risk be reduced?

Liquidity risk in private equity is difficult to reduce, although it is simpler to handle for investors in an overall asset allocation model. If an investor is solely focused on private equity assets and they need to sell in difficult market times, they cannot circumvent the liquidity risk. However, if private equity is only a small part of a well-diversified asset allocation, as is the case for many insurance companies, pension funds and banks, many other assets are more liquid and can be traded. In reality, the experience is that banks or insurance companies use the secondary market in years of high prices to sell their assets and do not use it frequently in distressed markets.

Furthermore, this depends largely on the market period. While in some years the market for large transactions seems to be very efficient with multiple buyers bidding for large, well known fund portfolios in a very short timeframe (as in 2013-2015), it can be more difficult in others. As previously discussed in the funding risk section, since most investors have other assets which are easier to liquidate in times of financial instability than private equity, it is recommended to run a funding test and sell other assets before selling private equity funds.

2.4 Market risk

Market risk is the risk of holding an asset which can be traded on a (secondary) market and whose value changes over time. This risk often refers to equity in listed companies through the purchase of stocks. As the main risk factors for public equity are market risk measures, academics and practitioners often try to fit private equity into this framework as well. Due to the lack of real continuous market prices for private equity, quarterly net asset values are often used as substitutes for market prices. These substitutes must be used as the secondary market in private equity is neither large nor efficient enough, and the data is not readily available, so that prices from this market could be used instead. With NAVs as substitutes, it is possible to calculate typical public market measures such as periodic returns, their volatilities and correlations with returns from other asset classes.

In private equity, market risk is often defined as the quarterly change (return) of the net asset value adjusted by the cash flows between the two observations.[15] Changes between two quarters are mainly due to the performance of the underlying portfolio company or the financial structure. The revenues and EBITDA or the financial structure could have changed, such that its net asset value increases or decreases. Market factors, like stock market performance through comparison methods, also affect the short-term value of the investment. Similarly FX movements can have a large impact on the value of the company.

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14 See Diller / Wulff (2013).
15 Please note the adjustment of the cash flows might also have an influence on the development and change of the quarterly net asset value. In some extreme cases, when capital calls are very high and many new investments are taken into the calculation, the quarterly movement is expected to be lower as fund managers tend to keep valuation constant at cost during the first time period. In other extreme cases when exit activity is high, quarterly NAV movement might be driven by large uplifts. These issues are especially important when calculating this measure for only a small set of observations and should have less influence in a larger diversified portfolio.

However, it is important to note that the results are heavily dependent on decisions made by the fund managers and their auditors. It should also be noted that market events such as the 2008 financial crisis are only reflected in fund valuations with a lag and that, in general, valuations are smoothed over time.[16]

For example, US funds were not obliged to apply fair market value standards before 2008. As a consequence, they often kept the valuations of the underlying companies at cost until their realisations. The time-series of such a fund that decides to value all investments at cost would show no volatility until the companies exit and no correlation with public markets. Of course, no investor would take this as evidence that the fund serves as a great investment with regards to the diversification properties in the overall portfolio, but simply as a result of the poor data quality. In addition, there are more subtle reasons why valuations differ from the true underlying value. For example, Barber and Yasuda (2014) and Jenkinson et al. (2013) show that some funds inflate their valuations to increase their chances for a successful fundraising.

How can market risk be measured and which solutions are possible?

As the NAVs are available on a quarterly basis, statistics that are applied to continuously traded securities can also be used for private equity investments, such as the volatility of the NAV-based return time series on a quarterly basis. However, as mentioned above, such unadjusted time series would unfairly favour private equity investments over the stock market and therefore should not be used.

To still allow for a simple comparison with other asset classes, there are approaches to de-smooth those NAVs before running risk analyses.[17] Other analyses focus on the time-lag of reporting.[18] However, it is debatable how well such adjustments work for private equity returns. Furthermore, results based on such market risk measures are centred on the implicit assumption that the quarterly NAVs are actual market values which an investor could buy and sell. This is not true for private equity investments and as such the results can give an investor a misleading view on their investment. Rather, they should focus on the long-term properties of private equity as it is inherently a long-term asset class. This is also why this report focuses primarily on capital risk and only focuses briefly on market risk.

How can market risk be reduced?

Market risk as the quarterly change of the net asset value is a short-term risk measure and, therefore, also depends on the short-term movement of public and FX risks. As such, if the portfolio is largely diversified over various geographies, markets and industries, this volatility can be minimised.

2.5 Capital risk

Closely related to market risk is capital risk for the investor. Capital risk for the investor is defined as the probability of losing capital with a private equity portfolio over its entire lifetime.[19] As a consequence, the investor would have a realised loss in their portfolio, while market risk is based on unrealised values. Similarly to market risk, capital risk is driven both by internal and external factors.

In the long-term, the development of the underlying companies in a fund portfolio affects the performance and the capital risk of the investments. The positive operational development of the companies and their financial situation is a substantial source of value creation for investors. As such, the fund manager spends a significant amount of time working with the management analysing and improving the companies' strategies during their holding periods in order to exit the company to a value above the investment cost. The conditions of the exit market, method and timing of the exit can also be a route through which the fund manager can create value for investors. As many investors

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16 See, for example, Getmansky / Lo / Makarov (2004) and Emery (2003).
17 Getmansky / Lo / Makarov (2004).
18 Emery (2003).
19 Mathonet / Meyer (2005) and Mathonet / Weidig (2004).

hold a portfolio of private equity funds and are exposed to hundreds of portfolio companies, the idiosyncratic risk of each company gets diversified. It is important to mention that the positive side of diversification in private equity is that the statistical distribution is skewed towards positive returns. Therefore, positive outliers can recover losses of individual companies and the same is true for funds. This is significantly different to loan models in which the maximum achievable value is to get back the nominal value. Instead, in private equity positive outliers can recover poorly performing funds. In addition to these company specific risks, equity markets, together with the interest rate level and the availability of debt and refinancing possibilities, affect the long-term risk for investors to lose capital. If fund managers are unable to refinance their companies on the market or if they are not able to exit them at attractive equity prices, managers may lose some of the equity in their portfolio companies. These factors are external and are difficult to influence. Investors can influence their long-term risks when investing in private equity, mainly through diversification. Academic studies and practitioners have consistently shown that diversification over multiple private equity funds and over many years is the best and most important capital risk reduction mechanism in private equity. Through a high degree of diversification in companies in different regions, industries and stages of funding, which have been purchased over various market conditions, the right skewed dispersion of returns is achieved, and long-term capital risk can be reduced substantially.

How can capital risk be measured and which solutions are possible?

For liquidated or mature funds, the ratio between distributions and paid-in capital can be used as a measure for capital risk (DPI). If this ratio is below one for a specific investment, an investor has lost money. This measure can be calculated on the portfolio level of the investor, on the fund level and on the portfolio company level. For funds that are still active, the residual NAV should be added to the numerator to measure total value to paid-in capital (TVPI). This measure is then dependent on the quality of the reported NAV.

While the TVPI is a backward-looking measure, comparing the distributions that have been received as well as the current NAV with capital calls that have to be made so far, we argue that an investor is also interested in the risk of losing money going forward. Given that their investment currently stands at a certain book value as reported by the fund manager, how likely is it that an investor will not get this book value back as distributions? To calculate this risk, which we call Realisation Risk, we propose a new risk measure which we describe in detail in Chapter 5.

As most of the long-term investors focus on the loss rate of their investment, our research paper focuses on this risk class.

How can capital risk be reduced?

Studies have shown that, over the long-term, internal factors are critical when building a successful private equity portfolio. Investors are able to minimise their capital risk significantly when diversifying over a large number of funds in many geographies, industries, and over many years and with different fund managers. In general, the best results have been achieved when funds have equal weighting with the same investment strategy. Apart from investing in direct funds, doing so in co-investments and secondary funds further increases diversification.

2.6 How to set up a risk framework of an investor?

The most important question for investors is how to build up a risk model for private equity to reflect the risk characteristics in the asset class correctly.[20]

When an institutional investor such as an insurance company or pension fund considers investing in private equity, their first strategic consideration is usually whether or not they can bear the funding and liquidity risk of investing in an asset class where they are locked-in to the investments. These risks are judged either by the internal asset allocation team or by the trustees who set the strategy. Consideration of capital and market risk lie in the hands of the private equity portfolio manager and are the risks to be considered by the manager in how they implement the strategic decision to be exposed to the asset class.

As such, we propose first running a funding and liquidity test (FLT) which shows whether or not the investor is able to hold their assets to maturity, even in times when distributions are drying out and capital will be called (**Step 1).** This funding test assesses what will happen if an investor runs into the risk that they are not able to fund all contractual liabilities through cash and other liquid assets.[21] Many regulated investors and trustees know that the funding and liquidity risks are important in private equity and therefore consider these carefully and keep liquid assets (mainly cash or liquid bonds) for their open commitments. Many also run simulations in order to estimate how much they can allow themselves to invest in illiquid assets without any liquidity and funding issues.

Step 2a: If the investor is unable to cover the funding and liquidity test (FLT) and cannot show that they are able to cover all open commitments through liquid assets, they run the risk of being unable to finance all capital calls and therefore have to sell their private equity funds on the secondary market or default. In this case, we assume that the investor is not able to trade with a fair arm's length transaction and may have to accept a discount. This risk has to be reflected accordingly in the risk analyses.

Step 2b: If the funding test is positive and if it shows that the investor is able to hold their private equity investments until maturity, then the investor should not be forced to liquidate their investment during the holding period.[22] As such, the investor only faces long-term capital risk. As we will show in this paper, this long-term capital risk is much lower. Therefore, investors such as insurance companies, pension funds and banks with large amounts of other liquid assets can use this low risk weight.

In addition to the long-term risk in private equity, it is also possible to calculate the interim NAV volatility to assess the volatility of the fair market value. However, this risk only describes the quarterly changes of the NAV.

Figure 4 gives an overview of the risk and its various steps:
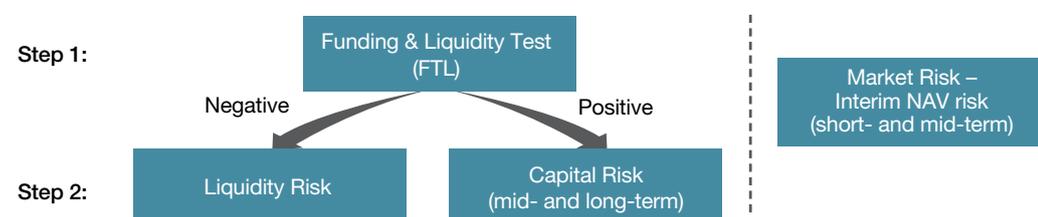
Figure 4: Main risks in private equity and how to use them to build a risk framework

In summary, with such a model, many investors would be able to show that they can fulfil the funding test positively and hence can focus in their risk calculation on the long-term capital risk which is very low in private equity, as can be seen in our empirical analysis.

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20 For the methodology of setting up a risk model, we use the methodology explained in the EVCA Risk Measurement Guidelines.
21 See for a detailed description of various funding test Cornelius et al. (2013).
22 It is important to note that investors are not forced to sell due to funding or liquidity issues. In such a case, investors are using the secondary market in order to restructure their portfolio strategically and are able to perform arm-length transactions. Hence, it is expected that these transactions can be performed at or close to the fair price.

3. Data Description

After describing and explaining the various risks in private equity, we will present a comprehensive empirical analysis showing the risks when investing in private equity. One of the advantages of our study is the use of three different high quality datasets.

Before we describe the datasets in detail, we wish to mention that we have limited the analysis to the vintage years from 1990 onwards in this study. As we have already stated, diversification is the main tool to reduce the overall risk of investing in private equity and is followed by institutional investors who typically have funds in the double digits of in their portfolio. However, private equity was still in its infancy before 1990, and the number of funds included in each dataset is often fewer than ten. Consequently, these years do not represent the diversification potential that the universe of private equity funds offers today to investors and we therefore exclude it from the analysis.

3.1 Pevara

This dataset has some unique characteristics as it has a very low selection and survivorship bias in the data. Pevara, a subsidiary from e-front, provides cash flows provided by limited partners which are then subject to Pevara's rigorous data validation process.[23] This approach generates more reliable data than those pieced together from general partner surveys or from Freedom of Information Act requests. It also ensures that Pevara's benchmarks cover a wide range of strategies, geographies and fund sizes, as limited partners are required to benchmark all the funds in their portfolio.

The dataset contains cash flows and net asset values of 2,170 funds for our selected time period. More than 70% of these funds are still active, which demonstrates that private equity is still a young asset class with more participants still entering the market. The majority of funds, almost 1,200, are focused on the US market, while 718 are from Europe. The remaining funds focus on the rest of the world, predominantly in Asia. 1,291 of the funds are buyout funds, while 763 are venture funds and 116 are mezzanine funds.

3.2 BVCA

The second dataset is from the BVCA. The dataset has been collected by the BVCA and is one of the most comprehensive datasets available for a particular market. As soon as one fund is added to the database it is tracked until the end of its lifetime.

This quality of information gathering is especially important to regulators as it takes away most of the criticism of survivor bias in datasets. It should be noted, however, that the BVCA tracks the NAV of each fund only once a year, in comparison to the quarterly update from Pevara and Preqin. Hence, the computation of the market risk is not meaningful for this dataset.

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23   We thank Pevara very much for granting access to this data set for this risk analysis study.

One limitation with this dataset is that it is limited to funds that are managed from and located in the United Kingdom. This considerably limits the potential universe of funds and is why there are only 431 funds with vintage years from 1990 onwards in this dataset. Unsurprisingly, most of these funds have a focus on the United Kingdom (278) in particular, or Europe in general. Therefore, this dataset complements the Pevara and Preqin datasets which are focused on the US.

3.3 Preqin

The dataset from Preqin is collected from various sources and is one of the most widely used in the industry. It has been collected from LPs and GPs and is checked by Preqin.

This dataset contains 1,640 funds for our period. As such, it has similar characteristics to the Pevara dataset. Preqin also has a clear bias towards active funds (1,384 funds) and buyout funds (837 buyout funds vs. 712 venture funds and 91 mezzanine funds). In addition, 77% of the funds are from the US, 14% are from Europe and 9% are from the rest of the world.

3.4 Summary of data description

In summary, we have three different datasets to test the robustness of our results. To make the analysis more accessible, we have decided to focus it on the Pevara dataset in the main section and display the results for the other two datasets in the appendix of the report. In general, the results across the three different datasets are very similar.

We chose the Pevara dataset as our main dataset because of two reasons: First, the cash flow information comes directly from the Limited Partners and is validated rigorously by the data provider. This ensures high quality of the data. Second, the number of funds is the largest and therefore offers a broad universe of funds to choose from for our Monte Carlo simulations later. Figure 5 shows the number of funds per vintage year and illustrates that Pevara has the most funds throughout our sample period. The relatively low number of observations in the BVCA dataset is of course a result of the geographical limitation of the funds. As can be seen in the figures of the appendix, this results in a less pronounced diversification effect for the BVCA dataset than for the other two.
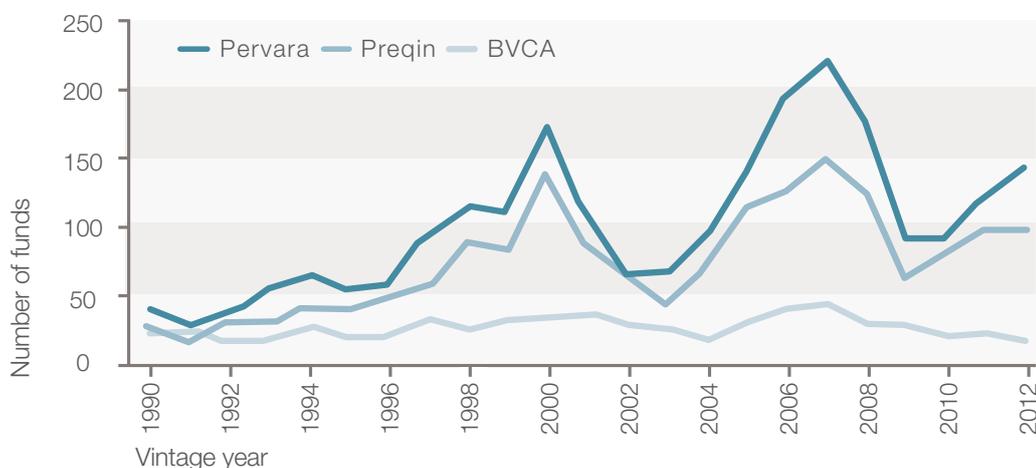
Figure 5: Number of funds per vintage year for the three different datasets.

4. What are the real risks of private equity investing?

4.1 Market risk

The short-term market risk for private equity funds is calculated on the basis of their net asset values adjusted by interim cash flows. In order to assess the return, the NAV at the end of the quarter, NAV_{t+1}, is adjusted by all cash flows which happen during the quarter, distributions D_{t+1} and capital calls CC_{t+1}, and set in relation to the NAV at the beginning of the quarter, NAV_t.

Return:
$$r^{PE}_{t+1} = \frac{NAV_{t+1} + CC_{t+1} + D_{t+1}}{NAV_t}.$$

As we calculate a time-weighted return similar to public markets, a comparison with the returns of the S&P 500 is possible.[24] Figure 6 shows that the return volatility of private equity is lower than for public markets, with the exception of the dot-com bubble. This period was driven by strong outperformance of venture capital funds, exceptional exits and very high valuations at the height of the markets in 2000. This significant outperformance of more than 40% is reflected as an outlier. The generally lower volatility is due in part to the stale pricing effect in valuations in combination with the reporting lag as discussed before. For example, during the financial crisis the downturn of the S&P 500 was much more pronounced – as was the recovery afterwards.
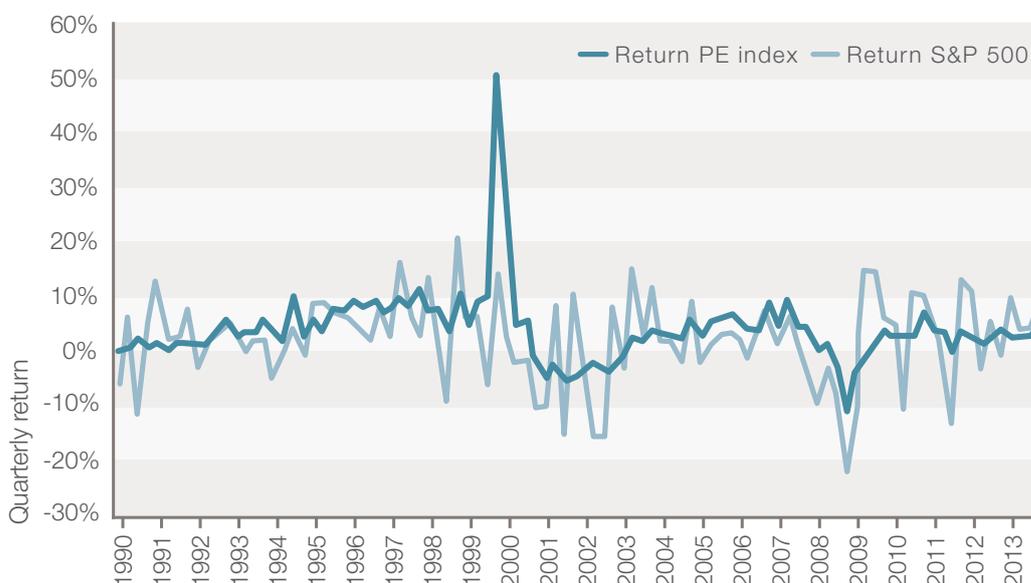
Figure 6: Market risk – Changes of NAVs adjusted by cash flows of aggregated private equity funds compared with S&P 500. Data source: Pevara and Capital IQ.

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24 The time series for the S&P 500 was obtained from CapitalIQ. In the appendix, we also show the results for two additional indices, the Russell 3000 and the MSCI World. These indices might be more appropriate: the Russell 3000 also includes many smaller firms that are more similar to the companies in which private equity funds typically invest; and the MSCI World covers listed companies around the world, which might be more appropriate since we are also using a global private equity index. Nevertheless, the results are very similar, driven by the large correlation between the three public indices.

The most likely explanation for the smaller decline and recovery in the private equity index is that some fund managers were slow in adjusting their valuations for the macroeconomic shock and did not adjust their valuations accordingly. As such, they did not have to write them up again when the markets recovered.[25] The correlation between the two indices is 41% in our sample. The lower volatility in private equity and the low correlation are both expected as private equity data is based on accounting figures rather than market prices, with the negative effects of stale pricing and report lagging mentioned before.

Due to the similarity to public market methods, regulators and some investors prefer to use these kinds of analyses to determine the risk of their portfolio. However, this data series does not reflect the "real" risk of a private equity investor; just the change of the NAV from quarter to quarter. In our Pevara dataset, the expected average quarterly change is at 3.7% (median at 3.0%), while the upper quartile is at 6.1% and lower quartile of the observation period at 1.1%. The lowest return in the private equity index was only -11.4%. This is in contrast to the S&P 500, which dropped by 23% in a single quarter during the financial crisis In order to use the data for more advanced comparisons, adjustments to de-smooth the data series would be necessary. To do so, various methodologies have been suggested.[26]

The conclusion of the market risk analysis is that private equity investors face a market risk which correlates to public markets, but that the NAV does not move to the same extent as the public markets. This is good news for insurance companies, banks and pension funds as private equity has a stabilising effect on their balance sheet. However, it is important to note that these results can paint too positive a picture for private equity if the time series of the private equity index is not adjusted for its limitations.

4.2 Funding risk

Funding risk is an important risk, particularly during market instability with a mismatch of capital calls and distributions for investors running an over-commitment or self-funding strategy. In the event of an equity market downturn as was the case in 2009, M&A activity dries out as none of the funds are willing to sell their investments at low market prices. As soon as signs of recovery appear, fund managers start to invest again at relatively low prices, which results in larger capital calls compared to distributions.

Our analysis evaluates the likelihood of an extraordinary event subject to the diversification of the investor and does not take individual over-commitment strategies into account. The following analysis relies on a Monte Carlo simulation in which a random portfolio of private equity funds is drawn from the Pevara universe in each run. The number of funds in the portfolio is varied to examine the effects of diversification on the outcome for an investor. For the simulations, it is assumed that the commitments in each randomly selected fund are of equal size. Vintage years are drawn with probabilities equal to their representation in the dataset. In each run, only funds within a range of three vintage years are drawn. This ensures that the diversification effect is not overstated by allowing investors to draw freely from vintage years throughout the sample period in the simulations, which is not possible for real investors.

The following figures show the capital calls for the first five years, as well as the distributions and net cash flows for the first ten years of the funds' lifetime. This implies that we have to limit the funds to those with vintage years before 2009 and 2004, respectively, to ensure that the funds existed long enough to have cash flows up to five or ten years, respectively. This results in the elimination of younger vintage years with a large number of funds to draw from and therefore underestimates, in our opinion, the true diversification potential for a private equity investor.

We report the median case as well as the outside percentiles; being the 5th,10th, 90th, and 95th percentile case. Unsurprisingly, the median draw down rate for one fund, five funds or a portfolio of 20

25   The results for the Preqin data set look very similar, as can be seen from Figure 17 in the appendix. In particular the spike during the dot-com bubble is present in both samples. However, the private equity index based on the Preqin data fluctuates much more in the beginning of the sample and shows a cyclical pattern for the first few years. This could be an indication that the accuracy of the data improved through time for the Preqin data set. Later on, we also find that the ranges for the Monte Carlo simulation results are typically the widest for the Preqin data set, which is another indication that this data set includes some outliers that drive especially the extreme cases.
26   Getmansky / Lo / Makarov (2004) and EVCA (2013) as well as Diller / Jäckel (2009).

funds is relatively similar. However, there is a significant difference in the percentile cases. As expected, the distribution of outcomes narrows down for larger portfolios. Therefore, the probability of ending up with capital calls around the median curve increases with a well-diversified portfolio, as is evident in Figure 7.

One fund selected per run

Five funds selected per run

Twenty funds selected per run
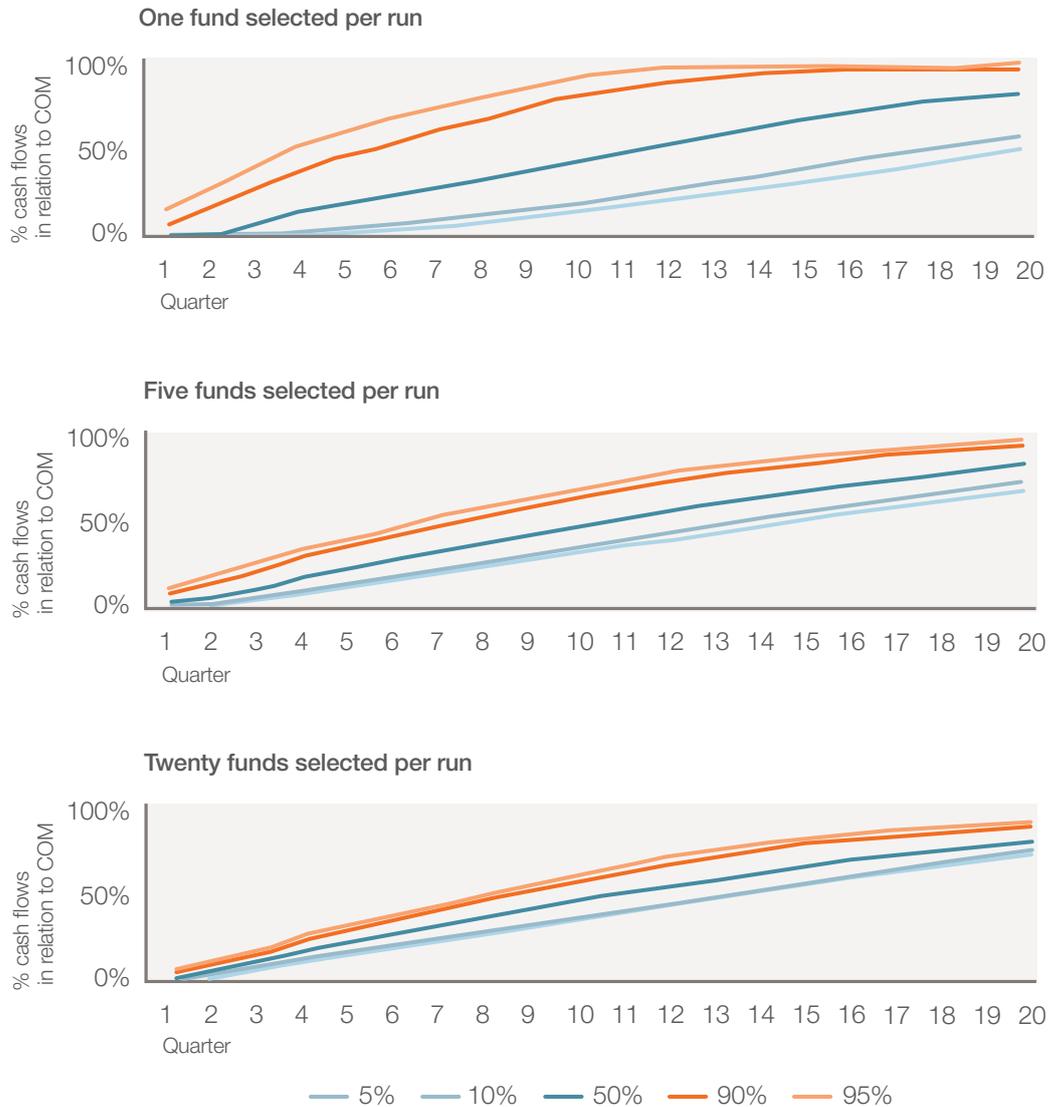
Figure 7: Funding risk – Capital call pattern (% cash flows in relation to commitment) for simulated portfolios of private equity funds in the 5th, 10th, median, 90th, and 95th percentile case. Data source: Pevara. Number of runs: 5000.

The analysis of the behaviour of distributions for diversified portfolios demonstrates that a random investment in just one fund has a lower median curve than more diversified portfolios, especially in the earlier quarters, but higher probabilities for very large distributions. As such, the positive outliers with the 95th percentile case are much more pronounced. On the contrary, the probability of selecting a fund that does not distribute any money is also non-negligible. Therefore, a random selection of one fund is much riskier than a diversified portfolio. Figure 8 shows that diversification over a number of funds

helps the investor to stabilise their portfolio. The median case is developing well and is above the single fund case. This chart shows that the diversification effect is even more important for distributions than for capital calls. Diversification helps to improve the median performance by making sure to pick the positive outlier funds that help driving the overall performance of the private equity portfolio.

One fund selected per run

Five funds selected per run

Twenty funds selected per run
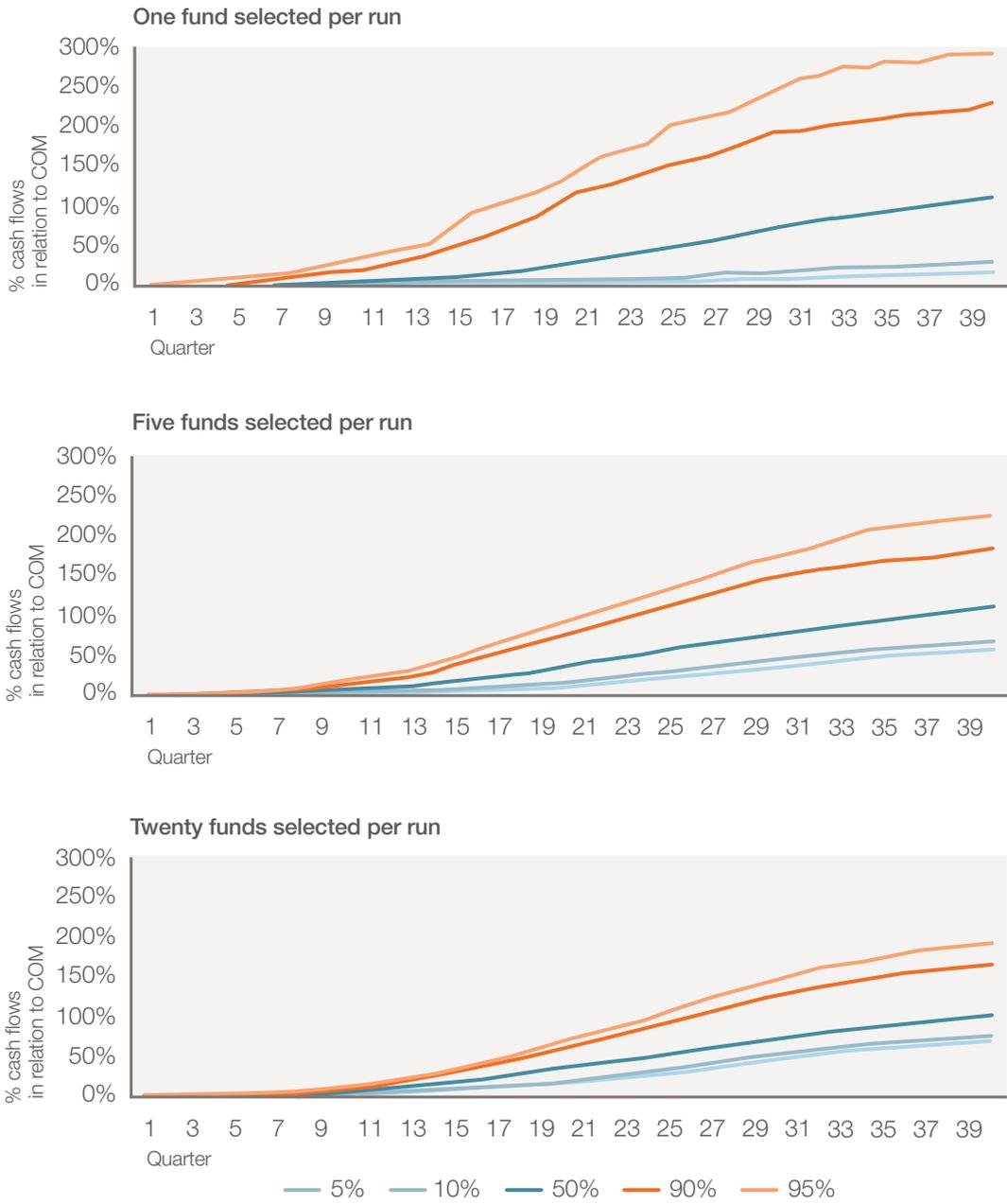
Figure 8: Funding risk – Distribution pattern for simulated portfolios of private equity funds in the 5th, 10th, median, 90th, and 95th percentile case. Data source: Pevara. Number of runs: 5000.

However, the figure also shows that the range for the 5th and 95th percentile is much wider in the case of distributions than in the case of capital calls. This is not surprising: a fund manager has to deploy the commitments of their investors in a certain time period and doing so is not difficult. Doing so well, i.e. choosing the right investments, is the difficult part, which separates the good managers from the bad

ones and this separation is visible in the distribution chart. While more than 5% of the funds in the Pevara universe were not able to return any money to their investors after five years, the best funds were able to return even more than the invested capital within this time period. It should be noted that the timing of the exits is also dependent on the macroeconomic situation.

While Figure 7 and Figure 8 are based on our Monte Carlo simulation approach, Figure 9 focuses on the aggregated amount of capital calls and distributions per year since 2000. Here it can be seen that in many years the aggregated amount of capital calls outpaced the amount of distributions due to industry growth and market conditions. In the years 2008 and 2009 in particular, there was a large discrepancy between distributions and capital calls. Specifically in 2009, capital calls stayed at a very high level, while distributions already decreased significantly. This negative net cash flow effect was also the reason why many investors ran into issues with their over-commitment or self-funding strategies.
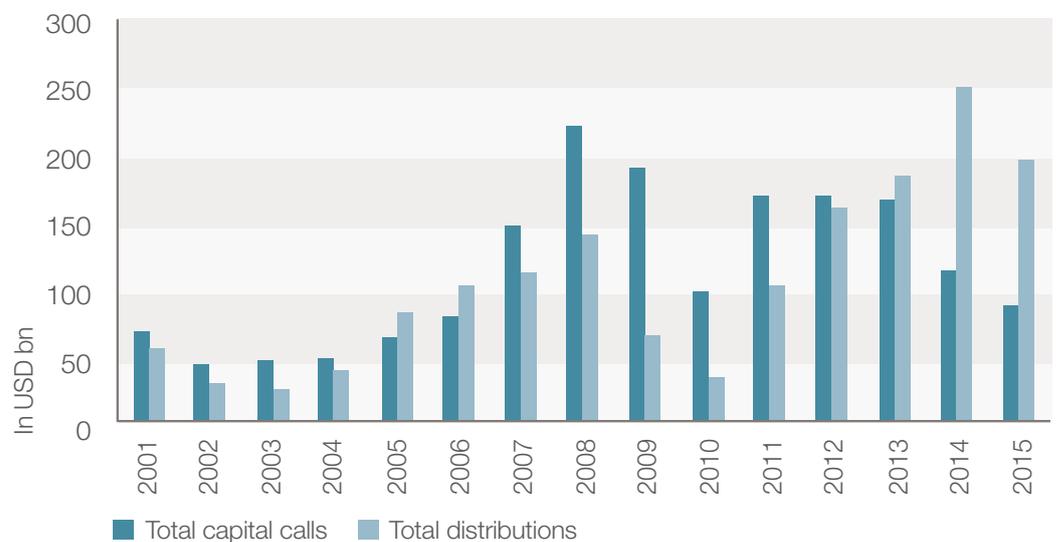
Figure 9: Funding risk – Annual comparison of capital calls and distribution for aggregated private equity funds. Data source: Pevara.

Therefore, we want to have a closer look at the general net cash flow pattern of private equity funds using our simulation approach again in order to highlight the importance of diversification over a number of funds. Figure 10 shows the J-curve for an investor investing in one fund, five funds, and 20 funds. The three charts demonstrate that the median curve for all three portfolio cases is very similar. This is also the risk for an investor who only looks at the normal market environment. By taking into account extreme scenarios and looking at portfolio compositions in which capital calls have been high and distributions low, the 5th percentile can provide us with new insights. An investor with one fund needs to have much more capital available than our 20 fund investor because of the large degree of diversification. In summary, the analyses in this section show that diversification substantially decreases the liquidity risk for an investor.

One fund selected per run

Five funds selected per run

Twenty funds selected per run
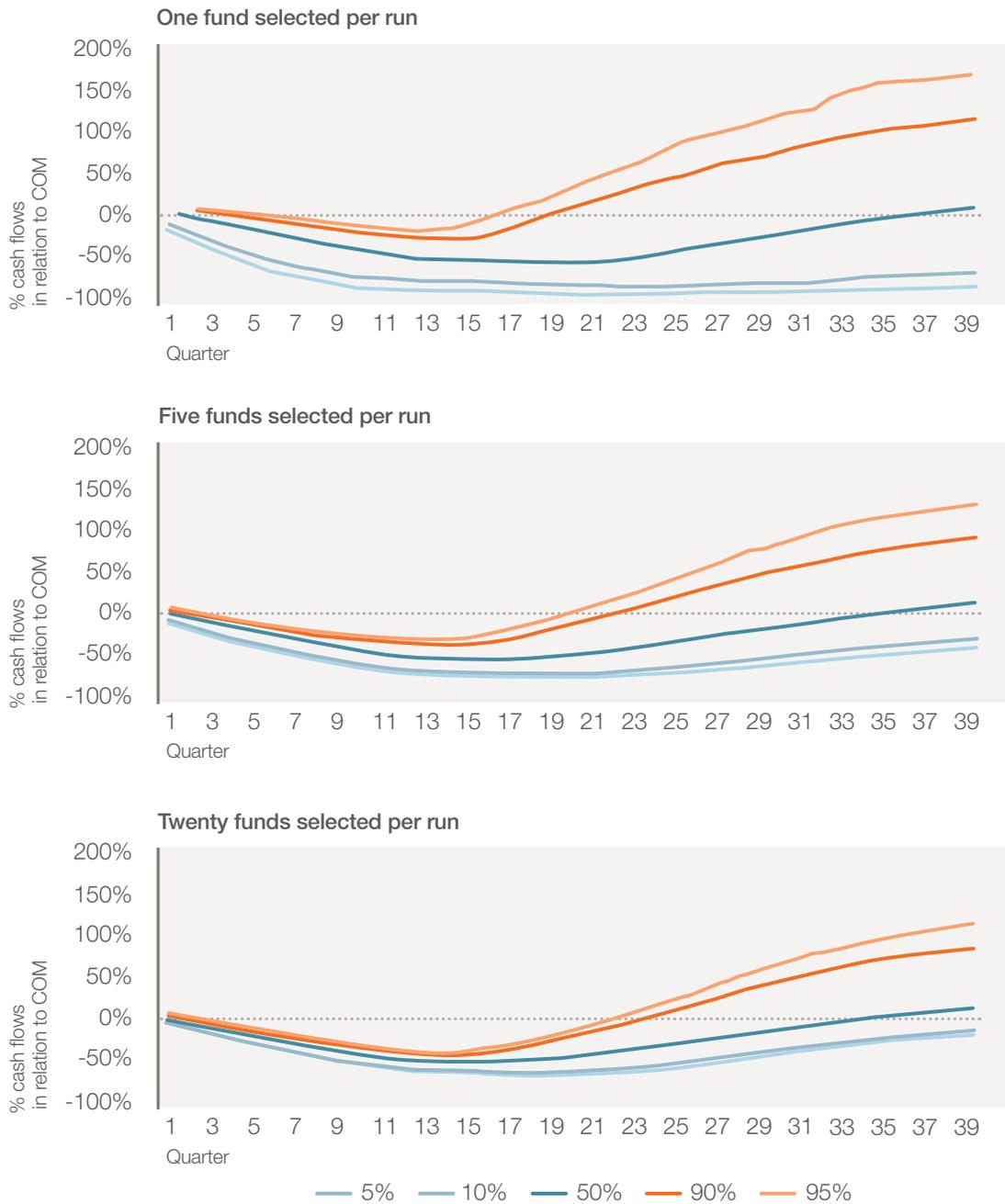
Figure 10: Funding risk – Net cash flow pattern for simulated portfolios of private equity funds. Data source: Pevara. Number of runs: 5000.

4.3 Capital risk

This section of the report focuses on the most important risk for an investor as it reflects the risk that an investor's entire invested capital will not be paid back. In order to assess this risk, a Monte Carlo simulation approach similar to the one used when assessing the funding risk is used. First, we randomly select a vintage year. We then randomly invest in either one, five or 20 funds with vintage years that are in a three year range of this vintage year.

Figure 11 displays the results of our simulation by plotting the TVPI of each portfolio composition over its lifetime. The results are very much in line with the previous discussions: diversification reduces the uncertainty of the outcome substantially. In the case of the TVPI, an investor who only selects one fund ends up with a TVPI of 0.4x or lower with a 5% probability. If they commit equally to five funds, the TVPI for the 5th percentile is increased significantly to 0.9x. And in the case of 20 funds, the TVPI in 95% of the runs in the simulation is 1.1x or higher. Even at the 1st percentile, the TVPI is just below 1x, which shows that it is very hard for an investor to lose money with a well-diversified portfolio.

One fund selected per run

Five funds selected per run

Twenty funds selected per run
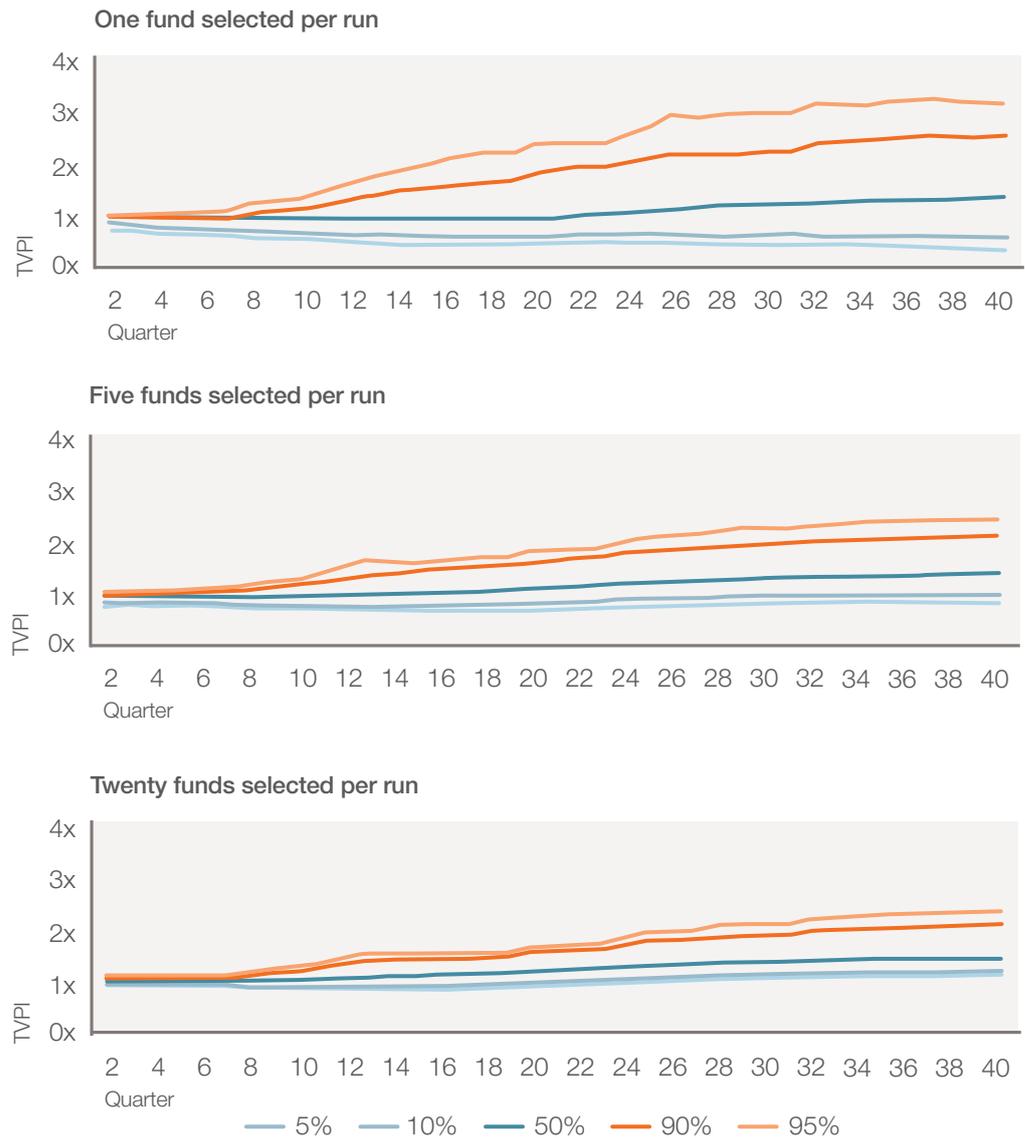
Figure 11: Capital risk – TVPI for simulated portfolios of private equity funds. Data source: Pevara. Number of runs: 5000.

Figure 12 displays a different representation of this statement with a focus on the downside risk, showing the number of runs for which the TVPI after 40 quarters was below 1x. It is evident in our dataset that an investor randomly selecting one fund has a risk of losing capital in 28% of cases. A randomly selected portfolio of five funds results in a reduced risk of 10% of cases in which an investor would lose capital. In the case of a randomly selected portfolio with 20 funds, the risk for an investor is substantially reduced to 1.4%. This is an important finding as the risk for investors who hold a portfolio over the entire lifetime

(or at least 10 years) is very low. This risk can be reduced further with additional funds in the portfolio and we have therefore added a simulation in which 50 funds are drawn randomly within three vintage years. In this case, the risk of ending up with a portfolio of fund that has a TVPI below 1x is virtually 0 (0.26%).
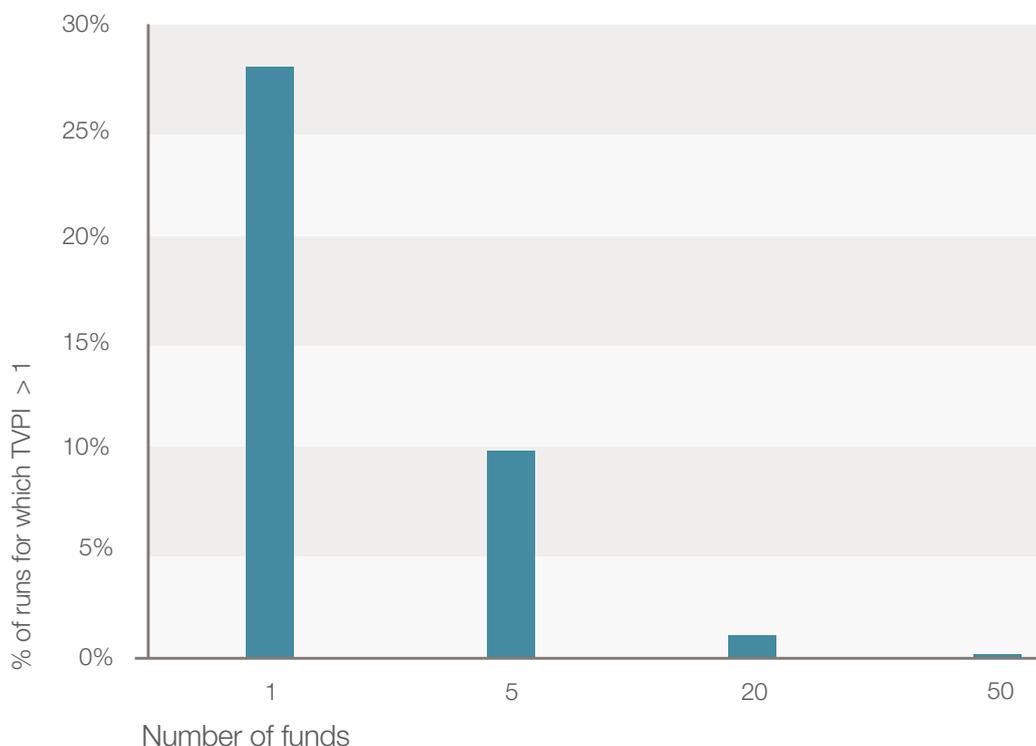
Figure 12: Capital risk – Cases for which the TVPI for simulated portfolios of private equity funds was below 1x after 10 years. Data source: Pevara. Number of runs: 5000.

It should be noted that our analysis underestimates the true effect of diversification for an investor today. Since we allow vintage years to be drawn from 1990 onwards, this means that there are several years without many funds to choose from. For instance, there are only 77 funds in the Pevara dataset with vintage years 1990, 1991 and 1992. Since our simulation randomly draws funds with replacement, this means that funds are often drawn several times. This effect is more pronounced for the other two datasets. In the case of the Preqin dataset, there are only 46 funds to draw from in the first three years while in the BVCA dataset there are even fewer (35). Nevertheless, even in such cases, the TVPI for a well-diversified portfolio is above 1x for almost all runs, as the results in the appendix show.

5. What is the Realisation Risk for investors not receiving the current NAV as cash distributions over time?

In the previous section, we analysed the risk of investing in a private equity portfolio and holding it over the entire time period. This is the risk of a typical investor who has the ability and intention to keep the assets throughout the entire holding period. As is evident from the analyses above, the risk of losing any capital with a diversified portfolio is very low.

With this new analysis, we want to go one step further and extend the previous analysis. Specifically, we want to analyse the "Realisation Risk" of an investor at a given point in time during the lifetime of the portfolio. We define "Realisation Risk" as the risk of receiving a lower value of distributions by the end of the lifetime of the fund portfolio than the current valuation implies.[27] This is a very important question for regulators, auditors and some institutional investors as it gives an impression of how realistic the valuations are and how high is the risk of not getting back the current value of the portfolio in cash flows. In order to do this, we calculate a ratio between all distributions which an investor will receive until the end of the fund's lifetime and the current net asset value plus the capital calls which they have to pay going forward:

$$RR_t = \frac{\sum_{j=t+1}^{T} D_j}{NAV_t + \sum_{j=t+1}^{T} CC_j}.$$

As the formula shows, we define the Realisation Risk RR at any given point in time t as the ratio between all distributions D received from t onwards until the end of the lifetime T and the sum of the current NAV and all capital calls CC from t onwards.

If one does not want to limit the analysis to only liquidated funds, one has to add the residual NAV at time T instead:

$$RR_t = \frac{\sum_{j=t+1}^{T} D_j + NAV_T}{NAV_t + \sum_{j=t+1}^{T} CC_j}.$$

For our Monte Carlo simulations, we use this approach and set T to 40 quarters or ten years. As shown in Chapter 3, datasets in the private equity industry are biased towards active funds. So as not to not limit our analysis to so few funds, we consider this a reasonable approach, especially since the majority of the distributions normally occur within the first ten years of the lifetime of a fund.

However, before we turn to the results of the Monte Carlo simulation, we show the median Realisation Risk for all liquidated funds in the Pevara dataset in Figure 13 for the first 32 quarters. Since these funds

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27   Alternatively, one can also interpret the "Realisation Risk" measure as the multiple an investor on the secondary market achieves by buying the fund at par and holding it until liquidation.

are already liquidated, their residual NAV is 0 and we can apply the first formula above. Put differently, there is no reliance on a residual NAV for the computation here.

The chart shows that the Realisation Risk measure declines throughout the lifetime of a typical private equity fund. At the beginning of the lifetime, the ratio is around 1.5x and almost identical to the DPI of a liquidated fund because the NAV at the beginning is negligible in some cases or simply 0 in most cases. Initially, if an investor commits to a fund, there are no companies yet and therefore no NAV to report. Hence, the Realisation Risk measure is simply the ratio of all future distributions divided by all future capital calls. In the median case, an investor in a private equity fund can expect to receive 50% more distributions than the capital they invested.

Over time, the fund calls money from the investor and invests in companies with it. The denominator in the above equations is more and more dependent on the NAV, which now represents the estimated fair market value of the companies bought by the fund managers. Eventually, when all money has been called, the Realisation Risk is simply the received proceeds in future quarters from selling those companies, divided by the NAV of all portfolio companies at a certain point in time.

The longer the fund exists, the more value creation is already included in the current valuation and past distributions, which is why the ratio approaches 1x. Nevertheless, even a hypothetical investor that buys a fund at quarter 32 for a par price reflecting its NAV could expect that they would receive roughly 10% more than their investment and potential additional capital calls in the median case.
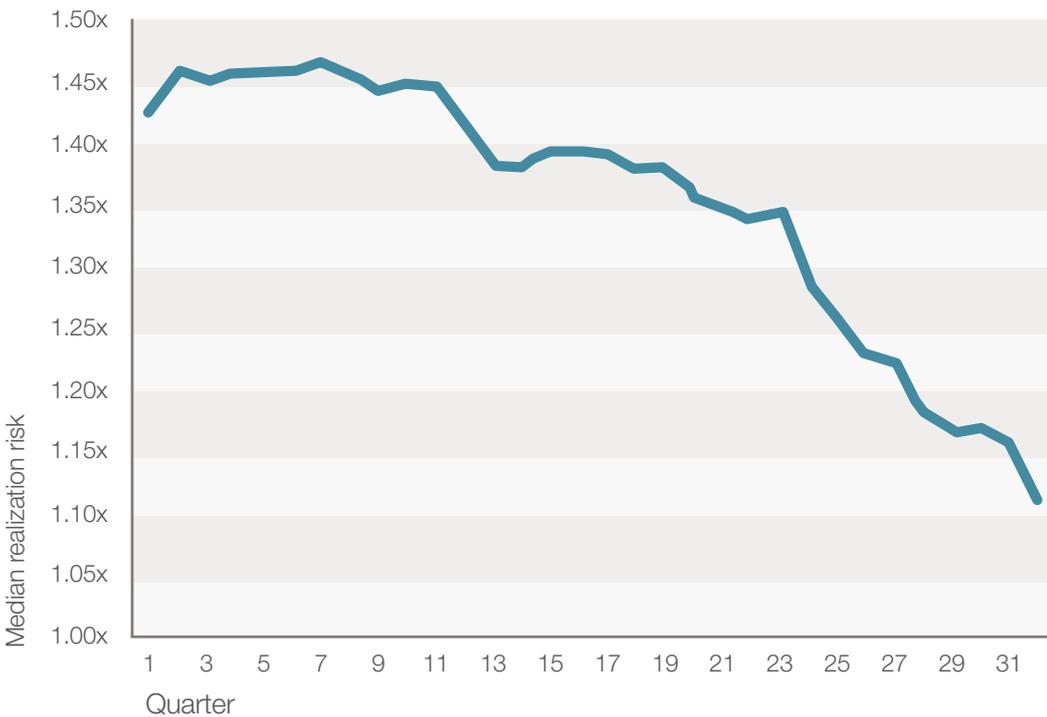
Figure 13: Median Realisation Risk for all liquidated funds in the Pevara dataset.

In a next step, we run our Monte Carlo simulation. The results are shown in Figure 14. The results are in line with our previous findings, namely that diversification reduces the uncertainty for an investor substantially. While an investor who commits to a single fund often receives fewer distributions than the current valuation of their portfolio would imply, the same is not true for well-diversified investors. These can be fairly certain that they at least get their money back, as the graphs in the case of five and 20 selected funds show.

One fund selected per run

Five fund selected per run

Twenty fund selected per run
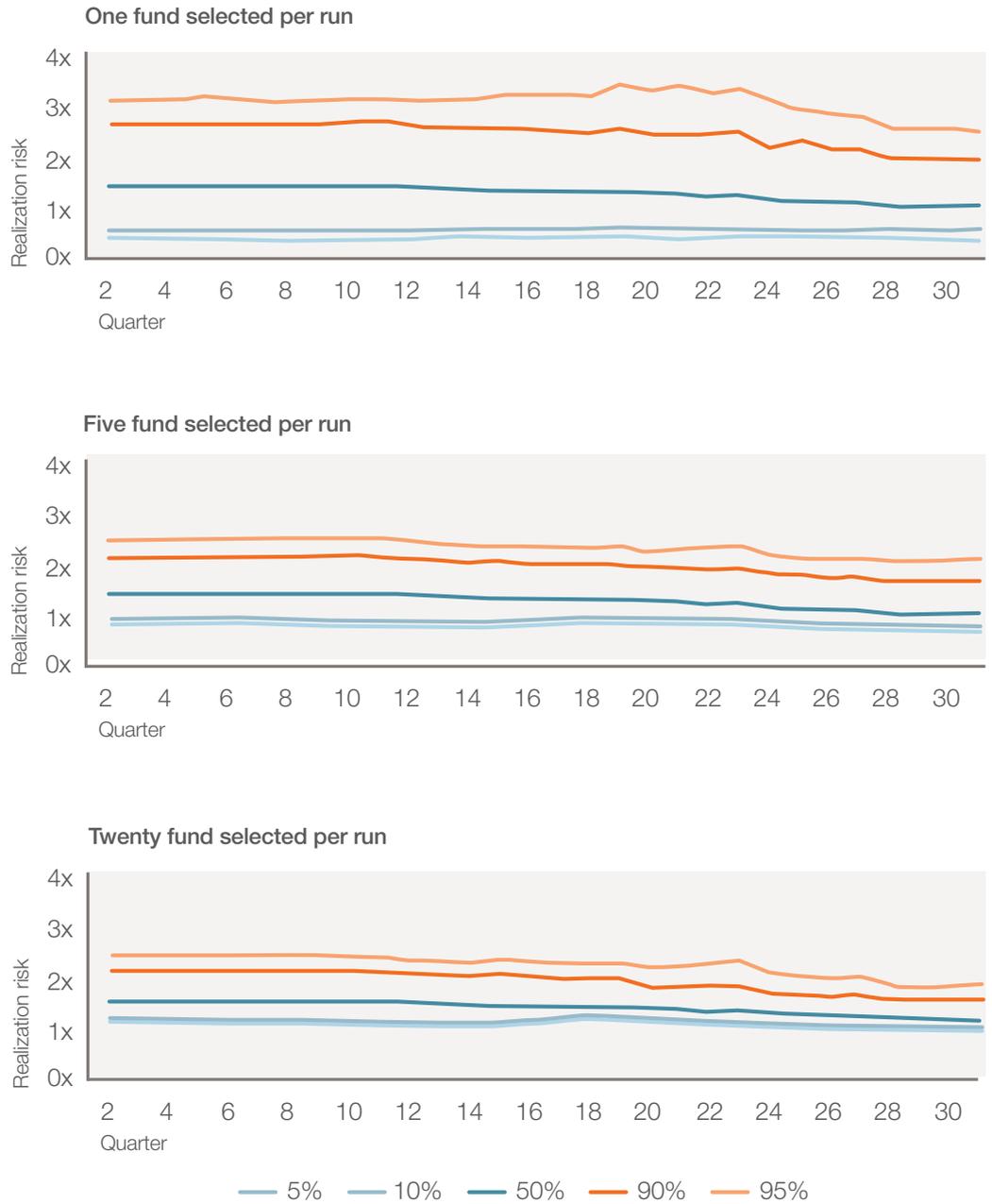
Figure 14: Capital risk – Realisation Risk for simulated portfolios of private equity funds. Data source: Pevara. Number of runs: 5000.

Figure 15 further supports this argument by showing how often the value of a portfolio ends up below its valuation after five years. If this portfolio consists of only one fund, the chances are quite high with a probability of roughly 28%. With a more diversified portfolio, this probability continuously falls. In the case of a fund portfolio of 50 funds, an investor would receive less than the valuation in quarter 20 (plus subsequent capital calls) in only 0.8% of runs.
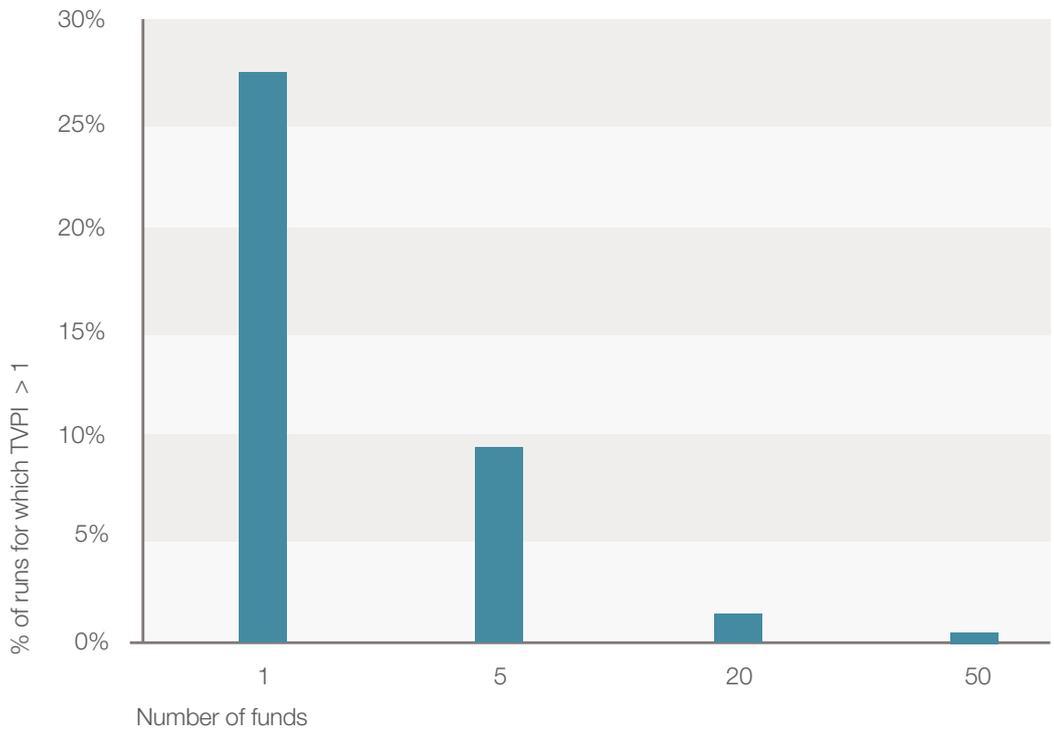
Figure 15: Capital risk – Cases for which the Realisation Risk for simulated portfolios of private equity funds was below 1x after 5 years. Data source: Pevara. Number of runs: 5000.

6. Conclusion

This study discussed in detail the four major risks of private equity investments: funding risk, liquidity risk, market risk and capital risk. It also described and analysed the concept of Realisation Risk – a key risk specific to private equity which investors have to contend with when managing their private equity portfolios.

First, we explained how private equity is different from traditional asset classes because of certain intrinsic characteristics unique to the asset class, such as unobservable market prices and the typical fund structure used by investors to gain exposure to the asset class. These characteristics require specific tools to quantify the risks of the asset class correctly. We then showed that a simple comparison of the returns of a public equity and private equity index understates the true risk of a private equity investment due to stale-pricing, report lagging and the fact that the NAVs are only reported and do not represent prices in the market. Put differently, the quarterly returns in the public equity index could have been achieved by buying and selling the stocks. The same is not true for the private equity index since investments typically have to be hold throughout the lifetime of a fund. Because of this illiquid nature, we next focused our attention on the funding and capital risk that are computed over longer periods of time. In the empirical section of our study, we demonstrated that diversification across funds substantially reduces the risks of private equity investments.

This study has demonstrated the risks which an investor in private equity should focus on and how these risks can be evaluated and better managed. A key message of this study is that diversification is the main tool to reduce risk, just as is in the case of public equity. In the empirical section of our study, we showed that the risk of losing any capital over the entire holding period with a portfolio of just 20 funds is just 1.4%. This can be reduced even further to close to zero for a portfolio of 50 funds. Understanding this aspect of private equity is crucial in managing a private equity portfolio and in framing regulation in relation to risk-management for investors.

Finally, we calculated the "Realisation Risk" for private equity portfolios. An investor with a portfolio of 50 funds has a 0.8% risk of not receiving the interim NAV or book value (after five years) of private equity over the remaining lifetime of the funds. These results show that private equity is far less risky than it is often perceived as being by those who are not actively involved in investing in this long-term asset class.

7. Appendix

7.1 Market risk analysis with different public market indices and for Preqin dataset
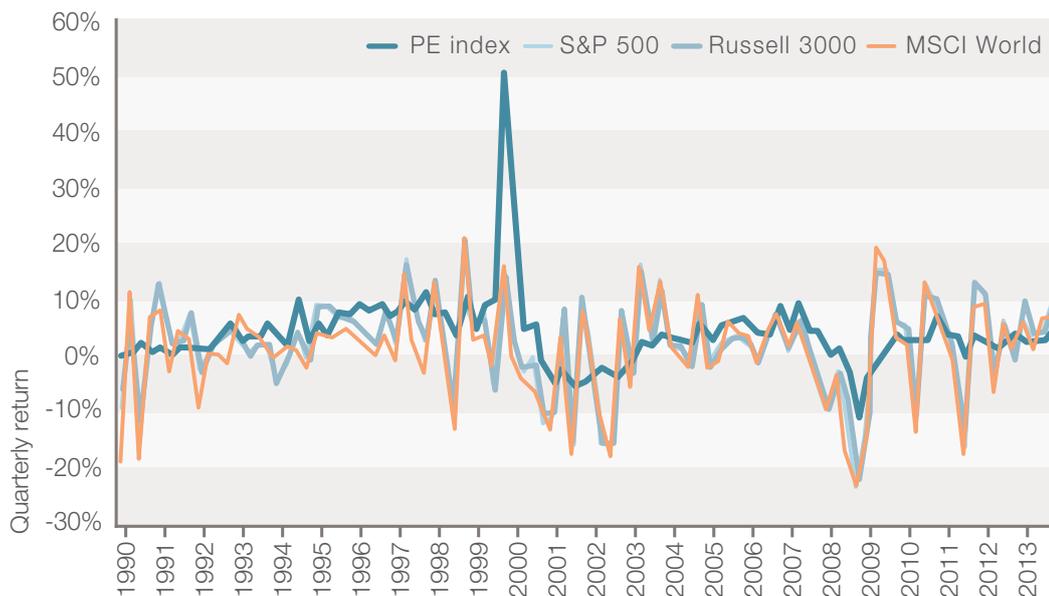
Figure 16: Market risk – Changes of NAVs adjusted by cash flows of aggregated private equity funds compared with S&P 500, Russell 3000 and the MSCI World. Data source: Pevara and Capital IQ.
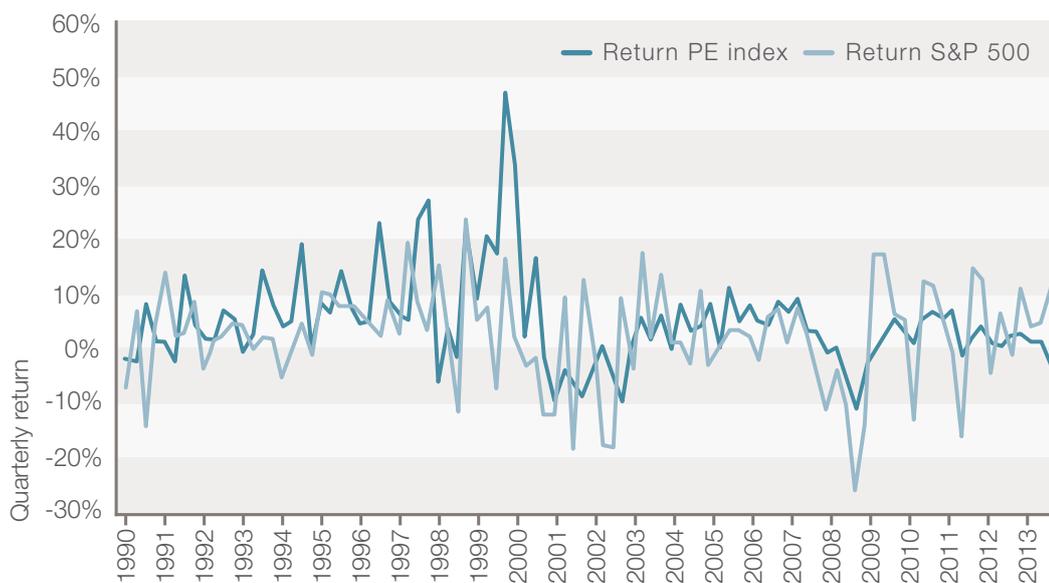
Figure 17: Market risk – Changes of NAVs adjusted by cash flows of aggregated private equity funds compared with S&P 500. Data source: Preqin and Capital IQ.

7.2 Funding risk analysis for Preqin and BVCA dataset

One fund selected per run

Five funds selected per run

Twenty funds selected per run
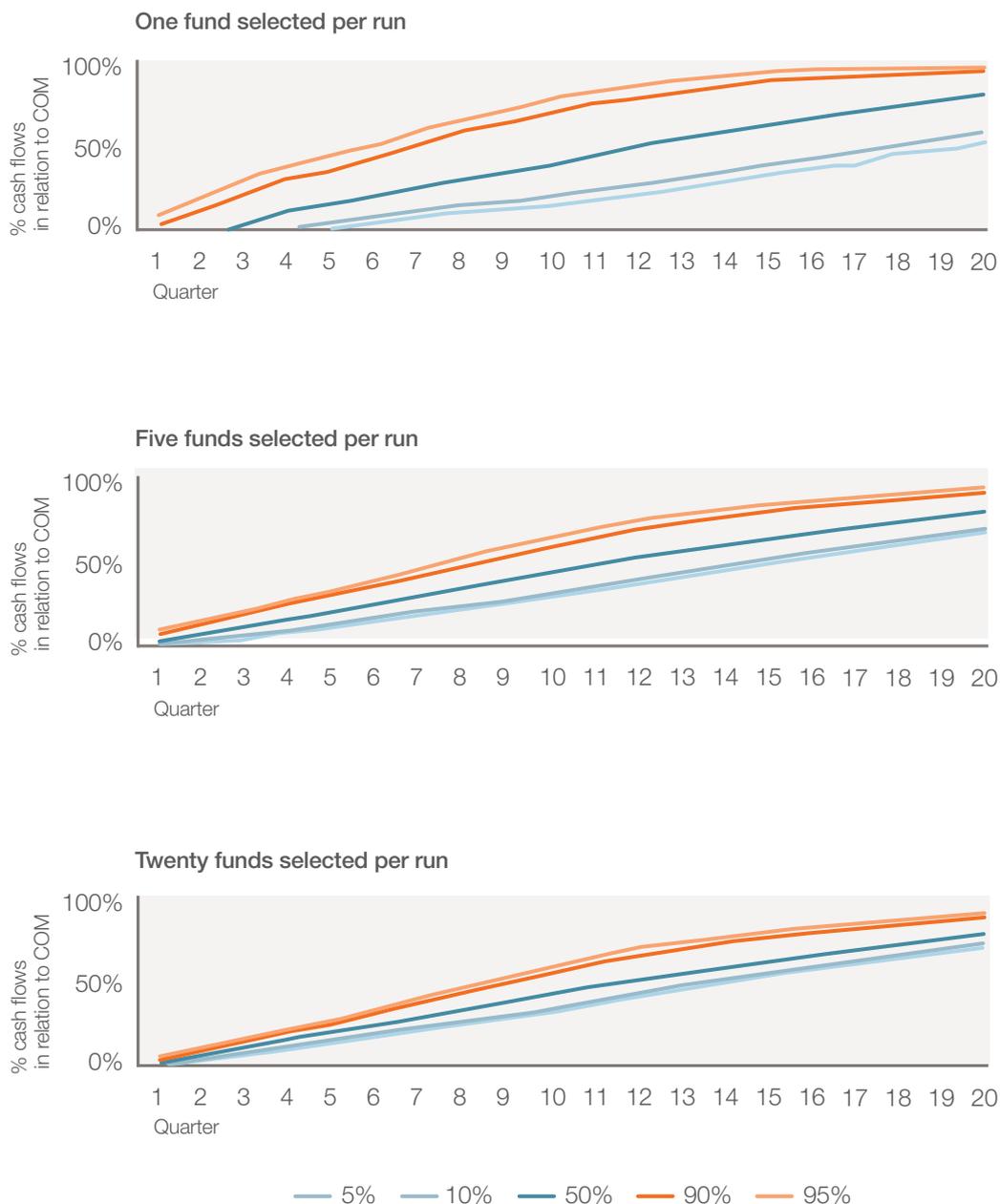
Figure 18: Funding risk – Capital call pattern for simulated portfolios of private equity funds in the 5th, 10th, median, 90th, and 95th percentile case. Data source: Preqin. Number of runs: 5000.

One fund selected per run

Five funds selected per run

Twenty funds selected per run
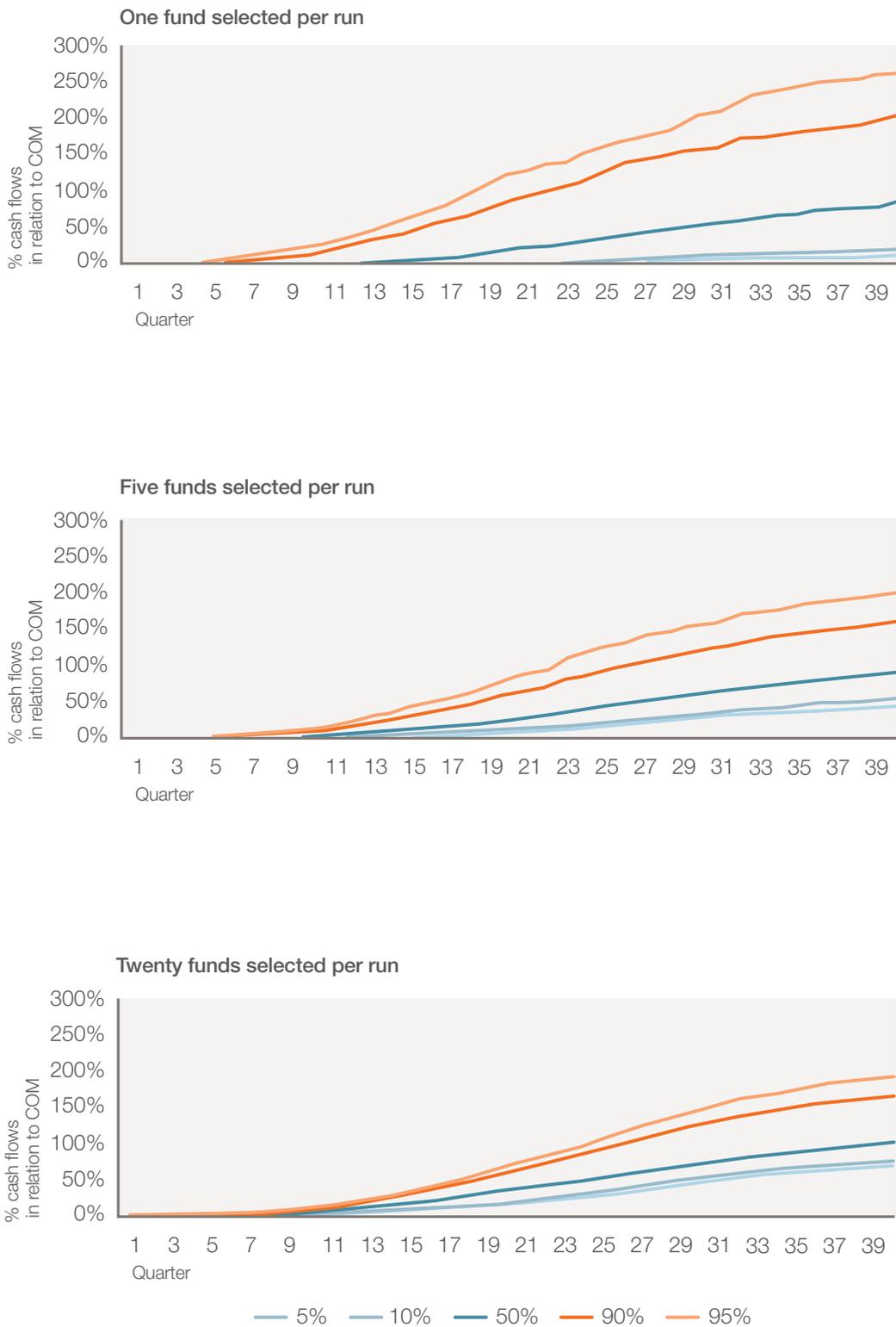
Figure 19: Funding risk – Distribution pattern for simulated portfolios of private equity funds in the 5th, 10th, median, 90th, and 95th percentile case. Data source: Preqin. Number of runs: 5000.

One fund selected per run

Five funds selected per run

Twenty funds selected per run

Legend: 5% — 10% — 50% — 90% — 95%
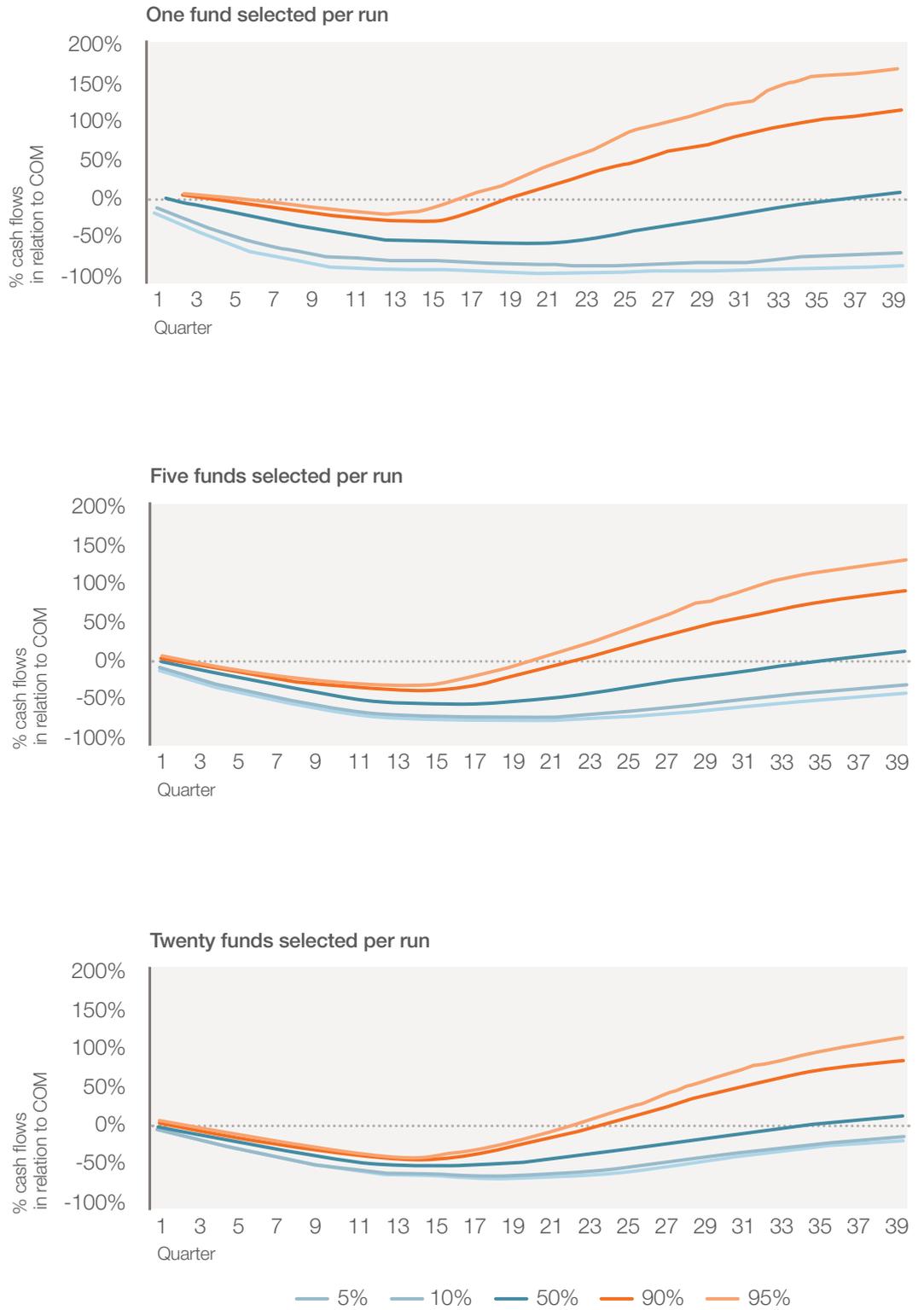
Figure 20: Funding risk – Net cash flow pattern for simulated portfolios of private equity funds.
Data source: Preqin. Number of runs: 5000.

One fund selected per run

Five funds selected per run

Twenty funds selected per run
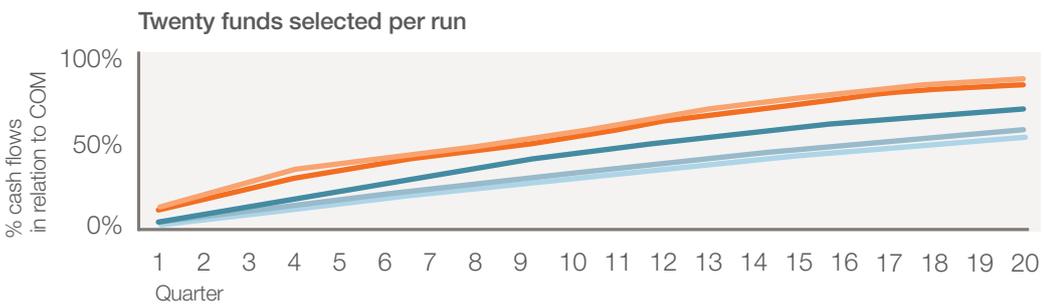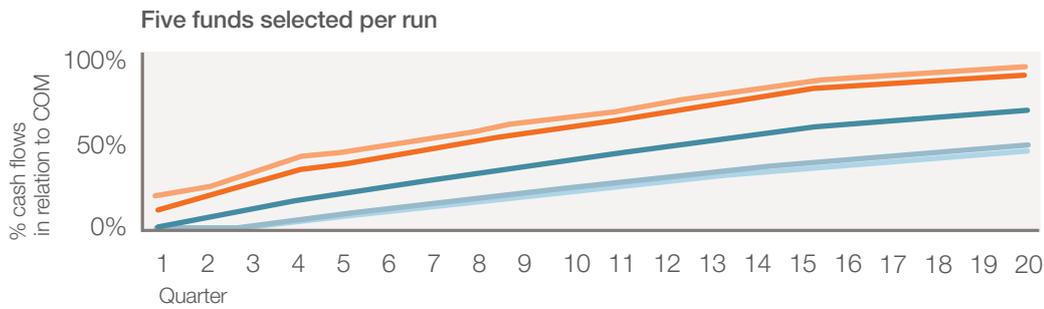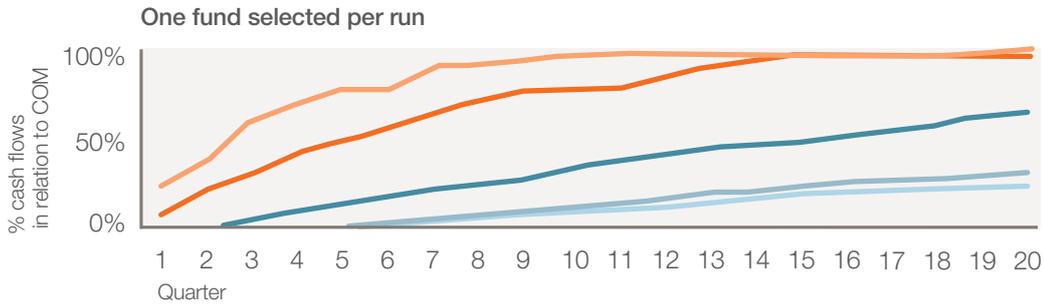
Legend: 5% | 10% | 50% | 90% | 95%

Figure 21: Funding risk – Capital call pattern for simulated portfolios of private equity funds in the 5th, 10th, median, 90th, and 95th percentile case. Data source: BVCA. Number of runs: 5000.

One fund selected per run

Five funds selected per run

Twenty funds selected per run

Legend: 5% | 10% | 50% | 90% | 95%
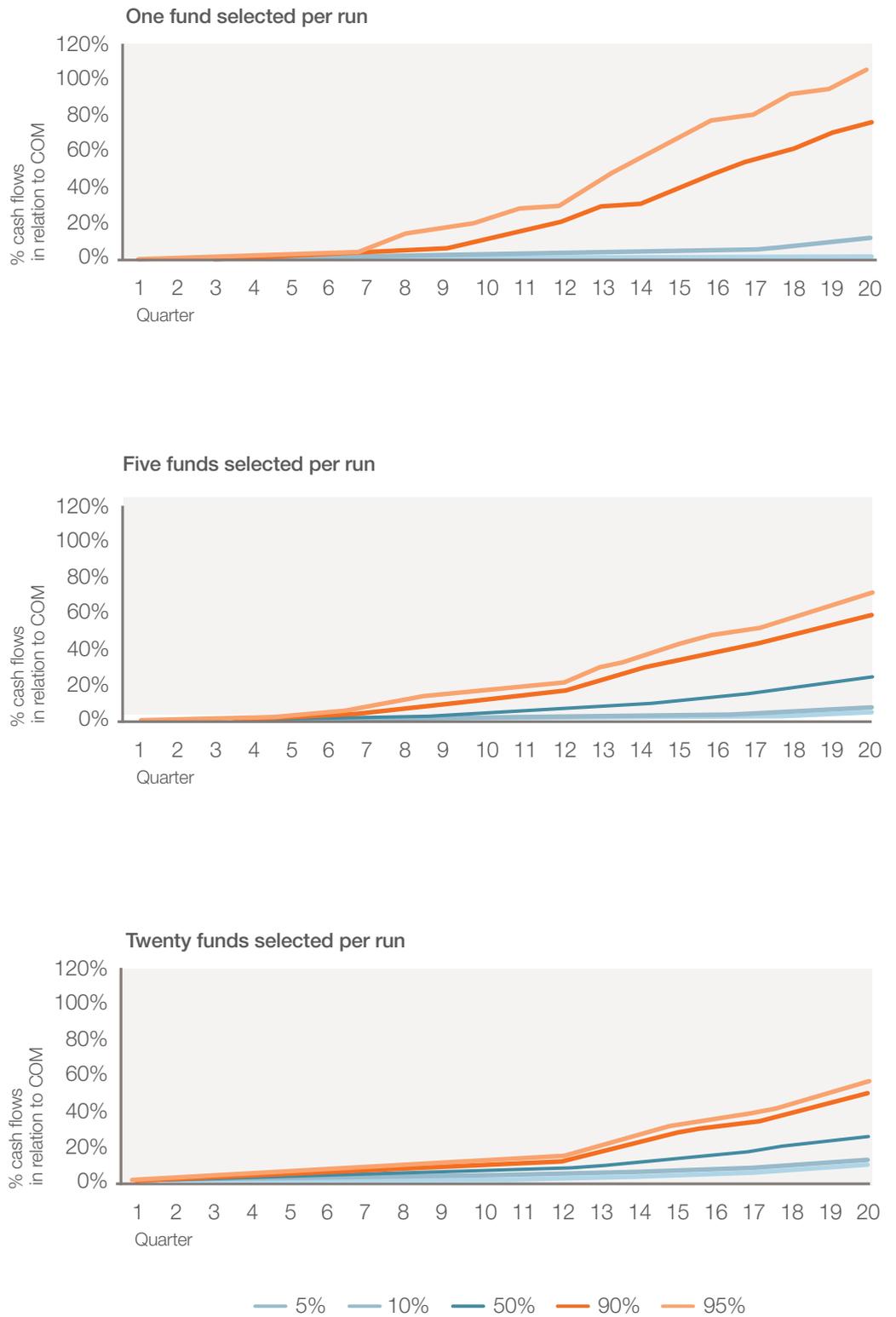
Figure 22: Funding risk – Distribution pattern for simulated portfolios of private equity funds in the 5th, 10th, median, 90th, and 95th percentile case. Data source: BVCA. Number of runs: 5000.

One fund selected per run

Five funds selected per run

Twenty funds selected per run

Legend: 5% | 10% | 50% | 90% | 95%
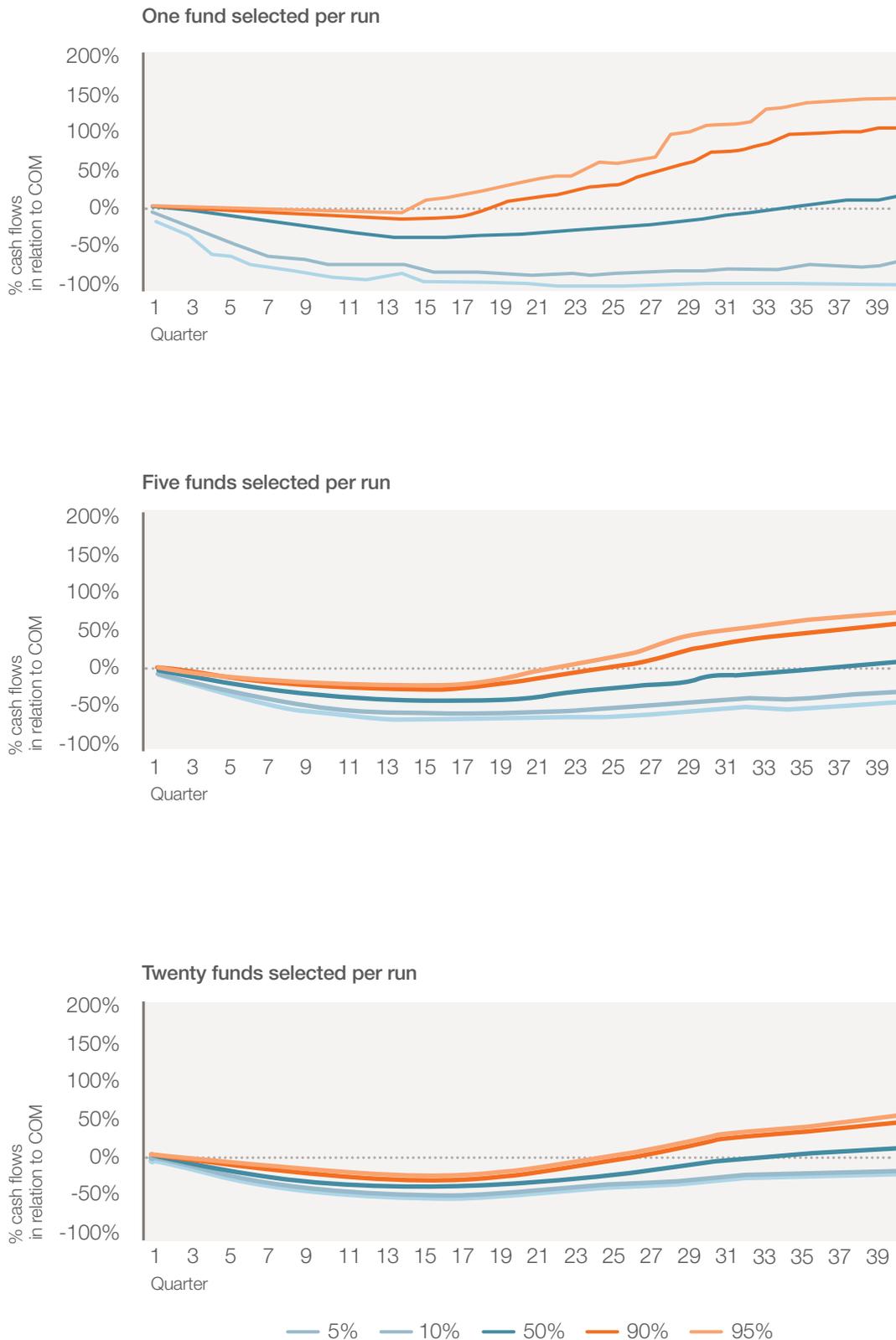
Figure 23: Funding risk – Net cash flow pattern for simulated portfolios of private equity funds.
Data source: BVCA. Number of runs: 5000.

7.3 Capital risk analysis for Preqin and BVCA dataset

One fund selected per run

Five funds selected per run

Twenty funds selected per run

Legend: 5% · 10% · 50% · 90% · 95%
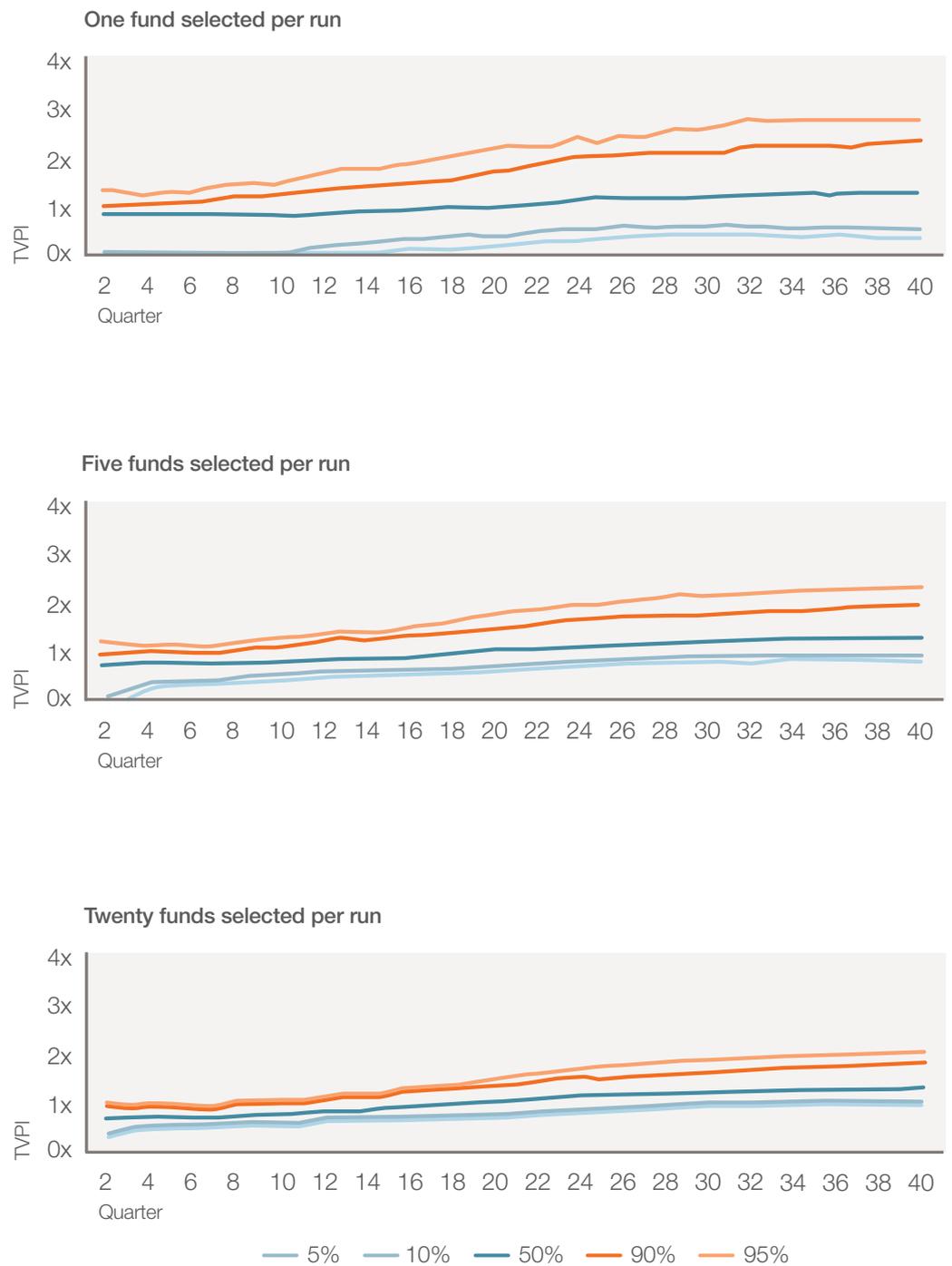
Figure 24: Capital risk – TVPI for simulated portfolios of private equity funds. Data source: Preqin. Number of runs: 5000.

One fund selected per run

Five funds selected per run

Twenty funds selected per run

Legend: 5% — 10% — 50% — 90% — 95%
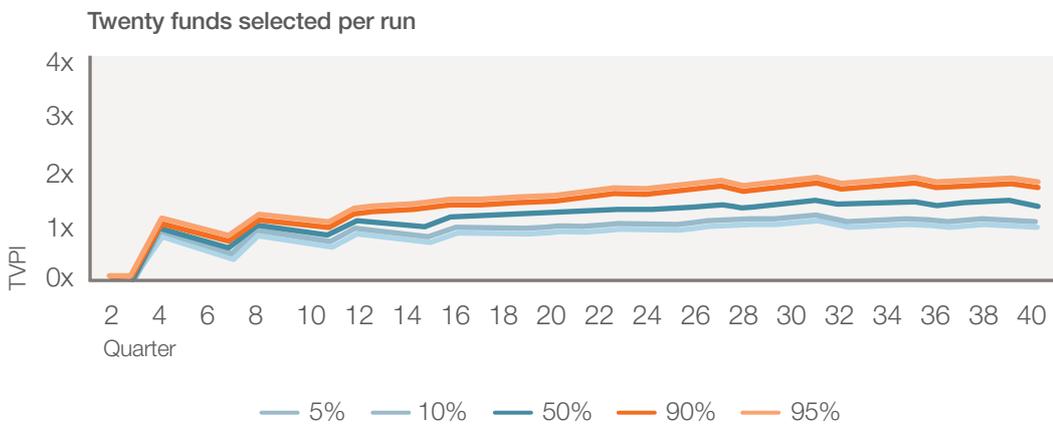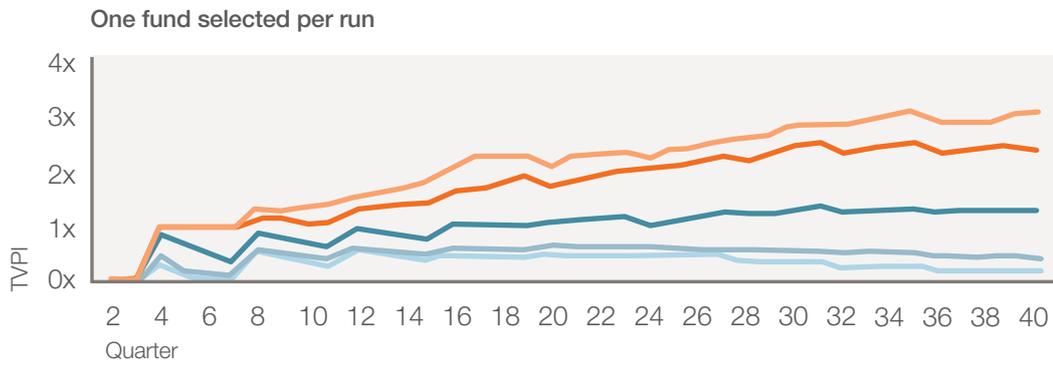
Figure 25: Capital risk – TVPI for simulated portfolios of private equity funds. Data source: BVCA. Number of runs: 5000. Note that the NAV is only updated annually in the BVCA dataset which explains the cyclical pattern in particular for the first few years which are heavily dependent on the NAV.
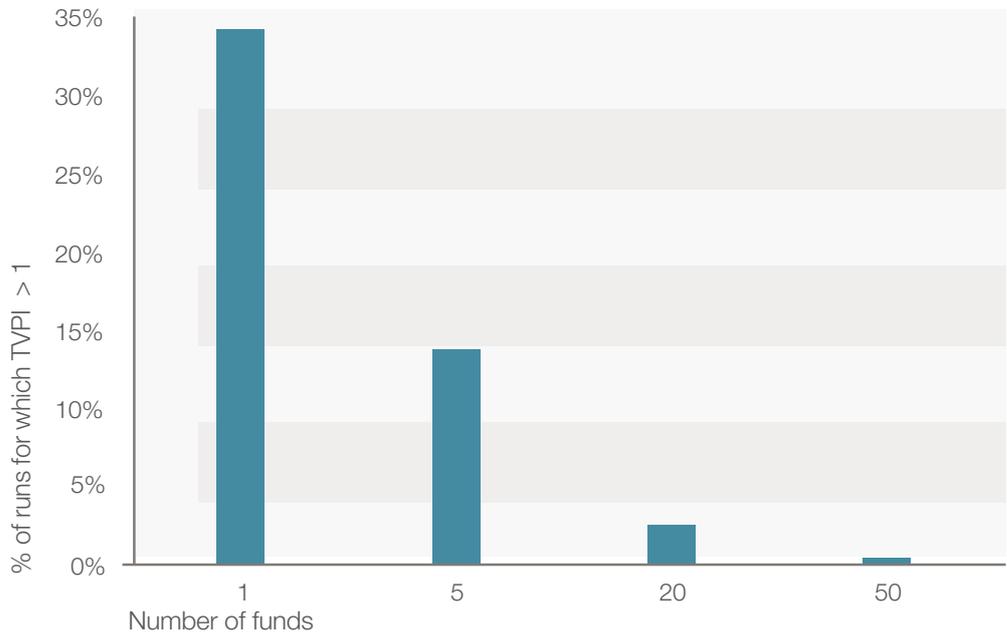
Figure 26: Capital risk – Cases for which the TVPI for simulated portfolios of private equity funds was below 1x after 10 years. Data source: Preqin. Number of runs: 5000.
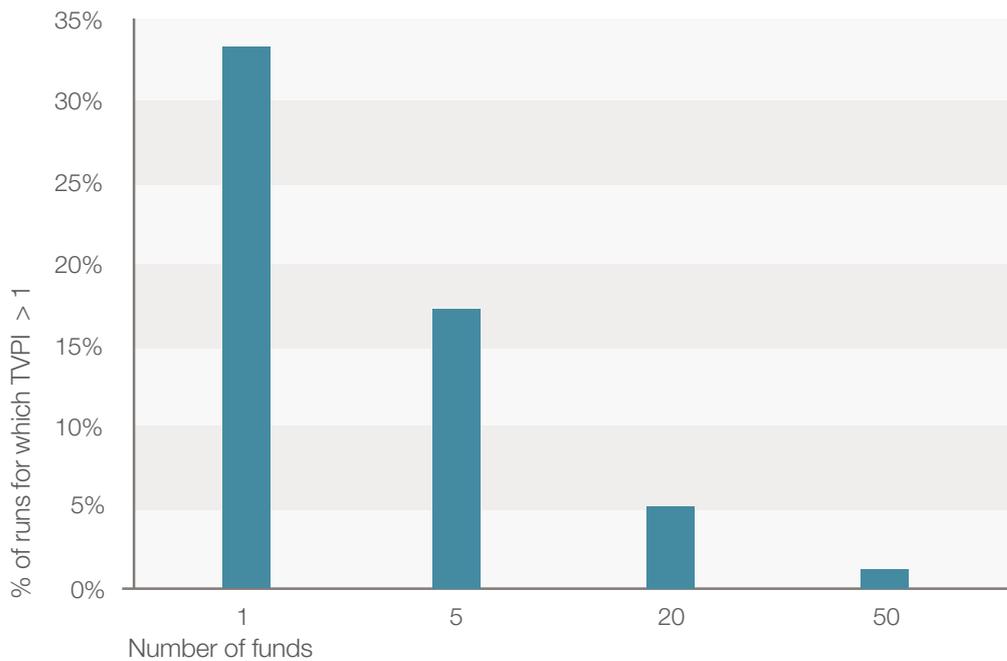
Figure 27: Capital risk – Cases for which the TVPI for simulated portfolios of private equity funds was below 1x after 10 years. Data source: BVCA. Number of runs: 5000.

One fund selected per run

Five funds selected per run

Twenty funds selected per run

Legend: 5% — 10% — 50% — 90% — 95%
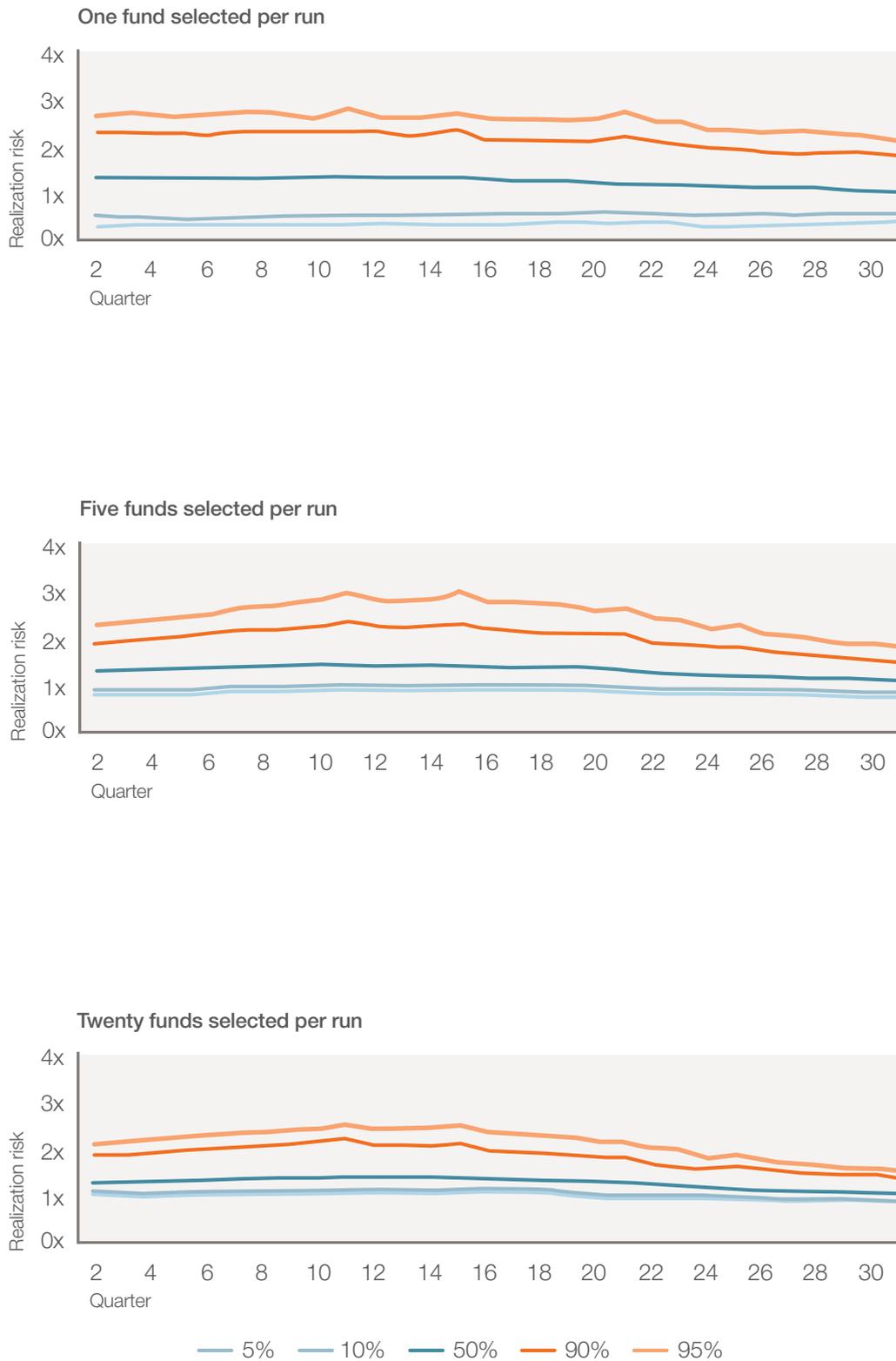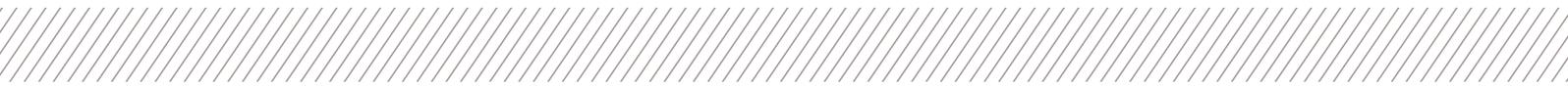
Figure 28: Capital risk – Realisation Risk for simulated portfolios of private equity funds. Data source: Preqin. Number of runs: 5000.

One fund selected per run

Five funds selected per run

Twenty funds selected per run

5% — 10% — 50% — 90% — 95%
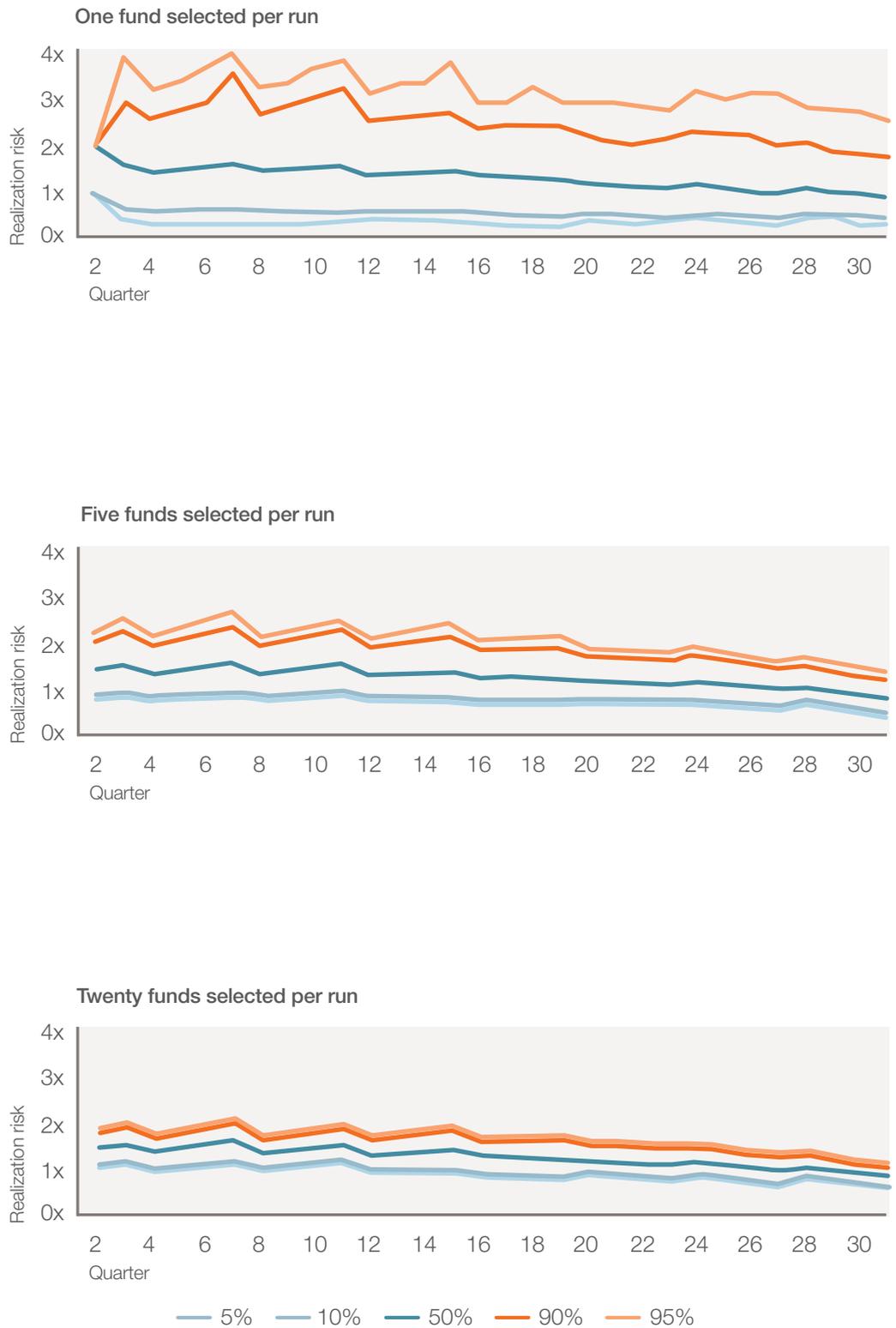
Figure 29: Capital risk – Realisation Risk for simulated portfolios of private equity funds. Data source: BVCA. Number of runs: 5000. Note that the NAV is only updated annually in the BVCA dataset which explains the cyclical pattern in particular for the first few years which are heavily dependent on the NAV.
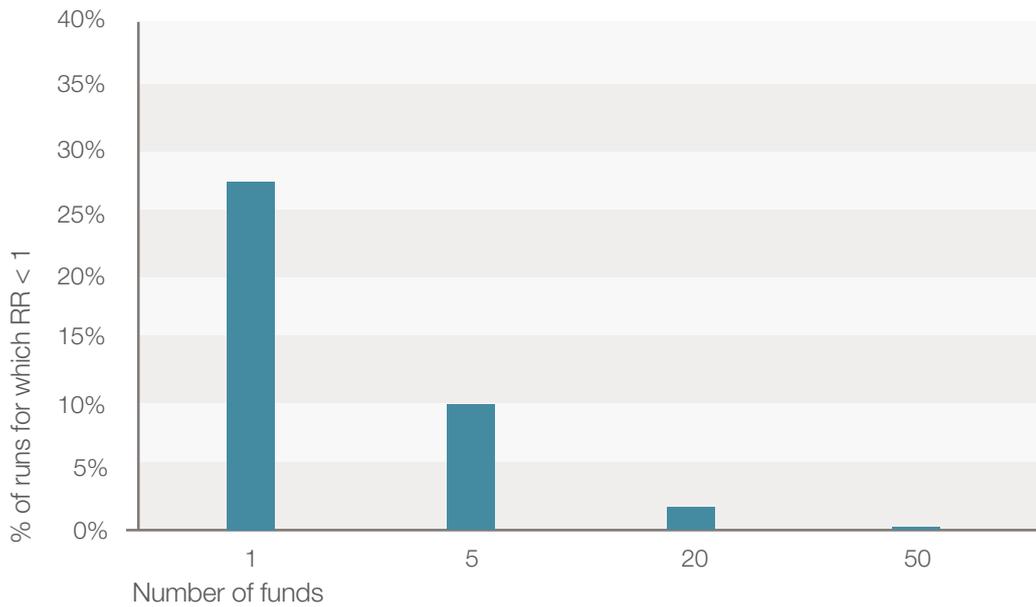
Figure 30: Capital risk – Cases for which the Realisation Risk for simulated portfolios of private equity funds was below 1x after 5 years. Data source: Preqin. Number of runs: 5000.
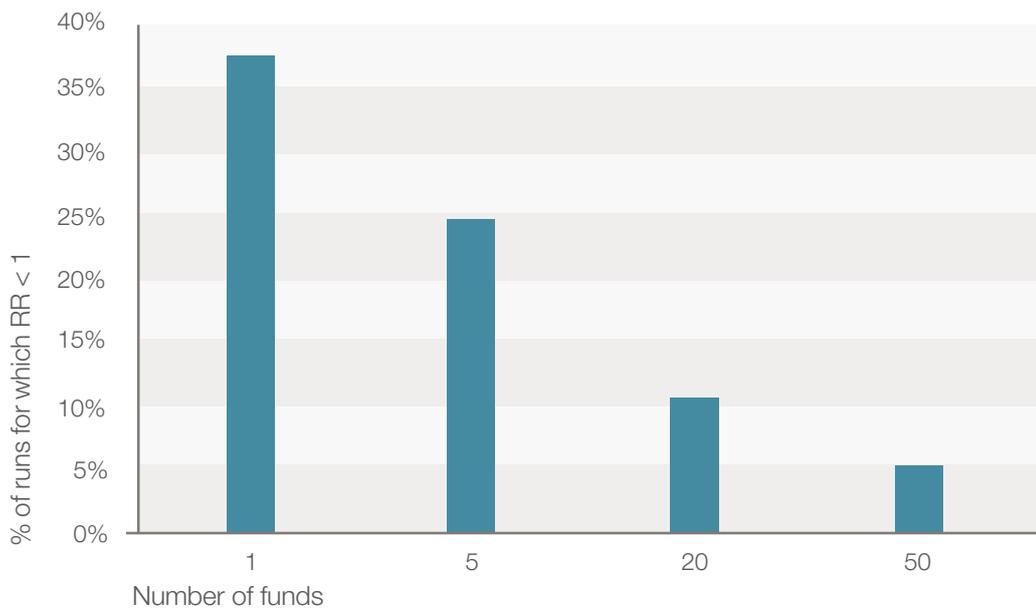
Figure 31: Capital risk – Cases for which the Realisation Risk for simulated portfolios of private equity funds was below 1x after 5 years. Data source: BVCA. Number of runs: 5000.

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