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EUROPEAN PRIVATE EQUITY FUNDS -
A CASH FLOW BASED PERFORMANCE ANALYSIS

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European Private Equity Funds -

A Cash Flow Based Performance Analysis*

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Abstract

This paper presents a cash flow based analysis of the return and risk characteristics of European Private Equity Funds. For that purpose a comprehensive data set has been provided by Thomson Venture Economics. We document the typical time pattern of cash flows for European private equity funds. Specifically, it is recorded that the average European private equity fund draws down 23% of total committed capital on the vintage date; within the first three years 60% of the total commitment is draw down. It turned out that limited partners on average get back the money invested slightly after 7 years.

Over the time period from 1980 to June 2003, we calculate various performance measures. For that purpose we use only liquidated funds or funds with a small residual net asset value. Under this restriction one specific data set consists of 200 funds. We document a cash flow based IRR of 12.7% and an average excess-IRR of 4.5% relative to the MSCI Europe equity index. In order to circumvent the problems associated with the IRR-approach we focus on the alternative public market equivalent approach. There it is assumed that cash flows generated by a private equity fund are reinvested in a public market benchmark index. We record an average PME of 0.96 and a value-weighted average PME of 1.04.

Based on the PME-approach we develop a viable methodology to estimate the return and risk characteristics of European private equity funds and the correlation structure to public markets. As a benchmark index we used the MSCI Europe Equity Index as well as the J.P.Morgan Government Bond Index. Over the period 1980-2003 private equity funds generated an overperformance with respect to the bond index and two of our three samples an underperformance with respect to the equity index. Over the period 1989-2003 private equity funds generated an overperformance with respect to both indexes.

Finally, we analyze to what extent performance measures are associated with specific funds characteristics, like size, payback period and vintage year, respectively. While the payback period and the vintage year seem to have a statistically significant influence on a fund's performance, the results with respect to size are inconclusive.

JEL classification: G24

Keywords: **private equity, venture capital, cash flow analysis, public market equivalent, internal rate of return**

1 Introduction

Private Equity has recently faced an increasing public awareness in Europe. From an economic perspective the allegedly positive impact of venture capital and private equity on economic growth is emphasized. From an asset management perspective it seems that private equity has become one of the most important alternative asset classes. It can be shown, in fact, that institutional investors[1] have increased their share of wealth allocated to this asset class substantially. This is also confirmed by the volume of capital raised by the private equity industry. According to statistics provided by EVCA, this figure increased from Euro 4.2bn in 1992 to over Euro 48bn in 2000. Of course, after the stock market downturn starting in 2000 these cash inflows into the private equity industry decreased as well; however, even in 2002 about Euro 27bn have been invested.[2] Recently published figures indicate that institutional investors are now going to increase their private equity portfolio ratio giving way to a more optimistic outlook for the future of this industry.[3]

Despite this long run increasing importance of private equity as an asset class there's only a limited understanding of the economic characteristics of this industry. For the time being, three important topics are discussed in this context. First, the question whether private equity enhances economic growth is discussed.[4] Second, the information advantages of allocating savings through a private equity contract are discussed. Third, the performance characteristics of private equity investments are analyzed. This paper aims to make a contribution with respect to this last issue.

Specifically, it may extend the existing literature for the following three reasons. First, for the first time a comprehensive cash flow based performance analysis of a large data set of European private equity funds is presented. For that purpose we analyze cash flow data of 777 European private equity

[1] Banks are the largest source for private equity funds. In fact, 25.7% of total funds raised in 1998-2002 stem from the banking industry. Pension funds contributed 23.1% and funds raised from insurance companies were the third largest source at 12.7% of total funds raised. Cf. European Private Equity and Venture Capital Association (EVCA) Yearbook 2003.

[2] Cf. EVCA Yearbook 2003.

[3] The European institutional investors want to increase their private equity portfolio ratio from 1.1% to 3.2% within the next 5 years in average. Cf. Mackewicz (2004)

[4] Cf. Gompers/Lerner (1999) for an extensive overview and Caselli/Gatti (2004) for a Europe-focused discussion.

funds over the period 1980 to 2003 provided by Thomson Venture Economics. Second, we develop an approach where performance figures can be derived without relying on net asset values disclosed by the general partners of private equity funds. This is an important advantage as it is often argued that net asset values are affected by strategic valuation decisions of the fund management. Third, as a corollary we are able to give some insight into the cash flow patterns of European private equity funds.

The paper is organized as follows: First, we start with a brief overview of the literature in chapter 2. Second, in chapter 3 we describe the dataset and in chapter 4 some important cash flow characteristics of private equity funds are highlighted. Third, in chapter 5 we record commonly used performance measures like the IRR or the excess-IRR. However, as the shortcomings of the IRR-method are well known we develop a methodology based on the public market equivalent-approach already known in the literature. Chapter 7 summarizes the results and gives a brief outlook.

2 Related Literature

Due to the limited availability of return data there are only a few empirical papers dealing with risk and return characteristics of private equity. Important research has been presented by Ljungqvist/Richardson(2003) and Kaplan/Schoar(2003). Both papers deal with returns of US-based private equity funds.

Ljungqvist/Richardson(2003) analyze cash flow data provided by one of the largest institutional investors in private equity in the US between 1981 and 1993. They document that it takes several years for the capital to be invested and slightly less than seven years for the capital to be returned to the investor. They investigate various determining factors for the dynamics of these cash flow patterns and come to the conclusion that these schedules do not arise by chance but depend on the underlying market conditions. For their sample they calculate excess-IRRs to the S&P 500 of five to eight percent per year.

Kaplan/Schoar(2003) used a data set from Thomson Venture Economics which includes 746 funds of the years 1980 to 2001. Over the sample period, they demonstrate that the average returns are equal to that of the S&P 500 net of management fees by using the public market equivalent (PME) approach. They found PMEs in the range from 0.96 to 1.05 in average. Furthermore, they document a strong persistence of funds' returns. In addition, they present evidence that market entry in private equity is cyclical and that funds starting in boom times perform worse. It will be interesting to compare these US-based results with European-based results as presented in this paper.

As an alternative paper, Cochrane(2003) focuses on the portfolio company level. Their performance is measured by using a dataset from Venture One which consists of the data of the financing rounds of 7.765 companies. After adjusting his results for the survivorship bias, the author calculates mean average returns to be equal to 59% with a standard deviation of 107%.

Chen/Baierl/Kaplan(2002) examine 148 venture capital funds in the Thomson Venture Economics data set that have been liquidated before 1999. By assuming intermediate cash flows to be reinvested at the IRR they find an annual average return of 45% with a standard deviation of 115%. The results are quite similar to those of Cochrane, who uses the same reinvestment hypothesis. Rouvinez(2003) proposes another cash flow based approach. By assuming that cash flows are reinvested at a constant interest rate over time he is able to derive a risk and return assessment for a set of more than hundred private equity funds provided by the Thomson Venture Economic data set. His results indicate an average return of 14.3% with a standard deviation of 34.4% for private equity funds with a vintage year between 1980 and 1990. Weidig/Mathonet(2004) analyze the risk profiles of direct investments in portfolio companies and investments in private equity funds from 1980 to 1998 in detail. They conclude that there is a diversification benefit for funds and funds-of-funds. The risk profile of a fund is relatively symmetric distributed and the probability of not getting back the total capital invested is stated as 30%.

In contrast to these cash flow based research papers, a few papers try to assess the return of private equity funds on the basis of disclosed net asset values. Bygrave/Timmons(1992) examine venture capital funds and find an average internal rate of return based on net asset values of 13.5% for 1974-1989. Thomson Venture Economics and EVCA report quarterly average IRRs based on net asset values for the US and for Europe. EVCA(2003) reports a cumulative annualized IRR based on net asset values of 4.1% for 1999-2002 and 10.1% for 1992-2002. Getmansky et al.(2003) derive an econometric time series model which considers return smoothing as a result of illiquidity in investment portfolios. Emery(2003) transfers this methodology to private equity investments and documents evidence of stale pricing of private equity returns. The average annual return difference between BO funds and the S&P 500 is 7.14% and the corresponding excess-return for VC funds and the Nasdaq is 7.45% for the time period from 1986-2001.

A completely different approach is used by Bauer/Bilo/Zimermann(2001). They concentrate on a set of 229 publicy traded private equity vehicles. Evidently, in this way a straightforward performance calculation applies. They document substantially larger Sharpe ratios of 1.5 for listed private equity firms than for traditional asset classes. They calculate a positive correlation between private equity and the MSCI World of 0.40 and the Global Bond Index of 0.02.

3 Data

3.1 Descriptive Statistics

We use a dataset of European private equity funds that has been provided by Thomson Venture Economics (TVE).[5] It should be noted that TVE uses the term private equity to describe the universe of all venture investing, buyout investing and mezzanine investing.[6] Actually, we have been provided with various information related to the timing and size of cash flows, residual net asset values (NAV), fund size, vintage year, fund type, fund stage and liquidation status for a total of 791 funds in the time period 1980-2003. Some 14 of these funds have been funds of funds. We excluded these funds from our data set as they combine a number of single private equity funds and, hence, provide redundant information for the purpose of this study. Moreover, given the small sample size it will not be possible to draw general conclusions with respect to the performance of this particular fund type.

As far as the different fund types and stages are concerned it should be noted that we use, in accordance with TVE, the following definitions:

Type definitions:

- Venture capital funds (VC): TVE uses the term to describe the universe of venture investing. It does not include buyout investing, mezzanine

[5]TVE is recording private equity data for five different world regions. One of them is Europe.

[6]Fund of fund investing and secondaries are also included in this broadest term. TVE is not using the term to include angel investors or business angels, real estate investments or other investing scenarios outside of the public market.

investing, fund of fund investing or secondaries. Angel investors or business angels are also not be included in the definition.

- Buyout funds (BO): TVE uses the term to describe the universe of buyout investing and mezzanine investing. It does not include venture investing, fund of fund investing or secondaries. Angel investors or business angels are also not be included in the definition.

Stage definitions:

- Early Stage (ES): A fund investment strategy involving investment in companies for product development and initial marketing, manufacturing and sales activities. We included seed and start-up funds in this definition.
- Balanced/Diversified (B): A venture fund investment strategy that includes investment in portfolio companies at a variety of stages of development (Seed, Early Stage, Diversified, Later Stage).
- Late Stage (LS): Development funds provide for the major growth expansion of a company whose sales volume is increasing. Although the company has clearly made progress, it may not yet be showing a profit. The money invested is used to finance the initial development of the young company. Later stage fund investment involves financing the expansion of a company which is producing, shipping and increasing its sales volume. In this definition, we included all the funds which stage is signed as development(DEV), expansion(EX) and Late Stage (LS).
- Buyout (BO): TVE uses the term to describe the universe of buyout investing and mezzanine investing. It does not include venture investing, fund of fund investing or secondaries. Angel investors or business angels are also not be included in the definition. The definition involves e.g. leverage buyouts (LBOs), management buyouts (MBOs) and bridge financing.

As one can see from Table 1, about 59% of the sample funds are venture capital funds, while the remaining 41% are categorised as buyout funds. The average fund size according to the TVE-data is Euro 182.75m[7]. Variation in

[7]It should be noted that TVE is calculating the fund size on the basis of committed capital.

fund size is considerably high, as the largest fund is 132 times as large as the median fund. Moreover, as one might expect, buyout funds are on average about 3.7 times as large as Venture capital funds. As far as the stage of the sample funds is concerned, it can be seen that one quarter are early stage funds. As one may expect, the size of the funds differs perceivably depending on their stage.

Type of Funds	All Funds	Venture Capital Funds				Buyout Funds
Stage of Funds		Early Stage	Balanced	Late Stage	VC Total	BO Total
Number of Funds	777	197	116	143	456	321
in %	100.0%	25.4%	14.9%	18.4%	58.7%	41.3%
Size in mio. Euro						
Average	182.75	70.89	144.13	60.50	86.26	319.81
Median	47.80	28.20	40.35	30.00	31.20	85.20
Stdev	513.04	122.55	435.79	109.38	243.66	722.35

Table 1: Characteristics of All Funds Included in our Data Sample

As far as the liquidation-status is concerned, it should be noted from Table 2 that only 95 out of the total of 777 funds have been liquidated before the end of the sample period, ending 30 June 2003. The average size of the liquidated funds is considerably smaller than that of the non-liquidated funds. Evidently, the average fund size has become larger for more recent vintage years. This effect may be driven by the growth of the private equity industry over the 1990s.

	All Funds	Liquidated Funds	Non-liquidated Funds
Number of Funds	777	95	682
in %	100.0%	12.2%	87.8%
Size in mio. Euro			
Average	182.75	52.14	202.87
Median	47.80	26.20	53.10
Stdev	513.04	103.62	546.30

Table 2: All Funds by Liquidation Status

Finally, the vintage year distribution of the sample funds can be found in Figure 1, the vintage year being the year of fund formation and its first draw down of capital. In accordance with the growth of the private equity industry during the 1990s an unprecedented vintage activity took place in the period 1997 to 2000. However, also during the period 1987 to 1996 a continuous fundraising activity at a fairly impressive level took place. With the exception of the year 1992 about 30 to 40 new funds entered the market every year during this period.

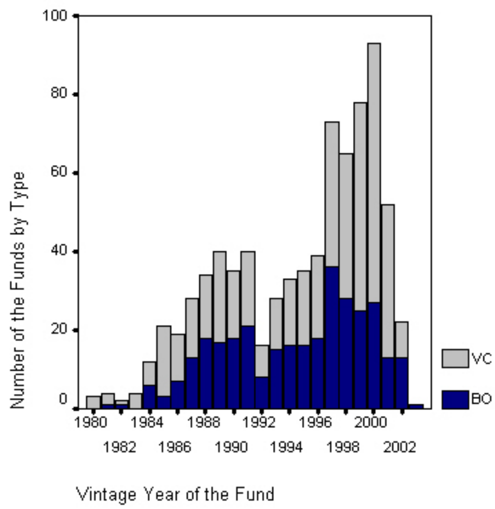

Figure 1: Number of Funds by Vintage Year (Number of Funds: 780)

3.2 Increasing the Data Universe

Before presenting the results in the next section we have to deal with a problem caused by the limited scope of liquidated funds included in our data set. Figure 2 show that we have 95 funds that have already been liquidated. Of course, inferring the performance of a fund on the basis of its cash flows requires knowing its whole cash flow history. In principle, this is only possible after a fund's liquidation. However, given that the age of the liquidated funds in our sample is about 13 years, one can easily see that restricting the analysis to liquidated funds could cause a bias as more recently founded funds would be systematically left out. From Figure 12 and Figure 16 it can easily be taken that by doing so we would exclude funds that had a very good performance. Restricting the analysis to liquidated funds only would, therefore, introduce a negative selection bias into the analysis.

In order to mitigate this problem different approaches have been developed in the literature. Basically, their starting point is the question whether it may be possible to infer future cash flows of a fund sufficiently well on basis of its cash flow history. If this is the case, it would be possible to include not yet liquidated funds in the cash flow analysis without incurring a systematic bias in the analysis.

Unfortunately, a closer look reveals that the problem is more difficult than it may seem at a first glance. For instance, Kaplan/Schoar (2002) pursued the idea that if the correlation of the IRR (NAV) with the IRR (CF)[8] is high, performance figures based on one of the return measures should lead to similar results. As they found this correlation coefficient to be about 0.9 for funds with an age of at least five years, they concluded that including on top of the liquidated funds all funds with an age of at least five years could enlarge the data universe in their study. For this group of not liquidated funds they used the IRR (NAV) instead of the IRR (CF). This method, however, has some severe drawbacks. The fact that the IRR (NAV) and the IRR (CF) are highly correlated implies only that their changes are correlated over the funds lifetime. However, this does not imply that they are almost on the same level. This can easily be seen in figure 2. Even one or two years before liquidation both IRR-measures differ substantially. Hence, any approach stating that funds with a given minimum age would be included in the sample, like the one used by Kaplan/Schoar (2002), is not suitable for enlarging the data universe.

We, therefore, propose another way for enlarging the data set. First of all, from figure 2 it follows that for doing this we have to make sure that there is no significant difference between the IRR (NAV) and IRR (CF). Basically, our idea is the following. When calculating the IRR (NAV) the residual NAV is considered as a last cash flow paid by the fund. Of course, the valuation bias caused by this approach is the least important the smaller the impact of this last hypothetical cash flow is. The first and most obvious way to make sure that this impact is small is to integrate only those funds in the sample whose residual NAV is small relative to the sum of absolute cash flows already paid in or out.[9] Therefore, we will integrate a non-liquidated fund into our sample only if it meets the following condition:

[8] For an explanation of the meaning of these two different IRR definitions cf. section 5.1. Basically, the first is an IRR treating the NAV as a last cash flow while the second is an IRR based on accrued cash flows only.

[9] A similar idea can be found in Meyer/Weidig (2003).

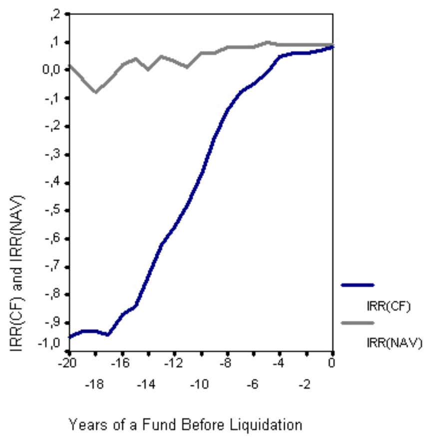

Figure 2: Average IRR(NAV) and IRR(CF) over a Funds Lifetime for Liquitaded Funds (Number of Funds: 95)

$$\frac{RNAV_N}{\sum_{t=0}^{N}|CF_t|} \leq q$$

Here, $RNAV_N$ stands for the residual net asset value of a fund at end of period N.[10] Of course, q is a parameter that has to be chosen in an arbitrary way. In this study we will work with a q equal to 0.1 for one sample and 0.2 for another, respectively. Hence, we add non-liquidated funds to our sample if their residual value is not higher than 10% for one sample and 20% for another sample, respectively, of the undiscounted sum of the absolute value of all previously accrued cash flows. For these funds the IRR (CF) is calculated under the assumption that the residual net asset value represents a hypothetical distribution accrued by the end of our observation period.

The condition stated above can be simplified by taking into account that the sum of cash flows can be rewritten in the following way:

$$\sum_{t=0}^{N}|CF_t| = \sum_{t=0}^{N} TD_t + \sum_{t=0}^{N} D_t$$

[10]In principle, it would be better to use discounted cash flows in the denominator rather than undiscounted. However, we believe that this difference is not so important, given that it can be taken into account by adjusting the parameter q. Therefore, we stick to the approach presented here, as in this case the condition can be easily transformed into another very simple condition.

Here TD_t is the capital paid into the fund at time t, while D_t is the distribution paid by the fund at time t. Hence, in this way we disentangle draw downs from distributions. Now, taking into account that the following definitions hold

$$DPI_N = \frac{\sum_{t=0}^{N} D_t}{\sum_{t=0}^{N} TD_t}$$
$$RVPI_N = \frac{RNAV_N}{\sum_{t=0}^{N} TD_t}$$

the initial condition stating which funds should be added to the data set can be rewritten as follows:

$$\frac{1+DPI_N}{RVPI_N} \geq \frac{1}{q}$$

All funds that are not liquidated by 30 June 2003, and satisfying this condition for q=0.1 together with the liquidated funds are put in sample I, while all funds satisfying this condition for q=0.2 together with all liquidated funds are put into sample II. As we will see in table 3, sample I has 200 funds, while sample II has 262 funds. This is a perceivable increase given that we have only 95 liquidated funds.

	Liquidated Funds	Sample I	Sample II
Number of Observations			
VC	47	99	131
BO	48	101	131
Total	95	200	262
Size in mio. Euro			
Average	52.14	78.05	121.24
Median	26.20	33.10	39.10
Stdev	103.62	128.89	433.76

Table 3: Description of our Three Data Samples

4 Cash Flow Characteristics of European Private Equity Funds

In this section we will highlight some important cash flow patterns of European private equity funds. The peak of aggregated take downs, i.e. the aggregated sum of funds committed by investors or limited partners to all private equity funds, as well as aggregated distributions or disbursements, i.e. the sum of funds returned by all private equtiy funds to their investors, is in the year 2000. The whole time pattern of take downs and distributions is shown in Figure 3. Take downs of committed capital by all sample funds in year 2002 aggregate to Euro 18.4bn; simultaneously, distributions aggregated to Euro 13.5bn. It should be noted that according to EVCA reports the aggregated volume of funds raised in the European private equity industry in the year 2000 was almost Euro 44bn. Hence, we can infer that for this particular year the sample of funds provided by TVE for the purpose of this study covers about 43% of the fund volume tracked by EVCA.

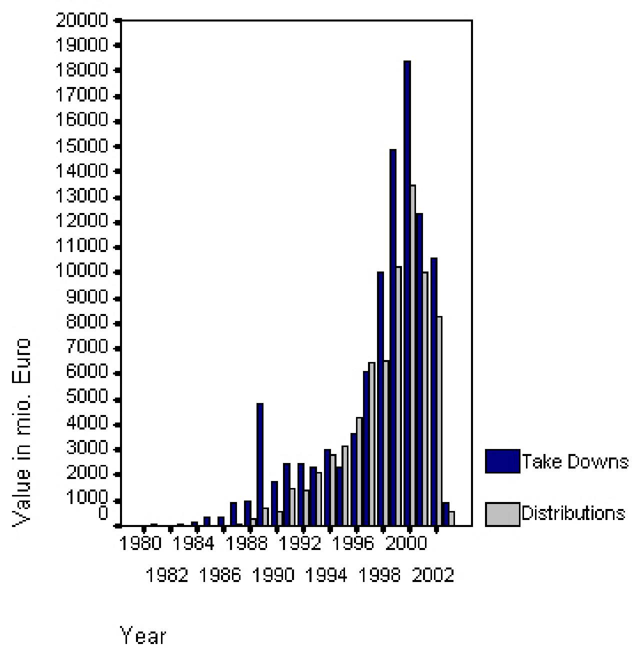

Figure 3: Time Pattern of Aggregated Sample Funds' Cash Flows (Number of Funds: 777)

The growth in the private equity industry is strongly correlated with the performance of the public equity market. In fact, the growth of private equity investments during the 1990s was strongly correlated to the lasting positive stock market performance during this period.

As far as structural issues of cash flow patterns are concerned four questions appear in this context. First, how long does it typically take until the general partner has taken down the committed capital? Second, what is the typical time pattern of disbursement? Third, how long does it typically take for a limited partner to get back his invested capital? Fourth, are these patterns different depending on fund size?

An answer to the first question is given by Figure 4. The average fund draws down 23% of the total investment volume when starting its business. Within the first three years 60% of total committed capital is invested in the fund. It should be noted that according to Ljungqvist/Richardson (2002) the average US fund draws down 57% of the committed capital within the first three years. Moreover, it seems that capital drawdown is faster for venture capital funds than for buyout funds. However, the difference is not that large, as general partner of venture capital funds have drawn down 68% of capital within the first three years, while for buyout funds this ratio is about 57%. Finally, from Figure 5 it can be seen that there is only a slight difference in the take down patterns between the various stages. Only late-stage and balanced funds take down their capital faster than the average funds.

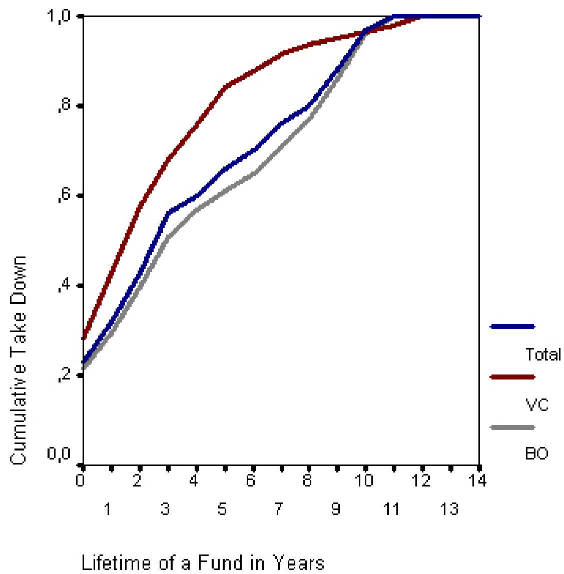

Figure 4: Time Pattern of Take Downs for Different Types of Funds (Sample II, Number of Funds: 262)

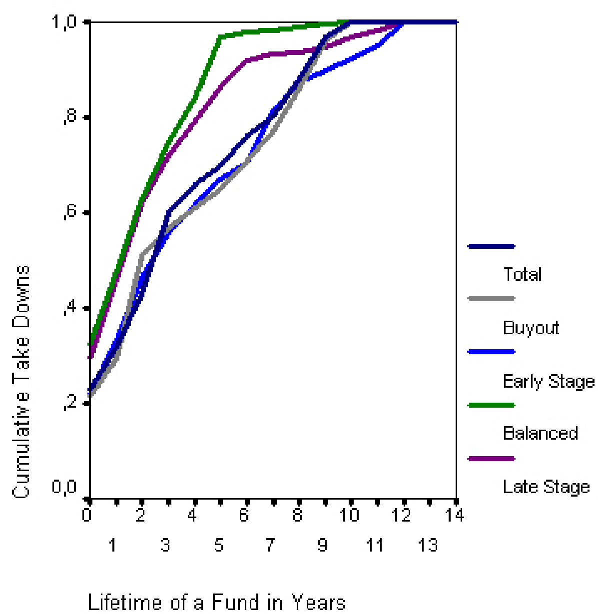

Figure 5: Time Pattern of Take Downs by Funds' Stage (Sample II, Number of Funds: 262)

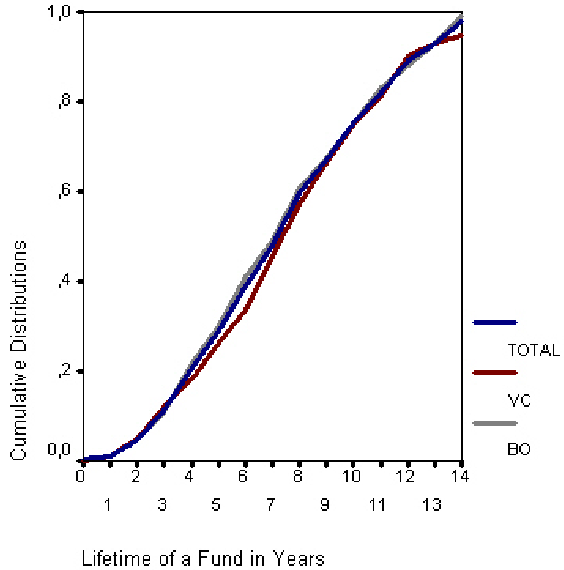

Figure 6: Time Pattern of Distributions for Different Types of Funds (Sample II, Number of Funds: 262)

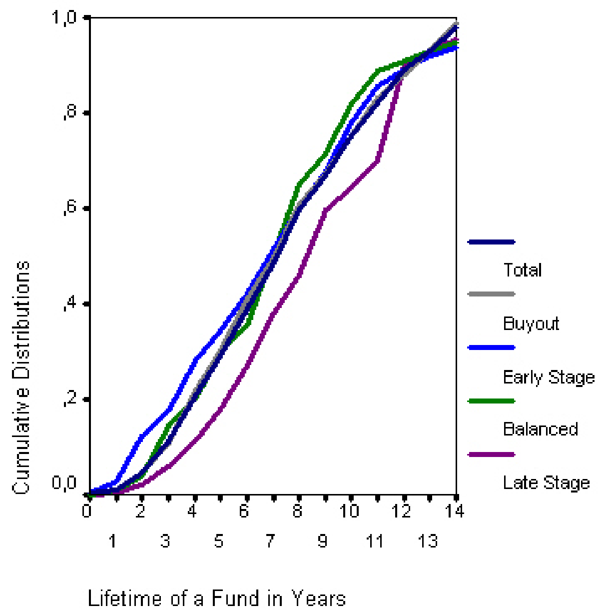

Figure 7: Time Pattern of Distributions by Funds' Stage (Sample II, Number of Funds: 262)

Two questions have been raised in the context of disbursements. First, what can be said about the typical time pattern of disbursements? Interestingly, from figure 6 it follows that average disbursements are distributed almost uniformly over a fund's lifetime. This is true, at least, if we ignore the relatively small distributions funds disburse in their first year and after the year 12 of their lifetime. In fact, our calculations show that 53% of total disbursements are paid out within the first seven years.

However, this uniform distribution does not hold for the single fund stages as can be seen from figure 7. In fact, for later-stage funds it takes much longer to achieve a 50% distribution ratio compared with the average fund in our sample.

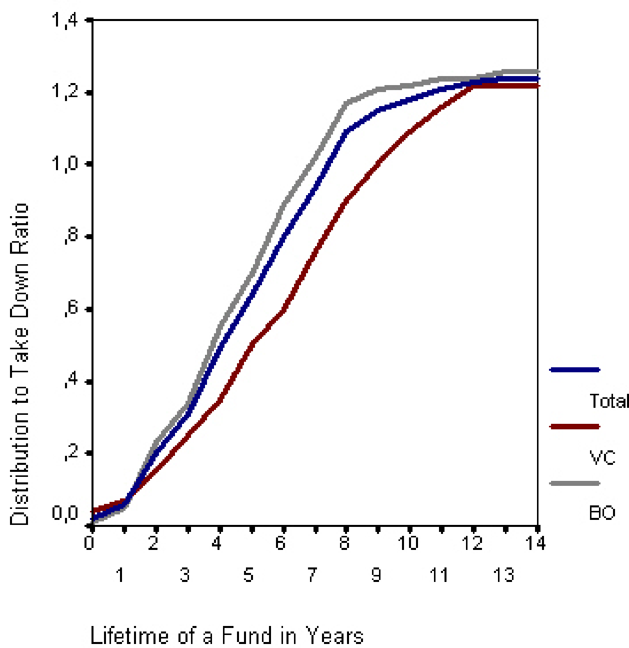

Figure 8: Value Weighted Average Payback Period (Sample II, Number of Funds:262)

The second question regarding disbursements is even more important for investors in private equity funds and relates to the payback issue. In fact, from a liquidity oriented perspective it may be very interesting to have an idea how long it takes on average to get back the money from a private equity investment. It is very interesting to see from figure 8 that for a European private equity fund investor, it takes 7.5 years to get the money back. Ljungqvist/Richardson (2002) report that for US private equity funds the payback period is slightly below seven years. It should be noted that this is the payback period an investor faces, if he allocates his money according to the size of single funds. Moreover, we can see that buyout funds have a lower payback period than venture capital funds. [11]

Finally, to answer the fourth question raised in the context of cash flow patterns, we investigate whether the payback period is really different depending on a fund's size. As one can see from figure 9 it is not clear, at least at a first glance, whether the payback behaviour is significantly different for different fund size brackets. In fact, a statistical analysis reveals that the partial correlation coefficient between these two variables is negative, but statistically not significantly different from zero. Hence, we have to conclude that the payback pattern does not depend on fund size.

Another question in this context is, whether payback pattern changed over time. Here it is presumed that funds with vintage years in the 1990s had shorter payback periods as they had better exit opportunities than funds founded during the eighties or even earlier. This is corroborated by figure 10, which indicates that the payback has become shorter the later the fund has been founded. In fact, the correlation coefficient between these two variables is -0.5 and statistically highly significant.

[11] We analyzed the payback period for our three data samples in detail, which is shown in table 4. Furthermore we examined the cash flow pattern of all 777 funds, which yields us to an average value weighted payback period of 7.4 years and identical cash flow patterns.

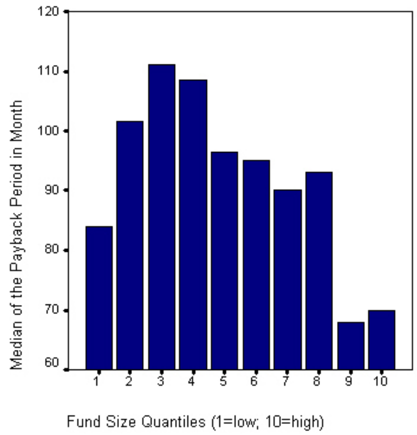

Figure 9: Fund Size and Payback Period (Sample I, Number of Funds: 200)

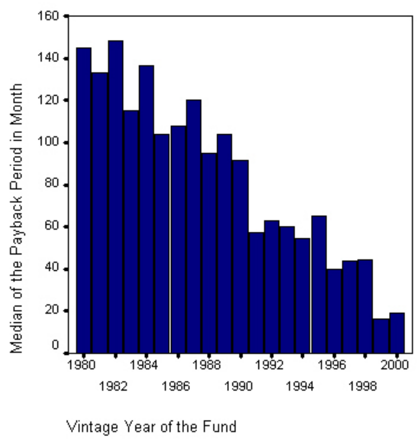

Figure 10: Vintage Year of the Funds and Payback Period (Sample I, Number of Funds: 200)

5 Assessing the Risk-/Return-Characteristics of Private Equity Funds

It has already been mentioned that a private equity investment can be undertaken directly or indirectly via a private equity fund. Therefore, risk-/return-characteristics of private equity investments can basically be defined from two different perspectives, either if we assess the return distribution of a company's specific investment or if we assess the return distribution of an investment in a private equity fund. As far as risk management issues are concerned the first perspective is especially relevant from the viewpoint of a General Partner, as he is supposed to make congruent decisions with respect to the allocation of capital to portfolio firms. The second perspective is relevant for a private or institutional investor who considers acting as a limited partner, i.e. to invest money in a private equity fund. Hence, when talking about return distributions one should make clear as to what kind of return processes he is referring to: returns generated at the level of a single portfolio company or returns generated at the level of a private equity fund.

As already mentioned, in this study we are focussing on return distribution at the fund level. From an economic point of view, the most important characteristic of private equity investments are the missing or highly imperfect secondary markets. As a consequence, for any single fund investment there are only a few points in time for which transaction prices can be observed: when limited partners pay in their capital and when the investment is liquidated. Usually, such transactions do not happen very frequently. As a consequence, no intermediate series of historical returns is available and, hence, estimating the performance of a private equity fund becomes a difficult issue. It is well known that there are at least two solutions in this regard.[12] The first is to estimate a private equity fund's return on the basis of net asset values (NAV). The basic problem is that net asset values are subject to valuation biases and, hence, returns estimated on this basis will be biased as well.

The idea of the approach followed in this paper is to circumvent these problems by inferring the private equity fund's return only on the basis of its cash flow history. In this way one could presume that an unbiased return estimation will be possible. However, even under this approach serious

[12] A detailed summary with respect to the solutions proposed in the literature can be found in Kaserer/Wagner/Achleitner (2004).

methodological problems will arise. They are discussed in the following sections.

5.1 The Cash Flow Based IRR as a Return Measure

It is often argued that the return on a private equity investment should be measured by using a value weighted return measure, i.e. the internal rate of return (IRR). The IRR gives the discount rate that makes the present value of all cash flows equal to zero. Mathematically, the IRR can be expressed as the solution to the following equation:

$$\sum_{t=0}^{T} CF_t \left(1 + IRR\right)^{-t} = 0$$

Here T is the lifetime of the fund and CF_t is the cash flow accrued over period t. The rationale behind this is the following. A value weighted return is heavily influenced by the time pattern of cash flows on which its calculation is based, while a time weighted return is defined as being independent of this time pattern.[13] If a fund manager is interested in assessing the performance of an open-end public market investment fund, he will not have control over time patterns of cash flows and his performance should be measured on the basis of a time weighted return. In fact, this is what is done in quoted mutual funds open to retail and institutional investors.

Things can be different, if one looks at a private equity fund. It could be argued that the general partner of such a fund has, at least to a certain extent, control over the time pattern of cash flows. If this is the case, it is asserted, his performance should be measured on the basis of a value-weighted return. This, however, is not correct as it is well-known that the IRR is not a return measure. In fact, a fund A may have a higher IRR than a fund B but at a given discount rate nevertheless a lower net present value. This is due to the fact that the IRR-method assumes cash flows generated by an investment to be reinvested at the IRR. This is obviously not a purposeful reinvestment assumption. Specifically, as far as an investment in a private equity fund is concerned, the limited partner may be interested to know the terminal wealth of his investment relative to the terminal wealth of a risk

[13]It should be noted that a time weighted return over a period of length T is simply the geometric mean of the single period return realizations; a value-weighted return can be regarded as a weighted average of these returns.

equivalent public market investment. Evidently, the IRR cannot be used for answering this question. Moreover, it will be shown that even a corrected IRR, like the excess-IRR, i.e. the difference between the IRR and the return generated on a public market investment, is unable to answer this question. In fact, we will show that the excess-IRR is systematically biased. This is why we stick to another performance measure that we call the public market equivalent. It is explained in the following section.

5.2 The Cash Flow Based PME as a Return Measure

The PME approach starts from the following simple question: Given that the investor invests – in terms of present value – Euro 1 in a private equity fund, how many Euros would he have to invest in a given public market index in order to generate a cash flow equivalent investment and, hence, in order to end up with the same terminal wealth? The PME is exactly the answer to this question. It is nothing else than the ratio of the terminal wealth obtained when investing in a private equity fund and reinvesting intermediate cash flows in a given public market benchmark compared to the terminal wealth obtained when investing the same amount of money in the benchmark. In this way a complete performance ranking of all available funds is possible. Mathematically, the PME is defined as follows:

$$PME = \frac{\sum_{t=1}^{T} cf_t \prod_{i=t+1}^{T}(1+R_{Ii})}{\prod_{t=1}^{T}(1+R_{It})}$$

Here, R_{It} is the net return of a public market index in period t, while cf_t is the normalized positive cash flow (distribution) of the private equity fund in period t.[14] As we can only observe the returns on a market index that are gross of management fees, we will make the following correction in this study: For an equity index we assume management fees to be equal to 50bp per year, while for a bond index these fees are assumed to be equal to 20 bp. Hence, the net yearly return is equal the gross yearly return, as indicated by the index performance, times 0.995 and times 0.998 respectively.

[14]In this context, positive cash flows are normalized by dividing every single positive cash flow accruing in period 1 or later with the present value of all investments, i.e. the present value of all negative cash flows. In this way the cash flows are normalized to an initial investment with a present value of Euro 1.

One last methodological remark with respect to this example should be made. From an investor's viewpoint the most important question is, of course, whether a private equity investment has a higher expected return than a public market investment. It should be noted that this question can be answered in two different ways. First, one can compare the public and the private investment on the basis of the PME. Second, the out-performance of private equity can be calculated as the average of a return difference. In this case one calculates first the cross-sectional average performance of all the funds on the basis of their terminal wealth. This average return is then compared with the average of all public market investment returns that could have been realised as an alternative to the private equity investment. It should be noted that the ranking obtained under both alternatives can be different. This may be quite surprising. It is due to the fact that the PME is an average return ratio while the second method corresponds to an average return difference. In general, an investor would be more interested in estimating the return difference of two different investment alternatives, as this difference indicates the gain – or loss – in wealth per Euro invested when realising one strategy instead of the other. For this reason we do not stop with calculating the PME. Instead we use it for deriving a result with respect to the return difference between a private equity fund investment and a specific public market investment. This is done as follows.

In order to transform the PME into an expected return we introduce the following definitions:

$$\tilde{R_{It}} = \frac{\tilde{I_t}}{\tilde{I_{t-1}}} - 1$$

Here, I_t is the period t value of the public market performance index used for reinvesting private equity cash flows.

$$\tilde{y_t} = \ln\left(1 + \tilde{R_{It}}\right)$$

Note, that a tilde indicates that we have to deal with a random variable. If the period is set equal to one year, y is the continuously compounded rate of return on a public market investment. According to our definitions the return of a private equity fund over its whole lifetime can be written as:

$$\frac{\tilde{W_T}}{W_0} = \exp\left[\sum_{t=1}^{T} \tilde{y}_t\right] \cdot P\tilde{M}E$$

Here, it should be noted that the left hand side of the preceding equation gives the terminal wealth of a Euro 1 private equity investment. The first expression on the right hand side gives the terminal wealth of a Euro 1 investment in the public market instrument. According to our definition of the PME, we need a public market investment of $PME{\cdot}Euro1$ in order to end up with the same terminal value as with the private equity fund. Therefore, the right hand side has to be multiplied with PME. Now, by defining

$$\tilde{x} = \frac{1}{T} \ln\left(\frac{\tilde{W_T}}{W_0}\right)$$

and using the definition of the total private equity return in the equation before we get:

$$\tilde{x} = \frac{1}{T}\left(\sum_{t=1}^{T} \tilde{y}_t + \ln P\tilde{M}E\right)$$

Assuming y and x to be identically and independently distributed (iid) the expected continuously compounded yearly returns can be derived as follows:

$$E\left[\tilde{y}_t\right] = \mu_y$$
$$E\left[\tilde{x}\right] = \mu_y + E\left[\frac{1}{T}\ln P\tilde{M}E\right] = \mu_x$$

Taking into account that σ_y and σ_x defines the standard deviation of the random variables x and y, the expectation of the yearly compounded rate of return is defined as follows:

$$E\left[\tilde{R_{It}}\right] = \exp\left[\mu_y + \frac{1}{2}\sigma_y^2\right] - 1$$
$$E\left[\frac{\tilde{W_t}}{W_{t-1}} - 1\right] = E\left[\tilde{R_{PEt}}\right] = \exp\left[\mu_x + \frac{1}{2}\sigma_x^2\right] - 1$$

5.3 Risk Characteristics of Cash Flow Based Returns

As far as the IRR-measure is concerned, risk characteristics can simply be derived from calculating distributional parameters. For this purpose we will present the most common parameters used in the literature. These are the average, the median, the standard deviation, as well as the highest and lowest realised IRRs.

For the PME the same distribution parameters can be calculated. However, we will be more interested in inferring the risk characteristics of private equity returns calculated on the basis of the PME approach. Under the already introduced assumption that x and y are iid it follows:

$$Var\left[\tilde{y}_t\right] = \sigma_y^2$$
$$Var\left[\tilde{x}\right] = \sigma_y^2 + Var\left[\tfrac{1}{T}\ln P\tilde{M}E\right] + 2Cov\left[\tilde{y}, \tfrac{1}{T}\ln P\tilde{M}E\right] = \sigma_x^2$$

From this it follows that the variance of the periodic yearly returns is calculated as follows:

$$Var\left[\tilde{R_{It}}\right] = \exp\left[2\mu_y + \sigma_y^2\right]\left(\exp\left[\sigma_y^2\right] - 1\right)$$
$$Var\left[\tilde{R_{PE}}\right] = \exp\left[2\mu_x + \sigma_x^2\right]\left(\exp\left[\sigma_x^2\right] - 1\right)$$

Finally, it should be noted that under this approach it follows that the correlation coefficient of the continuously compounded yearly returns of a private equity investment and a public market investment is defined as follows:

$$corr\left[\tilde{x}, \tilde{y}\right] = \frac{\sigma_y}{\sigma_x} + \frac{Cov\left[\tilde{y}, \frac{1}{T}\ln P\tilde{M}E\right]}{\sigma_x \cdot \sigma_y} = \rho_{xy}$$

5.4 Correlation Characteristics of Different Reinvestment Hypotheses

In the preceding sections we did not make any specific assumptions with respect to the public market instrument, which is used for reinvesting a private equity fund's cash flows. For our empirical analysis we have, of course, to make specific assumptions with respect to the instruments used. For this purpose we will allow for two different strategies:

1) Cash flows are reinvested in the MSCI Europe Equity Index,

2) Cash flows are reinvested in the J.P. Morgan European Government Bond Index.

Given this, the following two additional questions arise with respect to the correlation structure of the private equity investment: First, assuming that alternative 1) is realised, what is the correlation structure of the private equity investment return with the bond market? Second, assuming that alternative 2) is realised, what is the correlation structure of the private equity investment return with the equity market? The answers can be given in the context of the PME-approach presented here. In order to make things precise, let us assume that the formula introduced in the two preceding sections refer to alternative 1), i.e. a reinvestment in a public equity market index. If, instead, we would like to refer to alternative 2), i.e. a reinvestment in a public bond market index, we introduce the following formula:

$$\tilde{z}_t = \ln\left(1 + \tilde{R_{Bt}}\right)$$

Here, R_{Bt} is the return on the bond index in period t. The return of a private equity fund over its whole lifetime is then written as:

$$\frac{\tilde{W_T}}{W_0} = \exp\left[\sum_{t=1}^{T} \tilde{z}_t\right] \cdot B\tilde{M}E$$

with BME defined as the public bond market equivalent:

$$BME = \frac{\sum_{t=1}^{T} cf_t \prod_{i=t+1}^{T}(1+R_{Bi})}{\prod_{t=1}^{T}(1+R_{Bt})}$$

Now, the total private equity return realised under alternative 2) can be written as:

$$\tilde{x_B} = \frac{1}{T}\left(\sum_{t=1}^{T}\tilde{z}_t + \ln B\tilde{M}E\right)$$

Assuming x_B and z to be identically and independently distributed (iid) expected continuously compounded yearly returns can be derived as follows:

$$E\left[\tilde{z}_t\right] = \mu_z$$
$$E\left[\tilde{x_B}\right] = \mu_z + E\left[\frac{1}{T}\ln B\tilde{M}E\right] = \mu_{x_B}$$

Taking into account that σ_z and σ_{x_B} defines the standard deviation of the random variables z and x_B, the expectation of the yearly compounded rate of return is defined as follows:

$$E\left[\tilde{R_{Bt}}\right] = \exp\left[\mu_z + \frac{1}{2}\sigma_z^2\right] - 1$$
$$E\left[\frac{\tilde{W}_t}{W_{t-1}} - 1\right] = E\left[\tilde{R_{PEt}}\right] = \exp\left[\mu_{x_B} + \frac{1}{2}\sigma_{x_B}^2\right] - 1$$

Under the already introduced assumption that x_B and z are iid it follows:

$$Var\left[\tilde{z}_t\right] = \sigma_z^2$$
$$Var\left[\tilde{x_B}\right] = \sigma_z^2 + Var\left[\frac{1}{T}\ln B\tilde{M}E\right] + 2Cov\left[\tilde{z}, \frac{1}{T}\ln B\tilde{M}E\right] = \sigma_{x_B}^2$$

From this it derives that the variance of the periodic yearly returns is calculated as follows:

$$Var\left[\tilde{R_{Bt}}\right] = \exp\left[2\mu_z + \sigma_z^2\right]\left(\exp\left[\sigma_z^2\right] - 1\right)$$
$$Var\left[\tilde{R_{PE}}\right] = \exp\left[2\mu_{x_B} + \sigma_{x_B}^2\right]\left(\exp\left[\sigma_{x_B}^2\right] - 1\right)$$

The correlation coefficient of the continuously compounded yearly returns of a private equity investment and a public bond market investment is defined as follows:

$$corr\left[\tilde{x_B}, \tilde{z}\right] = \frac{\sigma_z}{\sigma_{x_B}} + \frac{Cov\left[\tilde{z}, \frac{1}{T}\ln B\tilde{M}E\right]}{\sigma_{x_B}\cdot\sigma_z} = \rho_{x_B z}$$

Finally, for the correlation structures of private equity returns under alternative 1) with the public equity market returns and of private equity returns under alternative 2) with the public bond market returns it follows:

$$corr\left[\tilde{x}, \tilde{z}\right] = \rho_{yz}\frac{\sigma_y}{\sigma_x} + \frac{Cov\left[\tilde{z}, \frac{1}{T}\ln P\tilde{M}E\right]}{\sigma_x\cdot\sigma_z} = \rho_{xz}$$
$$corr\left[\tilde{x_B}, \tilde{y}\right] = \rho_{yz}\frac{\sigma_z}{\sigma_{x_B}} + \frac{Cov\left[\tilde{y}, \frac{1}{T}\ln B\tilde{M}E\right]}{\sigma_{x_B}\cdot\sigma_y} = \rho_{x_B y}$$

6 Empirical Results

6.1 Results with Respect to IRR

In this section we present the results that have been obtained with respect to IRRs. Initially we present in figure 11 the result obtained with respect to NAV based IRRs (IRR (NAV)). This figure is directly taken from TVE, without further examination towards accuracy from our side. As one can see, funds with vintage years after 1997 have performed unsatisfactory on the basis of the IRR (NAV). Evidently, this is due to a decline in market prices since 2000 and the induced pressure to decrease the book values of portfolio companies. Additionally, the J-curve phenomenon may be responsible for the negative IRR (NAV) of the funds founded in the years 2000 till 2003.

Moreover, there is a second effect that can be seen from figure 11. Funds with vintage years 1992 to 1997 performed rather well on the basis of the IRR (NAV). By restricting our sample to liquidated funds only we create a downward bias, as one can assume that several funds with vintage years belonging to this period are not yet liquidated. This is an important motivation for increasing the data universe according to the method described in the preceding chapter. In this way we would include more funds with vintage years in the nineties in our sample. Simultaneously we can control for the selection bias by integrating only funds with small relative residual asset values.

The private equity fund performance on the basis of IRR (CF) becomes visible in Table 4. As already described in section 3.2, we extended the

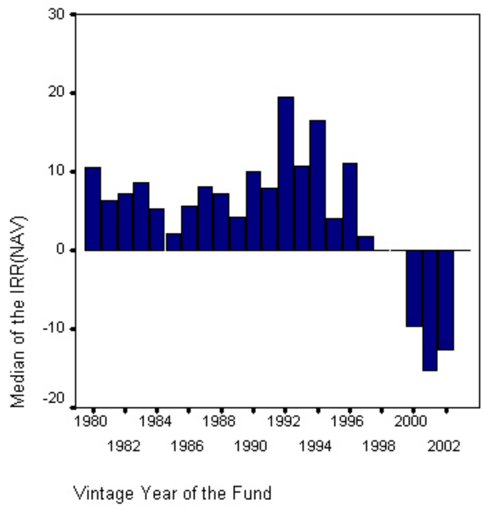

Figure 11: Average IRR(NAV) by Vintage Year (Number of Funds: 777)

data universe by generating samples I and II on top of the sample consisting of liquidated funds only. It should be noted that venture capital as well as buyout funds have almost identical weights by number of funds in our samples.

According to what has been said previously, the IRRs (CF) of samples I and II are perceivably higher than the IRR (CF) of the sample consisting of liquidated funds. In fact, starting with an IRR (CF) of 10% for the liquidated sample we reach an IRR (CF) of 13% for sample I and 14% for sample II. These figures are slightly lower than the results of Kaplan/Schoar (2003) for the US-market, as they report an average IRR of 17%. For buyout funds they report an IRR of 18%, for venture capital funds of 17%. Also these results are slightly higher than ours, as one can see in Table 4. Simultaneously, the standard deviation of the IRRs increases significantly when expanding the data universe. Our method to include well performing as well as bad performing funds in the sample, has a positive net effect and drives the IRR upward. It also should be noted that the average payback in all the three different sub-samples is about 90 months or 7.5 to 7.8 years. This is nearly the same than the value-weighted average payback period of the total sample.

Table 5 reports the excess IRR (CF) of different sub-samples. This excess return is defined as the IRR (CF) of a single fund minus the IRR of the MSCI Europe index realised over the lifetime of the fund. For the cross-sectional statistics that are reported here, one can see, that in most of the cases the excess IRRs are positive.

IRR and Payback	IRR(CF)			Payback in Month		
	VC	BO	Total	VC	BO	Total
Liquidated Funds						
Average	7.32%	12.64%	10.01%	108.53	83.63	94.62
Median	4.77%	9.79%	7.28%	110.00	84.50	95.50
75th Percentile	12.98%	18.67%	14.24%	143.50	113.75	120.50
25th Percentile	-4.00%	8.23%	0.00%	87.50	62.25	66.50
Min	-12.12%	-13.66%	-13.66%	32.00	21.00	21.00
Max	103.73%	88.05%	103.73%	215.00	139.00	215.00
Stdev	17.82%	17.67%	17.85%	41.38	33.61	38.99
Sample I						
Average	12.00%	13.39%	12.69%	102.79	78.38	90.35
Median	8.05%	10.80%	9.14%	104.00	70.00	90.00
75th Percentile	15.65%	18.76%	17.13%	127.50	106.75	118.50
25th Percentile	1.90%	9.00%	4.45%	74.50	54.25	61.50
Min	-13.56%	-13.66%	-13.66%	16.00	20.00	16.00
Max	153.91%	88.05%	153.91%	215.00	169.00	215.00
Stdev	22.06%	16.18%	19.34%	41.90	33.94	39.86
Sample II						
Average	12.50%	15.63%	14.07%	99.58	81.48	90.09
Median	7.40%	11.00%	9.56%	96.50	71.00	84.00
75th Percentile	16.31%	19.95%	18.17%	127.00	108.75	118.00
25th Percentile	0.00%	1.69%	0.05%	69.50	54.25	60.75
Min	-13.56%	-13.66%	-13.66%	16.00	18.00	16.00
Max	181.90%	133.25%	181.90%	215.00	200.00	215.00
Stdev	24.95%	20.59%	22.89%	42.84	37.35	40.97

Table 4: Size, IRR(CF) and Payback Period of our Samples by Different Fund Types

Excess-IRR of MSCI Europe	VC	BO	Total
Liquidated Funds			
Average	-2.27%	3.37%	0.58%
Median	-4.17%	-0.77%	-2.70%
75th Percentile	1.76%	9.47%	5.21%
25th Percentile	-10.84%	-7.08%	-9.21%
Min	-22.24%	-24.00%	-24.00%
Max	90.99%	84.13%	90.99%
Stdev	17.41%	19.14%	18.42%
Number of Ob.	47	48	95
Sample I			
Average	3.62%	5.29%	4.45%
Median	-1.37%	1.57%	0.61%
75th Percentile	5.94%	12.56%	10.24%
25th Percentile	-8.02%	-6.17%	-7.32%
Min	-22.24%	-24.00%	-24.00%
Max	169.35%	84.13%	169.35%
Stdev	24.27%	17.16%	21.01%
Number of Ob.	101	99	200
Sample II			
Average	5.10%	8.25%	6.68%
Median	0.64%	3.53%	1.71%
75th Percentile	8.22%	12.87%	11.23%
25th Percentile	-6.99%	-5.04%	-5.92%
Min	-22.24%	-20.00%	-22.24%
Max	176,0%	127.00%	176.00%
Stdev	25.07%	20.63%	22.96%
Number of Ob.	131	131	262

Table 5: Excess-IRR(CF) of MSCI Europe

Excess-IRR of J.P.M. Govt.	VC	BO	Total
Liquidated Funds			
Average	0.93%	6.55%	3.77%
Median	-2.92%	3.33%	0.95%
75th Percentile	6.67%	13.34%	7.51%
25th Percentile	-7.46%	-5.08%	-6.18%
Min	-18.19%	-19.86%	-19.86%
Max	98.13%	85.04%	98.13%
Stdev	17.96%	18.05%	18.13%
Number of Ob.	47	48	95
Sample I			
Average	4.69%	6.23%	5.45%
Median	0.70%	3.26%	1.24%
75th Percentile	7.89%	12.87%	10.94%
25th Percentile	-6.31%	-5.81%	-5.89%
Min	-21.72%	-19.86%	-21.72%
Max	147.40%	85.04%	147.40%
Stdev	22.12%	16.30%	19.42%
Number of Ob.	101	99	200
Sample II			
Average	5.15%	8.25%	6.70%
Median	0.59%	3.48%	1.64%
75th Percentile	10.49%	13.42%	12.51%
25th Percentile	-7.65%	-4.73%	-6.76%
Min	-21.72%	-24.00%	-24.00%
Max	187.00%	134.00%	187.00%
Stdev	27.07%	21.69%	24.53%
Number of Ob.	131	131	262

Table 6: Excess-IRR(CF) of the J.P.M. European Govt. Bond Index

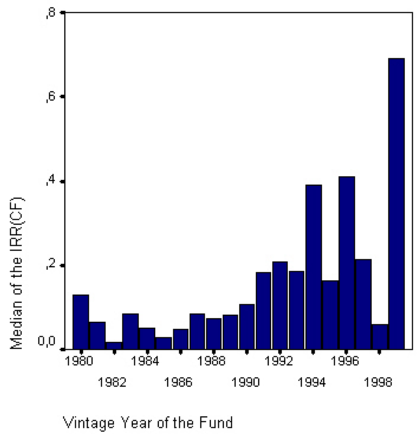

Figure 12: IRR(CF) by Vintage Year, Sample I

Moreover, buyout funds seem to have consistently higher IRRs than venture capital funds. A similar picture is presented in table 6 where the excess returns are given with respect to the J.P. Morgan Government Bond index. The IRRs of different vintage years can be inferred from figure 12. One can presume, funds that have been founded later have, on average, a higher IRR. The correlation coefficient of both variables is 0.4 and statistically highly significant.

A further aspect to look at is whether the IRR (CF) is different depending on the size of the fund. Based on the data presented in figure 13 no clear-cut answer to this question is possible. However, by calculating the coefficient of correlation one can see that this is positive and statistically highly significant. Hence, as far as the IRR (CF) is concerned we have to conclude that fund size has a positive impact on performance.

Additionally, it seems intriguing to find out if the structure of cash flows is related to performance measured in terms of IRR (CF). One would presume that well performing funds should be able to return the money earlier to investors and, hence, that there should be a negative association between the IRR (CF) and the length of the payback period, as it is indicated in figure 14. Moreover, the correlation coefficient between the two variables is negative and highly significant.

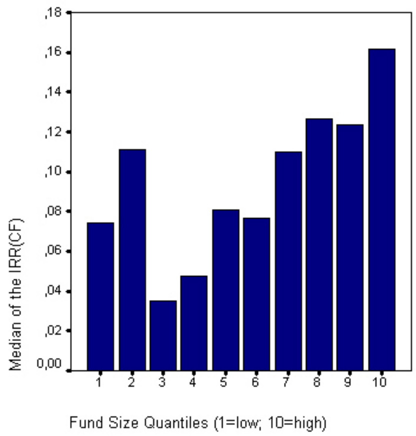

Figure 13: IRR(CF) by Fund Size, Sample I

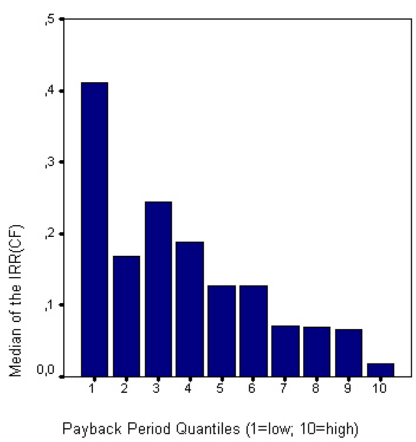

Figure 14: IRR(CF) by Payback Period, Sample I

6.2 PME Based Performance Characteristics

The PME-based performance measures have already been introduced under 5.2. In this section we will present the empirical results with respect to the PME and BME as well as with respect to the index and private equity funds' returns R_I, R_B and R_{PE}. We have chosen two different alternative indexes for calculating the public market equivalent. First, we used a public equity index, specifically the MSCI Europe index.[15] Alternatively we used a public bond index. As we are performing a European study we decided to use a European government bond index, specifically we opted for the J.P. Morgan European Government Bond Performance Index. However, this index is only available back to 1993. As we need a longer index history we used the REXP index for periods from 1993 backwards.[16]

Finally, we would like to emphasize again that we assumed the index investment not to be free of cost. This is necessary as otherwise a comparison between private equity returns, which are net of management fees, and public market index returns, which basically assume cost free investing, would be biased against the private equity industry. Of course, it is difficult to make a precise assessment of transaction costs, including management fees, associated with an investment in a public equity or bond market. These costs may differ from country to country as well as from investor to investor. Therefore, we finally agreed to assume transaction costs of 50bp per year for a public equity investment and 20bp for a public bond investment.

Having said this we can now present our results. First of all, table 7 gives the distribution of pooled PME and BME for our three different sample definitions as well as different fund types. The pooled PME is calculated as the cross sectional average of all PE funds included in the sample. The average PME is only larger than one for sample II, while the value-weighted average is larger than one for sample I and II. Moreover, we can see that there are obviously some good performing funds with very high PMEs, but also some poor performers with PMEs close to zero. Also the standard deviation is rather high. Table 8 shows the time-series PME and BME which are computed on the basis of annually average PMEs. In general, the results

[15]We did not opt for one of the STOXX indexes, as they are available only back to 1986. The MSCI Europe has a much longer history. However, one can imagine that both indexes are highly correlated.

[16]The REXP is a performance index of German treasury bonds over the whole maturity range.

for the time series PME are higher than for the cross sectional PME. In the following section, we use the time-series distributional parameters for calculating the return and risk characteristics of private equity.

Again we have to question whether the performance of the sample funds is different among different size brackets. Figure 15 gives the impression that there is no relationship between size and performance measured in terms of the PME. In fact, this is also true from a statistical point of view, as no significant correlation can be detected between these two variables.

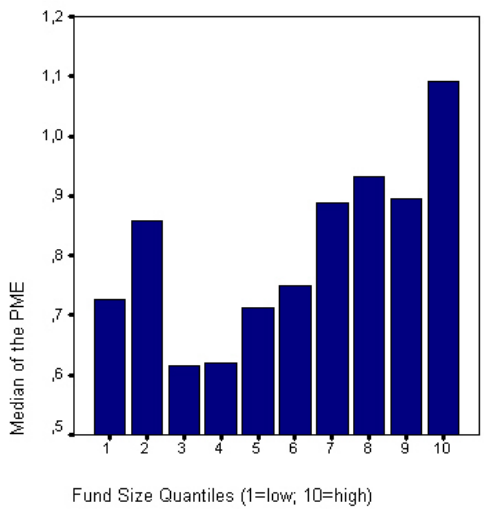

Figure 15: PME and Fund Size, Sample I

As far as the relationship of the PME with the vintage year is concerned figure 16 gives a seemingly clear picture: the later the vintage year, the higher the PME on average. This is also true from a statistical point of view as there is a significant positive correlation between these two variables. This corroborates the view that private equity funds with vintage years during the nineties performed especially well.

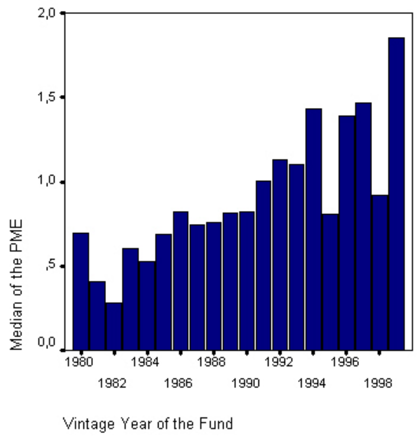

Figure 16: PME and Vintage Year, Sample I

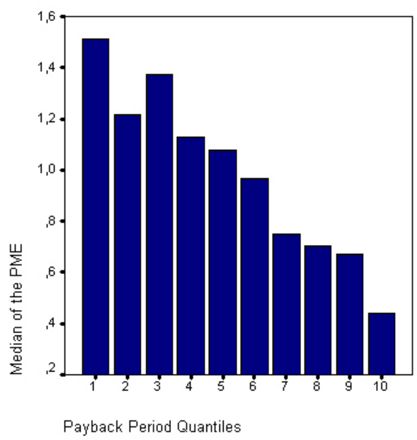

Figure 17: PME and Payback Period, Sample I

	PME			BME		
	VC	BO	Total	VC	BO	Total
Liquidated Funds						
Average	0.82	0.90	0.86	1.11	1.07	1.09
Median	0.68	0.89	0.80	0.81	1.09	0.99
75th Percentile	0.97	1.24	1.10	1.38	1.37	1.38
25th Percentile	0.33	0.51	0.42	0,54	0.64	0.58
Min	0.07	0.06	0.06	0.07	0.09	0.07
Max	6.97	2.79	6.97	10.45	2.95	10.45
Stdev	1.01	0.53	0.81	1.51	0.60	1.14
Value-weighted			0.94			1.21
Sample I						
Average	0.98	0.94	0.96	1.14	1.24	1.20
Median	0.75	0.86	0.82	1.06	1.02	1.03
75th Percentile	1.17	1.24	1.23	1.44	1.43	1.43
25th Percentile	0.40	0.59	0.51	0.66	0.63	0.66
Min	0.01	0.06	0.01	0.02	0.09	0.02
Max	6.97	2.79	6.97	10.45	2.95	10.45
Stdev	1.15	0.51	0.89	1.02	0.59	1.11
Value-weighted			1.04			1.27
Sample II						
Average	1.01	1.06	1.03	1.25	1.21	1.23
Median	0.76	0.92	0.85	0.99	1.13	1.07
75th Percentile	1.22	1.35	1.27	1.27	1.42	1.45
25th Percentile	0.44	0.61	0.55	0.60	0.77	0.66
Min	0.01	0.06	0.01	0.02	0.09	0.02
Max	7.27	4.61	7.27	10.45	5.27	10.45
Stdev	1.15	0.70	0.95	1.38	0.74	1.10
Value-weighted			1.16			1.30

Table 7: Pooled PME and BME of Private Equity Funds by Sample Definitions

	PME			BME		
	VC	BO	Total	VC	BO	Total
Liquidated Funds						
Average	0.86	1.02	1.04	1.23	1.25	1.38
Median	0.63	1.02	0.82	0.80	1.23	1.02
Min	0.28	0.58	0.28	0.52	0.73	0.61
Max	3.03	1.74	3.03	4.39	1.82	4.39
Stdev	0.72	0.40	0.66	1.02	0.38	0.87
Sample I						
Average	1.20	0.95	1.15	1.14	1.36	1.19
Median	0.82	0.92	0.87	1.12	1.21	1.20
Min	0.28	0.62	0.28	0.21	0.84	0.21
Max	4.56	1.41	4.56	2.37	2.95	1.72
Stdev	1.09	0.25	0.98	0.43	0.54	0.32
Sample II						
Average	1.14	1.08	1.09	1.32	1.20	1.26
Median	0.81	0.96	0.88	1.15	1.13	1.17
Min	0.28	0.62	0.28	0.61	0.55	0.61
Max	3.82	1.84	2.82	2.86	1.82	2.38
Stdev	0.90	0.35	0.63	0.68	0.39	0.46

Table 8: Time Series PME and BME of Private Equity Funds by Sample Definitions

Finally, we investigated if the structure of cash flows is related to performance measured in terms of PME. One would presume that well performing funds should be able to return the money earlier to investors and, hence, there should be a negative association between the PME and the length of the payback period. This is, in fact, true and is visualised in figure 17. Moreover, the correlation coefficient between the two variables is negative and highly significant.

As a second step we calculated the private equity returns R_{PE} based on the PME approach. It should be noted here that only time series-based distributional parameters with respect to PME can be used. They have been presented in table 8. As shown in table 9 to table 12 the average yearly return of an investment in the MSCI Europe was 14.12% over the period 1980-2003 with a standard deviation of 18.85%. Assuming a risk free interest rate of 3% the Sharpe ratio reaches 59.00%. The expected PME-based return of a private equity investment during this period was 13.40% for the sample of liquidated funds, 14.67% for the extended sample I and 13.50% for the extended sample II. The standard deviation is in a close range of 18% to 19%. For this reason, and taking into account that the return difference of private equity for liquidated funds and sample II is negative with respect to public equity, the Sharpe ratios for the private equity funds are distinctly lower than for the diversified public equity market investment. Only sample I has a higher return as well as a higher Sharpe ratio than the public markets. Finally, the PME-based correlation coefficient between the private equity and the public equity returns are, depending on the sample definition, between 0.96 and 0.84. Given the definition of the investment strategy, this is not surprising as distributions are reinvested in the public market index.

An alternative to this is that cash flows generated by private equity funds are reinvested in a public bond market index. For that purpose we used the J. P. Morgan European Government Bond Performance Index chained up with the REXP Index in order to cover periods backward from 1993. The results are presented in the tables below. The average government bond index return over the period 1980 to 2003 was 7.98% with a standard deviation of 4.10%. This leads to a Sharpe ratio of 121%. Compared the BME based private equity return under this reinvestment hypothesis is 9.57% for the sample of liquidated funds with a standard deviation of 6.70%. For sample extension I and II the rates of return are 8.41% and 8.60% with standard deviations of 5.59% and 5.63% respectively. Sharpe ratios are between 96 and 98% and therefore lower than for the public equity investment. Correlation coefficients with the bond market investment are between 59% and 74%.

From tables 12 and 13 one can see that the return difference between buyout and venture capital funds is rather small under the PME approach.

Finally, we once more presume that the private equity returns are higher for funds with later vintage years. For this purpose we recalculated the returns for the funds of our three samples, assuming that only funds with a vintage year starting from 1989 are considered. The results for sample II are presented in table 14. As one can see, our presumption is correct. This sub-sample of private equity funds now generates an overperformance also with respect to the public market index. This effect is also observable for the liquidated funds and still for sample I.

Sample: Liquidated Funds

J.P.M. European Govt. Index		**MSCI Europe**	
Historical Return	7.98%	Historical Return	14.12%
Standard Deviation	4.10%	Standard Deviation	18.85%
Sharpe Ratio	121.31%	Sharpe Ratio	59.00%
Private Equity		**Private Equity**	
Estimated Return	9.57%	Estimated Return	13.40%
Standard Deviation	6.70%	Standard Deviation	19.06%
Sharpe Ratio	98.07%	Sharpe Ratio	54.57%
Coefficient of Correlation	0.598	Coefficient of Correlation	0.960
(1) corr$[x, z]$	0.1885		
(2) corr$[x_B, y]$	0.0988		
corr$[y, z]$	0.2021		
Number of Ob.	95		

Table 9: PME and BME Based Private Equity and Public Market Returns (Liquidated Funds, 1980-2003)

Sample I

J.P.M. European Govt. Index		MSCI Europe	
Historical Return	7.98%	Historical Return	14.12%
Standard Deviation	4.10%	Standard Deviation	18.85%
Sharpe Ratio	121.31%	Sharpe Ratio	59.00%
Private Equity		**Private Equity**	
Estimated Return	8.41%	Estimated Return	14.67%
Standard Deviation	5.59%	Standard Deviation	19.21%
Sharpe Ratio	96.74%	Sharpe Ratio	60.77%
Coefficient of Correlation	0.745	Coefficient of Correlation	0.841
(1) corr$[x, z]$	0.2153		
(2) corr$[x_B, y]$	0.0739		
corr$[y, z]$	0.2021		
Number of Ob.	200		

Table 10: PME and BME Based Private Equity and Public Market Returns (Sample I,1980-2003)

Sample II

J.P.M. European Govt. Index		MSCI Europe	
Historical Return	7.98%	Historical Return	14.12%
Standard Deviation	4.10%	Standard Deviation	18.85%
Sharpe Ratio	121.31%	Sharpe Ratio	59.00%
Private Equity		**Private Equity**	
Estimated Return	8.60%	Estimated Return	13.50%
Standard Deviation	5.63%	Standard Deviation	17.88%
Sharpe Ratio	99.51%	Sharpe Ratio	58.71%
Coefficient of Correlation	0.742	Coefficient of Correlation	0.966
(1) corr$[x, z]$	0.2020		
(2) corr$[x_B, y]$	0.0910		
corr$[y, z]$	0.2021		
Number of Ob.	262		

Table 11: PME and BME Based Private Equity and Public Market Returns (Sample II, 1980-2003)

Sample I: Buyout Funds Only

J.P.M. European Govt. Index		**MSCI Europe**	
Historical Return	7.98%	Historical Return	14.12%
Standard Deviation	4.10%	Standard Deviation	18.85%
Sharpe Ratio	121.31%	Sharpe Ratio	59.00%
Private Equity		**Private Equity**	
Estimated Return	9.67%	Estimated Return	12.59%
Standard Deviation	5.68%	Standard Deviation	18.65%
Sharpe Ratio	117.55%	Sharpe Ratio	51.43%
Coefficient of Correlation	0.600	Coefficient of Correlation	0.993
(1) corr$[x, z]$	0.2121		
(2) corr$[x_B, y]$	0.1160		
corr$[y, z]$	0.2021		
Number of Ob.	99		

Table 12: PME and BME Based Private Equity and Public Market Returns (Sample I: Buyout Funds Only, 1980-2003)

Sample I: Venture Capital Funds Only

J.P.M. European Govt. Index		**MSCI Europe**	
Historical Return	7.98%	Historical Return	14.12%
Standard Deviation	4.10%	Standard Deviation	18.85%
Sharpe Ratio	121.31%	Sharpe Ratio	59.00%
Private Equity		**Private Equity**	
Estimated Return	7.60%	Estimated Return	15.17%
Standard Deviation	5.47%	Standard Deviation	19.29%
Sharpe Ratio	84.07%	Sharpe Ratio	63.07%
Coefficient of Correlation	0.771	Coefficient of Correlation	0.805
(1) corr$[x, z]$	0.2063		
(2) corr$[x_B, y]$	0.0933		
corr$[y, z]$	0.2021		
Number of Ob.	101		

Table 13: PME and BME Based Private Equity and Public Market Returns (Sample I: Venture Capital Funds Only, 1980-2003)

Sample II: Funds with a Vintage Year Later Than 1989

J.P.M. European Govt. Index		**MSCI Europe**	
Historical Return	7.84%	Historical Return	10.26%
Standard Deviation	4.57%	Standard Deviation	18.62%
Sharpe Ratio	105.90%	Sharpe Ratio	38.98%
Private Equity		**Private Equity**	
Estimated Return	10.10%	Estimated Return	12.50%
Standard Deviation	6.37%	Standard Deviation	18.10%
Sharpe Ratio	111.53%	Sharpe Ratio	52.47%
Coefficient of Correlation	0.714	Coefficient of Correlation	0.970
(1) corr$[x, z]$	0.1995		
(2) corr$[x_B, y]$	0.1500		
corr$[y, z]$	0.1748		
Number of Ob.	155		

Table 14: PME and BME Based Private Equity and Public Market Returns (Sample II,1989-2003)

7 Conclusion

The objective of this study was to infer risk and return characteristics of a European private equity fund investment from realized cash flows only. For that purpose a comprehensive data set has been provided by Thomson Venture Economics. We documented the typical time pattern of cash flows for European private equity funds. Specifically, it is recorded that the average European private equity fund draws down 23% of total commited capital on the vintage date; within the first three years 60% of the total commitment is draw down. It turned out that limited partners on average get back the money invested slightly after 7 years.

Over the time period from 1980 to June 2003, we calculated various performance measures. For that purpose we used only liquidated funds or funds with a small residual net asset value. Under this restriction one specific data set consists of 200 funds. We documented a cash flow based IRR of 12.7% and an average excess-IRR of 4.5% relative to the MSCI Europe equity index. In order to circumvent the problems associated with the IRR-approach we focused on the alternative public market equivalent approach. There it is assumed that cash flows generated by a private equity fund are reinvested in a public market benchmark index. We record an average PME of 0.96 and a value-weighted average PME of 1.04.

Based on the PME-approach we developed a viable methodology to estimate the return and risk characteristics of European private equity funds and the correlation structure to public markets. As a benchmark index we used the MSCI Europe Equity Index as well as the J.P.Morgan Government Bond Index. Over the period 1980-2003 private equity funds generated an overperformance with respect to the bond index and two of our three samples an underperformance with respect to the equity index. Over the period 1989-2003 private equity funds generated an overperformance with respect to both indexes.

Finally, we analyzed to what extent performance measures are associated with specific funds characteristics, like size, payback period and vintage year, respectively. While the payback period and the vintage year seem to have a statistically significant influence on a fund's performance, the results with respect to size are inconclusive.

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