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**Net Asset Value Discounts
in Listed Private Equity Funds**

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WORKING PAPER SERIES



**Center for Entrepreneurial and
Financial Studies**



Net Asset Value Discounts in Listed Private Equity Funds

Henry Lahr^{*†}, Christoph Kaserer^{*}

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Abstract: This paper investigates determinants and consequences of net asset value discounts in listed private equity funds. Listed private equity funds share characteristics of closed-end mutual funds and traditional unlisted private equity funds and can therefore offer insights into both. Our results have particular relevance to the pricing of unlisted private equity funds where no market prices are observable. We find that funds start at an initial premium of -2.5% and adapt to the long-term average of -21% after two years. Fund returns display a U-shaped seasonality, which is related to publishing dates of annual reports. Stock performance is exceptionally weak in buyout funds after their initial public offering. Premia predict future stock returns and are explained by liquidity and by investor sentiment, but not by the fund's investment degree. A decrease in premia over the first few quarters after the fund's IPO remains unexplained, which partially supports the management ability hypothesis. Private equity fund premia depend on credit markets and systematic risk. This relation suggests that some information about the fund's portfolio is not reflected in net asset values, which seem to proxy for future fund cash flows.

Keywords: Listed Private Equity, Private Equity, Venture Capital, Net Asset Value, Book-to-Market Ratio, Closed-end Fund Discount

JEL Classification Codes: G12, G14, G24

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1 Introduction

Since the emergence of exchange traded private equity¹ funds (listed private equity, LPE) as an asset class in the 1990's, these vehicles have constantly been trading at a discount to their respective net asset value (NAV). If listed private equity funds were similar to holding companies, they should trade at a premium on average. Historically, book-to-market ratios in stocks have been well below one (see, for example, Loughran (1997) and Kothari and Shanken (1997)). This translates into an average NAV premium for stocks, not into a discount. One can also view listed private equity funds as traded portfolios of unlisted companies. If this was the correct perspective, these funds would be more similar to mutual funds which also represent a portfolio, albeit of securities instead of unlisted shares. The cross-sectional average NAV discount in closed-end mutual funds is almost always positive and has been moving in the range between 5 % and 15 % over the past 20 years. (Cherkes et al. (2008), Dimson and Minio-Kozerski (1999)). During the same time, listed private equity funds showed an average discount to NAV of about 15 %.

This paper investigates the causes and consequences of discounts in listed private equity funds. We will refer to the ratio of market value to the fund's net asset value as its "premium". The importance of listed private equity funds is that they bridge the gap between closed-end mutual funds, unlisted private equity funds and listed holding companies. It is thus not immediately clear which theories apply. If premia could be successfully explained, our results would have implications for the pricing of private equity funds and in particular secondary transactions, since there are usually no market prices observable for traditional private equity funds.

We find many similarities between premia in listed private equity funds and closed-end funds but also several striking differences. LPE funds do not start with a premium like closed-end mutual funds but show a negative premium of -2.5 % instead. This premium takes about 2 years to adjust to the long-term average of -21 %. This behavior is very

¹We use the term "private equity" to refer to venture capital funds and buyout funds

similar to traditional private equity funds. Premia predict future stock returns, what we interpret as mean reversion following Pontiff (1995). We document a U-shaped seasonality in fund returns with higher-than-average returns in the first quarter and lower returns in the second and third. This pattern cannot be explained by the usual arguments involving tax effects to account for the January effect, but to a substantial extent by publication dates of annual reports.

The drop in NAV premia during the first two years cannot be explained directly by economic causes but has only small explanatory power. One likely reason why we observe decreasing premia is a market mechanism when participants learn about management ability, as proposed by Berk and Stanton (2007). Cash holdings can proxy for a fund's investment degree, which should provide some information about successful or unsuccessful portfolio acquisitions. The fund's investment degree has no significant effect on premia, which casts doubt on managerial ability being the only explanation for declining premia. Variables related to investor sentiment, on the other hand, offer some insight into cross-sectional and time-series properties of premia. Premia that are 10 % lower than in closed-end mutual funds across the board could be an indication of higher noise trader risk in listed private equity. Sensitivity to small-cap indices and proxies for hot markets lends further support to the investor sentiment hypothesis.

We find a positive relation between the fund's bid-ask spread and premia. Surprisingly, infrequently traded funds have exceptionally high premia. Private equity fund valuations seem to depend on credit markets, since premia are inversely related to the long-term credit spread between government and corporate bonds. Moreover, premia are higher in funds with low systematic risk, which suggests that systematic risk is not fully reflected in net asset values. Another new effect in listed private equity funds is the apparent underperformance of buyout funds following their IPO. Buyout funds exhibit premia that are 10–11 % lower than premia in other funds, which is almost entirely attributable to poor stock performance over their first few years of trading.

The remainder of the paper is organized as follows. In section 2, we review theories explaining fund premia and account for the specifics of private equity funds. We motivate the empirical analysis by combining theories from the closed-end fund literature with empirical phenomena in private equity funds. In section 3, we provide detailed information on private equity net asset values and variables used to estimate premia. In Section 4, we discuss the results on the predictability of fund returns and fund premia and their implications. Section 5 contains a summary and conclusions.

2 Premia in (private equity) funds

Several theories have been put forward to explain the difference between NAV and market price of a listed fund. On the one hand, the extant literature focuses on closed-end funds that invest in securities. The description as a “closed-end fund puzzle” in the literature highlights the difficulty of investigating NAV premia in these vehicles. On the other hand, there are private equity-specific explanations, which take account of the fact that private equity funds invest in unlisted companies.

The closed-end fund puzzle

Most of the theories dealing with NAV premia concern closed-end mutual funds, which invest only in securities. The fact that these funds are traded at premia to NAV is even more surprising, since such premia should be eliminated by arbitrage in perfect markets. Closed-end investment funds are usually issued with a premium of up to 10%. Within a few months, they trade at a discount. If the fund is converted into an open-end fund (open-ending), merged with an open-end fund, liquidated, or if the fund’s portfolio is sold as a whole, the fund price rises and the discount vanishes (Brauer (1984), Brickley and Schallheim (1985), Kadapakkam et al. (2005)). We discuss the relevant theories trying to explain the closed-end fund puzzle and highlight the similarities to listed private equity.

Management fees

Several scholars have proposed theories why management fees of a fund should correlate with NAV premia. Their results are, nevertheless, contradictory. Boudreaux (1973) argues that fees might imply a NAV discount, if the fund's charges are too high. Malkiel (1977) finds no significant relationship between fund returns or NAV premium and fees. Ammer (1990), however, shows that the fees usually charged by UK funds explain the discounts well. His model is criticized by Dimson and Minio-Kozerski (1999), because it neither explains the variance of NAV premia in different types of closed-end funds nor the variance in different countries. Lee et al. (1991) argue that fees are not responsible for the large fluctuations in premia, since they are typically calculated as a fixed percentage of NAV. Thus the present value of future fees varies mainly because of changing interest rates. According to their study, there is no correlation between NAV premia and interest rates and thus not with management fees. Furthermore, they state that fees cannot explain why closed-end funds typically start with a premium. Kumar and Noronha (1992) use a larger dataset than Malkiel (1977). Taking account of control variables, they find a significant correlation between NAV premia and fees. The small part of total variance explained by their regression suggests that there may be other determining factors.

Management fees in private equity funds are usually determined as a fixed percentage of net assets as well. All arguments put forward to explain closed-end mutual fund premia should therefore carry over to private equity funds.

Managerial ability and performance persistence

The theory of managerial ability posits that many closed-end funds have higher costs than the expertise of investment managers could justify. Shares of those funds should therefore trade at discounts while offering comparably low returns (Dimson and Minio-Kozerski, 1999). Both Malkiel (1977) and Thompson (1978) find no evidence for this hypothesis in their analysis. Going a step further, this theory suggests that a large NAV discount is followed by low

future NAV returns (Dimson and Minio-Kozerski, 1999). According to Chay (1992) and Chay and Trzcinka (1999), there is a significant correlation between high discounts and low future NAV returns. Lee et al. (1990) as well as Pontiff (1995) do not find this correlation in their analyses. They demonstrate the opposite, namely that large NAV discounts lead to better future NAV returns. In the most recent model involving managerial ability, Berk and Stanton (2007) argue that discounts change over time as investors change their beliefs about the manager's ability. If managers cannot be fired, poor managerial performance leads to discounts. Premia are short-lived, because managers learn about their above-average performance and negotiate a pay increase.

Taking previous returns as an indicator of the management's skills in closed-end funds, future NAV returns could be inferred from past observed NAV returns. Premia and discounts could be explained by this performance persistence. Dimson and Minio-Kozerski (2001) analyze British closed-end funds but find no evidence for the existence of performance persistence in their data. Bleaney and Smith (2003) consider the relationship between past returns and NAV premia. They examine closed-end funds in the US and UK that invest either in bonds or stocks. Past returns are shown to have a positive impact on NAV premia, but only in equity funds. The performance persistence explanation should also apply to listed private equity. Kaplan and Schoar (2005), for example, show that it exists at least for traditional non-listed private equity funds.

Private benefits

If closed-end funds can be opened or liquidated, discounts should tend to zero. However, if managers own very little of the fund, they do not benefit substantially from opening the fund, but would run a risk of losing their job. Therefore, managers resist open-ending proposals and discounts persist. Larger managerial stock ownership should lead to an incentive to open the fund and to declining discounts. Barclay et al. (1993) find exactly the opposite relation. The greater the managerial stock ownership in closed-end funds, the larger are the discounts

to net asset value. The average discount for funds with blockholders is 14%, whereas the average discount for funds without blockholders is only 4%. They argue that blockholders receive private benefits such as management fees or payments for financial research that do not accrue to other shareholders. Therefore, they veto open-ending proposals to preserve these benefits. The situation in listed private equity funds is somewhat more complicated. While venture capital trusts generally allow the fund's dissolution by shareholder resolution, shareholder (or unitholder) rights differ in funds with a partnership structure. Limited partners in these funds typically have no right to terminate and dissolve the fund (e.g. KKR Private Equity Investors). We suspect that the legal structure has an influence on private benefits extraction and may interact with the proportion of block ownership.

Tax timing

Following Constantinides (1984), capital gains tax can be reduced by skillfully timed purchases and sales of shares. According to this theory, investors forgo their chance to minimize taxes through managing their portfolio by investing in externally managed funds. If investors replicate the fund's portfolio instead, they have better control over their tax payments (Kim, 1994). Brickley et al. (1991) support this theory with their findings. Kim (1994) shows that tax issues have a significant influence on the NAV premium of closed-end funds. Tax timing, however, cannot explain why funds are occasionally traded at a premium. Contrary to investment funds, LPE funds invest in rather illiquid assets that cannot be bought and sold as easily as stocks. The replication argument does not hold, since there is no precise control of tax payments possible.

Country funds and market segmentation

Closed-end funds that invest in a specific country or a particular region outside their home country are called country funds (Charitou et al., 2006). The theory is that restrictions on direct foreign investment are a possible explanation for NAV premia (Dimson and Minio-

Kozerski, 1999). Bonser-Neal et al. (1990) test whether there is a correlation between announcements of changes in international investment restrictions and changes in NAV premia. In four out of five funds they find a reduction in premia whenever a liberalization of investment restrictions is announced. The average premium reduction is 6.8%. A study by Malkiel (1977), however, shows no significant correlation between the proportion of foreign shares in the fund portfolio and its NAV premium. Country effects cannot explain the up to 100% premia of country funds which invested in Germany during the reunification, since Germany is a free market without investment barriers (Hardouvelis et al., 1993). This theory is hardly applicable for listed private equity funds, since private equity funds with an explicit country focus do not exist yet. Nevertheless, the German example shows the overreactions which may occur in the market.

Low sales incentives

Malkiel (1977) points out that investors usually do not *buy* mutual funds. They are rather *sold* to investors by brokers, but brokers sell those products that promise the highest commission. Open-end funds usually pay higher commissions. According to Pratt (1966), this is the reason for an imbalance of sales efforts between open and closed funds. NAV discounts are thus caused by a weaker demand for closed-end funds. Weiss (1989) adds that the higher NAV premium at the moment of listing could be due to higher sales commissions in IPOs of closed-end funds. There is no reason to believe that sales efforts are higher or lower for LPE funds than for other closed-end funds, but the overall effect is hard to measure, since there are no LPE funds comparable to open-end investment funds.

Investor sentiment

Because the previously mentioned theories cannot sufficiently explain NAV discounts, the rationality of the market is called into question. A visible sign of this irrationality could be decreasing NAV discounts in times of bull markets and declining premia when stock prices

are falling. Zweig (1973) argues that premia in closed-end funds mirror the expectations of private investors. De Long et al. (1990) investigate the impact of these investors and the possibility to reduce premia by arbitrage. They suggest the existence of two different groups of investors: rational and irrational investors. Rational investors have unbiased expectations of future returns, but irrational investors' predictions are systematically biased in either direction. Rational investors are assumed risk averse and having finite investment horizons. Because of their unpredictable behavior, irrational investors prevent rational investors from eliminating premia by arbitrage. If irrational investors expect positive stock returns and drive the stock price up, future expectations by irrational investors could be even higher, thus making an arbitrage strategy partially infeasible. If a rational investor pursuing such a strategy cannot hold his position any longer, he must liquidate it at a loss. Fear of this loss should discourage at least investors that have a short investment horizon from arbitrage. According to this theory, the reason for the existence of NAV premia is that irrational investors directly cause deviations of market value and NAV and indirectly lead to higher discounts or lower premia. Market price inflations on their own cause market values to deviate from NAV in closed-end funds because of infeasible arbitrage.

In addition to this direct but symmetric effect, there is a second, indirect reason for discounts caused by noise trader risk. It is not due to the general pessimism of irrational investors that closed-end funds are traded at a discount most of the time. Noise traders rather induce discounts because of a non-predictable risk of stochastically acting irrational investors (Lee et al., 1991). Investors wanting to sell their investment in finite time have to be compensated for this noise trader risk, resulting in NAV discounts. Note that both rational and irrational investors are affected by this additional risk. In this way, irrational investors with unpredictable changing return expectations cause stochastic changes in the demand for the shares of closed-end funds, which in turn lead to stochastic changes in the NAV premia. Lee et al. (1991) support this theory with their analysis based on the similar ownership structures of closed-end funds and small listed companies and show a high correlation of

NAV premia and stock returns of small companies.

There are, however, conflicting results. Ammer (1990) compares the closed-end funds in the US with the closed-end funds in the UK. He concludes that in both countries similarly high NAV premia can be observed, although British funds have a much higher proportion of institutional investors (which is 70–75 % during the time period Ammer studies). Since institutional investors are seen as rational, this finding contradicts the investor sentiment theory. According to Lee et al. (1991), there is sufficient evidence that shares of closed-end funds are owned and traded to a large extent by irrational investors. They estimate the proportion of irrational investors in closed-end funds much higher than their share in the fund’s portfolio companies. In her study of 64 funds investing in stocks or bonds, Weiss (1989) shows that three months after an IPO only 3.5 % of all outstanding shares of a closed-end fund are held by institutional investors. The proportion of small and possibly irrational investors is presumably high in listed private equity funds. We can safely assume that their share of the fund’s individual portfolio companies is much lower, since funds typically own large stakes in unlisted portfolio companies. Consequently, even listed funds can be affected by noise trading and investor sentiment.

Private equity-related explanations

In addition to explanations focusing on mutual funds and the closed-end fund puzzle, there are several explanations of NAV premia which apply to LPE-specific characteristics. These are the dependence on credit markets in buyout funds, illiquidity of portfolios and listed funds, stale pricing and the J-Curve effect.

Dependency on credit markets

Private equity transactions and predominantly those in the buyout sector typically involve large amounts of debt. Between 1990 and 2006, the average equity contribution in buyout transactions was constantly about 30 % of transaction value (Guo et al., 2008). Although it

is not immediately clear how changes in the cost of debt affect equity valuations, two direct mechanisms that work in LPE are conceivable. Kaplan and Strömberg (2009) argue that private equity funds may take advantage of systematic mispricings in the debt and equity markets. When the cost of debt is relatively too low compared to an appropriate level, private equity funds can arbitrage or benefit from the difference by overleveraging. A similar argument is put forward by Baker and Wurgler (2000) and Baker et al. (2003) for public companies. The validity of this argument, however, relies on market frictions which cause a segmentation of debt and equity markets.

Axelsson et al. (2009) propose a different hypothesis based on the observation that private equity firms pursue large transactions relative to their fund sizes. Private equity firms might be constrained in the amount of equity they can invest in a given deal. Therefore, they must use leverage to fund their investments. Both theories imply a dependence on credit markets. Based on Kaplan and Stein's (1993) observation that overly favorable terms from high yield bond investors could have fueled the 1980s buyout wave, Kaplan and Strömberg (2009) find a cyclicity in debt levels. They also document lower debt levels of about 30% in the second buyout wave from 2005 through mid-2007 compared to 10–15% during the first wave in the 80s, which they interpret as evidence for Kaplan and Stein's argument that debt investors might have been too optimistic. More transactions should be undertaken by LPE funds if interest levels are unusually low. Excess value creation by funds during these periods could be anticipated by fund investors, which in turn increases NAV premia.

Liquidity

Liquidity can play a role on two levels. On one hand, it is important to investigate whether the portfolio companies' liquidity have an influence on the fund's NAV premium. On the other hand, the liquidity of the fund itself might affect premia. Lee et al. (1990) show that the liquidity of the securities the fund holds cannot be responsible for the NAV discount in investment funds, because only a few funds have illiquid securities in their portfolio. LPE

funds, however, mostly hold illiquid shares in portfolio companies. Cherkes et al. (2008) find that closed-end funds that hold illiquid securities are traded at higher premia. They justify this by the additional liquidity these funds offer their investors compared to direct investments in these portfolio companies. While the funds's stock is listed on an exchange, shares in the portfolio companies are highly illiquid. Since the illiquidity of an investment is not taken into account when calculating the NAV, investors of such a fund pay an additional liquidity premium. Note that this argument is directly opposed to the arbitrage argument that premia should be lower if the liquidity of the fund's underlying portfolio is high and arbitrage strategies are thus easier to implement. On the fund level, Datar et al. (1998) and Chordia et al. (2001) show that the illiquidity of an investment is generally related to a higher rate of return, as investors want to be compensated for the higher risk in illiquid investments. Many LPE vehicles are rather small and illiquid. Thus, the illiquidity both at the level of the fund as well as on the level of the portfolio companies might have an impact on NAV premia.

Stale pricing

The quality of net asset values is highly dependent on the choice of parameters and the method used for their calculation. Therefore, a PE fund or the management company can act with relatively high flexibility in pricing those portfolio companies for which there is no market price available (Anson, 2002). Since many PE firms accept the International Private Equity and Venture Capital Valuation Guidelines developed by the industry organizations AFIC, BVCA and EVCA and based on the notion of fair value, valuation methods are largely the same across funds. However, many free parameters can be chosen at the firm's discretion. Many management companies are reluctant to change valuations in the absence of value-determining events such as a change of ownership. There can be long periods without such events, which can lead to NAVs containing less and less current information. Whenever the net asset value does not contain all available information, this situation is called stale pricing.

This leads to a delay between net asset value and observable market value. Therefore, the NAV will only occasionally coincide with the market value of portfolio companies measured by the hypothesized transaction value on a free market.

An inconsistency of NAV and market value or lagged book values can also be caused by managed pricing (Anson, 2002). The management company has certain leeway in calculating NAVs that can be exploited in the way most useful to fund management, that is, fast appreciation and slow depreciation of NAVs to boost performance-related compensation. Those fair values which are based on international valuation guidelines could be biased due to stale pricing. Since the guidelines advocate rapid depreciation to ensure conservative valuation, managed pricing should rather play a minor role.

Stale pricing and managed pricing are no longer a problem as soon as the portfolio company is sold and the investment is realized by the fund. The final return could be observed at this point in time. Emery (2003) analyzes quarterly NAV returns by regressing them on stock index returns and finds a coefficient of determination of 35 % when using NASDAQ returns as an independent variable and 56 % when using lagged NASDAQ returns. These results suggest a delay in the adjustment of net asset values to new information about portfolio companies. When using annual rather than quarterly data, the lag effect is less pronounced. However, Emery does not explore whether the delay is caused by stale pricing or managed pricing.

Anson (2002) finds a similar lag structure between NAV returns and stock index returns. In addition, he tests whether the delays are attributable to stale pricing or managed pricing. He examines how fast NAVs appreciate in rising stock markets and depreciate in bear markets. Managed pricing should be indicated by quickly appreciating and slowly depreciating NAVs. He notes that appreciation occurs slower than depreciation, which is in line with the international guidelines on valuation but contrary to NAV-based incentive schemes. Since listed funds employ the same business model as traditional private equity funds and their portfolio companies are valued according to the same standards, results should be similar

for listed funds. In listed funds, however, it is possible to construct incentive schemes based on the stock price, which should reduce managed pricing to some extent.

The J-Curve effect

A well established empirical phenomenon is the J-shaped relationship between a fund's age and its lifetime NAV return (see Phalippou and Gottschlag (2009), Kaplan and Schoar (2005), Artus and Teiletche (2004), Kaserer and Diller (2004)). Reported net asset values of most funds drop during the first few years and grow steadily until the end of the fund's lifetime. Several explanations can account for this phenomenon. First, management fees that are not offset by realized profits during the first years can push NAV below par. This effect is even more pronounced in funds where management fees are calculated as a percentage of committed capital and not paid-in capital. Second, most investments are made at the beginning of the fund's lifetime. Therefore, the majority of investment costs accrue over this time. Finally, the J-curve can be the result of asymmetric depreciation policies. Many PE firms depreciate aggressively if investments turn out worse than expected but write up only if the portfolio company is sold or some other valuation event occurs. This creates a downward pressure on net asset values during the first few months or years when no such value-determining event occurs. This pressure can be amplified, if the fund management is able to identify underperforming portfolio companies earlier than outperforming ones.

All these effects also apply to listed private equity with the exception of management fees, where the magnitude of the J-curve is supposedly lower than in traditional PE funds. Listed funds are usually paid in at once and thus no discrepancy between committed capital and paid-in capital can exist. More than half of the European institutional investors surveyed by LPEQ believe that listed private equity offers less management fees compared to limited partnership private equity and an attractive way to invest in private equity after the "J-curve", avoiding low returns on investment in initial periods (Cumming et al., 2010).

In efficient stock markets, price changes reflect changes in the expectations of shareholders

in net cash flows available for distribution to the shareholders and also in the interest rate used to discount future cash flows. Since the J-Curve effect is well known, it should be taken into account in rational capital markets and should thus have no impact on share price movements. If the fund's NAV shows a J-Curve effect but the share price does not, then NAV discounts should depend on the fund's age. This theory could, if confirmed, explain only a small part of NAV discounts shortly after the fund's IPO and does not explain premia at the IPO or late in the fund's lifetime.

3 Data and methodology

Net asset values and premia

Fund data were compiled from several sources. Net asset values per share between 1992 and 2008 were collected from the funds' financial reports. Share prices were obtained from Datastream. Practitioners usually define a fund's premium as the ratio of the fund's price per share to the book value of their portfolio per share minus one. In this paper, we compute premia as the natural logarithm of price to net asset value per share. Since one ratio can be transformed into the other, we do not lose information but are able to specify regression models correctly. A fund's premium can be expressed as $PREM_t = \ln(P_t/NAV_t)$ where P_t is the fund's price per share and NAV_t is defined as the fund's net asset value or, equivalently, book value of equity per share. We were able to collect 1727 premia from 100 funds, not all of which can be analyzed in all models due to missing data on covariates. Our sample comprises 79 ordinary funds and 21 listed private equity funds of funds (FoF) that invest in traditional private equity funds. Since funds of funds turn out to behave similarly to directly investing funds, we do not treat them as special, but address relevant FoF issues below. Most funds (64) are headquartered in the UK, 11 are based in the US, 20 in continental Europe and 5 in other countries.

Figure 1 shows the average premium over time. Most observations are from the last 5

years when many funds went public. Funds usually report NAVs quarterly, but sometimes change reporting frequency or business year. 48 funds report more than 3 NAVs per year on average, 26 report more often than twice per year. Our data thus have an unbalanced panel structure with gaps. We record NAVs in March, June, September and December. If business years are off by one leading or lagging month, NAVs are treated as being reported in the nearest quarter (for example, if the fund reports in May, we record this NAV in June). 79 funds report at the end of the quarter, 12 one month before and 9 one month later.

[Insert figure 1 about here]

Covariates

Table 1 reports summary statistics of the net asset value premia and covariates. The average ratio of NAV to market value is 84.2%, which corresponds to an average premium of -20.7%. One NAV below zero is observed but is excluded from further analyses when taking logs. 85.7% of all premia are below zero, only 3.1% are greater than 20%. The average fund age is 6.6 years, which documents the recent growth in this asset class.

[Insert table 1 about here]

- *Cash / Total Assets*: The funds' cash position and total assets in each quarter are taken from Worldscope and augmented by figures from the funds' financial reports. We define the cash position as cash and cash equivalents to total assets. We also compute a cash position relative to market capitalization but do not use it to explain

premia. Since most of this measure's variation is due to changes in market value, including it in a regression for premia would cause spurious correlation. The average cash position is 11.3% with a median of 5.8%. Compared to market value, funds hold 18.0% cash on average (Median 8.4%).

- *Bid-ask spread (Log)*: Bid-ask spreads are calculated for each fund as its share price's bid-ask spread averaged over each quarter. The average bid-ask spread is 2%. Two implausible negative values could not be verified, but are excluded when taking logs.
- *Trading days (Log)*: In each quarter, we count the number of days Datastream reports a trading volume for and take its natural log. The average number of trading days is 41, but most funds traded on 56 or more days each quarter. The variable that enters the regression is the percentage of trading days in each quarter in logs.
- *Age (Log)*: At the end of each quarter, each fund's age is calculated as the natural logarithm of the number of years from its IPO date.
- *Institutional ownership (Log)*: Ownership data is obtained from Thomson Financial for the years 1997 to 2008. The Thomson ONE Ownership database reports the institutional ownership for equities at the end of each year based on various sources, such as 13(f) filings by institutions or mutual fund data. We sum all shares held by investors other than individual investors to obtain the institutional ownership fraction and take logs. Average institutional ownership is 32%. Two funds have more than 100% institutional ownership in one year, which could not be resolved.
- *Ownership concentration (Log)*: To measure the extent of blockholdings, we construct a Herfindahl index for each fund-year from the ownership data obtained from Thomson ONE Ownership for our sample. This measure does not only include institutional investors but also individual ones. Holdings in listed private equity funds are diversified to a large extent, indicated by a median Herfindahl index of 0.017.

- *Beta*: Systematic risk is estimated by a time-series regression with Dimson (1979) betas over a one-year rolling window. We use this variable to proxy for systematic business risk associated with portfolio companies. Based on the international Capital Asset Pricing Model, the equation for the regression is given by

$$R_t = \alpha + \sum_{k=0}^7 \beta_k M_{t-k} + \gamma_1 GBP_t + \gamma_2 EUR_t + \gamma_3 JPY_t + \epsilon_t, \quad (1)$$

Beta is the sum of β_k . R_t and M_{t-k} are the respective observed logarithmic (excess) weekly index and market returns at time t and $t-k$, whereas k corresponds to the respective lag, α , β and γ are the slope coefficients and ϵ_t is an error term. Asset and market returns are in US dollars. We include seven lagged market returns, since this number of lags turns out to be statistically significant for equally weighted indices of listed private equity (see Lahr and Herschke (2009)). GBP , EUR and JPY are the weekly log returns of currency portfolios to account for exchange rate fluctuations and movements in local interest rates. They are constructed as (excess) returns on short-term deposits denominated in local currency and measured in the reference currency. All returns are continuously compounded. Since market return autocorrelations are relatively small compared to autocorrelations in our LPE indices, we exclude leading market returns to avoid look-ahead bias. The risk-free rate of return was estimated by averaging the monthly averages of three month Treasury bill returns over the observed period and taking logs.

- *Management fee*: Private equity funds usually charge two types of fees. Management fees typically are a fixed percentage of NAV whereas performance-related fees can depend on income or capital gains. Performance fees of 20% of NAV gains combined with an 8% hurdle rate are most common in our sample. Since different performance fee provisions across funds cannot easily be concentrated in one variable, we choose to retain only nominal management fees as a covariate. Management fees range from

0.4% to 3.5%. The median fee is 1.8%.

- *Market and small cap indices:* The concurrent quarterly MSCI World index return is used to control for the market risk factor in equity markets. To test the investor sentiment theory, the FTSE Small Cap, DJ Stoxx Small and MSCI US Small Cap index returns are included for the UK, Europe and the US, respectively. Because of high collinearity, we construct a small-cap factor from these indices.
- *Commitments:* Cash inflows to private equity funds may well indicate hot markets according to the money-chasing-deals argument (Gompers and Lerner, 2000) and therefore influence premia. We obtain quarterly worldwide fund commitments in U.S. Dollars from Thomson VentureXpert to measure both level and changes in fund commitments.
- *IPO volume:* A second variable to proxy for investor sentiment in hot markets is the volume of international initial public stock offerings in U.S. Dollars. We obtain quarterly worldwide IPO volume from Thomson SDC.
- *Interest rates and spread:* We decompose long-term interest rates on corporate debt into 10-year government bond yield and the spread between long-term government and corporate bonds. UK and US interest rates are represented by their respective government bond yield, continental European interest rates are approximated by German 10-year benchmark bond yields.
- *Fund focus:* To account for possibly different business risk and organizational structures, we separate funds according to their stage focus. We only distinguish between venture funds (41) and buyout funds (38) because of the limited number of funds. The 21 funds of funds in our sample constitute a third category.

Estimation

Net asset value premia in listed private equity funds show considerable autocorrelation at lag one. We therefore employ estimation techniques that account for this autocorrelation. Returns in tables 3 and 6 are estimated by pooled OLS with inference using Newey-West standard errors. A more direct method to deal with autocorrelation is to adjust the variables previous to the estimation, which is done in tables 4 and 8. Variables are first purged of first-order autocorrelation by a Cochrane-Orcutt transformation. After that, we use the GLS method by Baltagi and Wu (1999) to handle unbalanced panel data. To identify coefficients for variables that are constant within each panel, the Baltagi and Wu random effects estimator is employed. We also report fixed effects estimates for comparison for some models.

Collinearity among independent variables can make it hard to assign effects to specific variables. Spurious significance or no significance at all could be the result of negatively or positively correlated variables, respectively. There is a large amount of common variation among the market index returns, interest rates, and (lagged) interest spreads. We try to overcome these issues by constructing factors from groups of variables by performing factor analyses and using the common factors in regressions instead of the original variables. Small capitalization index returns for U.S., U.K., and continental European stocks are aggregated into a small-cap factor. We also construct factors for interest rates on government bonds and for yield spreads between government and corporate bonds in these markets.

4 Empirical results

We record the first observation for one fund two days after its IPO. The average premium for this day is -2.58%. If extrapolated linearly from this first observation, the IPO premium is -2.5% (see table 2 and figure 2). This is considerably less than the premia reported for U.K. and U.S. closed-end funds. The average investment trust issue is quoted at an effective

premium of 5.72 % above its net asset value at the end of the first day of trading (Levis and Thomas, 1995). U.S. stocks still trade at 4.8 % premium 5 weeks after the IPO (Weiss, 1989). Considering an initial return of -6.48 % over the first 30 days, as reported by Weiss (1989), U.S. stocks sell at an even higher premium. According to Lee et al. (1991), first day premia are generally attributed to investor sentiment, which issuing firms are able to use to their advantage. If first day premia occur in hot issue markets due to positive investor sentiment, we observe less irrational behavior in listed private equity funds. This argument must be taken with a grain of salt, however, since not premia per se may be seen as an indication of investor sentiment but rather the large drop in premia after a fund's IPO, as we will argue below.

[Insert figure 2 about here]

After the first slightly negative premium on the first trading day, premia decrease to the long-run average of -21 %. The drop in premia is fairly linear and reaches its bottom after 2–2.5 years as depicted in figure 3. Weiss (1989) finds that within 24 weeks of trading, closed-end equity funds in the U.S. trade at a significant average discount of 10.02 %. Levis and Thomas (1995) find that after 200 trading days, equity funds in the U.K. fall in value by 5 %. The qualitative behavior of premia is thus very similar to closed-end funds but displays a time pattern like in traditional private equity funds where returns measured by IRRs usually turn around after 2–3 years and break even after 5–6 years. However, the pattern is actually *reversed* compared to what we should expect if the J-curve phenomenon was driving premia. If NAV returns were low over the first quarters but shares earned some risk-adjusted return, premia should *rise* first and then remain at an equilibrium. We find no correlation between NAV returns and age but higher stock returns in older funds. This suggests that the age effect is driven by stock returns rather than net asset values.

[Insert figure 3 about here]

[Insert table 2 about here]

An explanation for discounts in line with Berk and Stanton's (2007) management ability hypothesis is that the market needs some time to learn about the management's quality. This argument works for private equity funds, since it takes much longer in private equity funds to invest the IPO proceeds than in closed-end mutual funds. If, for example, management ability can be assessed based on the acquisitions during this initial investment period rather than the portfolio's subsequent performance, the largest changes in premia should be observed in this early post-IPO period. Consistent with this explanation, premia in venture capital funds take about four years to settle whereas premia in buyout funds and funds of funds reach their long-term average two years after their IPO. Initial changes in fund premia could therefore be an indication of managerial ability.

A post-IPO decline in premia can be explained by both investor sentiment and managerial ability. While consequences are similar, causes and mechanism of both hypotheses could hardly be more different. Positive investor sentiment, and therefore high premia, should be observed in markets when other indicators for investor sentiment, such as the volume of initial public offerings, are also high. Movements in premia due to discoveries of managerial ability should be correlated with indicators of information flow, such as a fund's investment degree. If premia reflect fund investors' assessment of managerial ability, it should be reflected in returns. Berk and Stanton (2007) point out that today's premium should be related to past returns, since high NAV and stock returns indicate high ability. Premia should also be related to future NAV returns but not to future stock returns, because better managers generate

higher NAV returns relative to the fees charged. These arguments hold only if funds have a limited life. Since most listed private equity funds do not have specific wind-up provisions in their charters, bounded premia would require stock returns and NAV returns net of costs to match in the long run. If funds have infinite lives, premia would rather reflect barriers to arbitrage or other variables than managerial ability. We therefore test the relation between returns and premia empirically before examining the determinants of premia.

Return predictability

Listed private equity NAV premia predict future stock performance in almost all of our subsamples (see tables 3 and 4). The negative relation is stable across different specifications and independent from the Fama-French HML factor.

In rational markets, sensitivity of returns to book-to-market ratios represents some financial risk associated with high (or low) book-to-market firms. The book-to-market effect is a well documented phenomenon across different markets. Fama and French (1992, 1993, 1998) document a strong positive relation between average cross-sectional returns and book-to-market equity. Empirical studies find that book-to-market ratios are inversely related to future firm performance (Fama and French (2004), Fama and French (1995)) and growth (Lakonishok et al., 1994) and are positively related to leverage (Chen and Zhang, 1998). Petkova and Zhang (2005) show that the value premium itself tends to covary positively with the expected market risk premium. These results suggest that high book-to-market firms are more financially distressed than low book-to-market firms, and therefore at least some of the documented stock performance is an artifact of expected returns for financial risk factors (Piotroski, 2007).

Contrary to these explanations, Lakonishok et al. (1994) argue that the subsequent returns to the book-to-market strategy represent a reversal of past valuation errors. The predominant finding in closed-end funds is a negative correlation between fund premia and future returns, which is the opposite of the negative relation between book-to-market ratios

and returns. Pontiff (1995) finds that funds with 20 % discounts have expected twelve-month returns that are 6 % greater than nondiscounted funds (0.7 % per month). Thompson (1978) finds that annual contrarian strategies based on this finding yield abnormal risk-adjusted returns of about 4 % per year. Pontiff (1995) attributes this correlation to premium mean-reversion, not to anticipated future portfolio performance. Economically motivated explanations such as bid-ask spread or tax considerations do not account for this effect.

[Insert table 3 about here]

Results for listed private equity fund returns displayed in table 3 show both effects. Fund returns can be explained by the book-to-market factor but also by past premia. Funds trading at a 20 % discount yield a quarterly return 1.5 % higher than those without such a premium. The effect is least in buyout funds and most pronounced in venture funds. Since returns are autocorrelated at lag one ($p < 0.05$), we perform the same regressions on adjusted variables and find similar results for all sub-samples (see table 4).

[Insert table 4 about here]

Additionally, we observe a U-shaped seasonal pattern in returns. Quarterly returns are highest in the first quarter and lowest in the second and third (see table 3). This would be a violation of market efficiency if no economic cause were to be found. In a three-factor CAPM world, the January effect in returns should disappear, if returns are regressed on risk factors that also show this effect (Fama and French, 1992). This is not the case in our data. The seasonality is robust to alternative model specifications as shown in tables 4 and

5. Explanations of this “January effect”, which are put forward in the literature, are mostly tax-related.

[Insert table 5 about here]

Pontiff (1995) argues that different taxation of dividends and capital gains can cause a transitional effect on returns and premia. When stocks go ex-dividend, their prices fall by an amount less than the dividend. This affects both the fund and its portfolio. In periods in which a fund collects dividends on its portfolio, its premium decreases, because its net asset value increases. When the fund passes on these dividends to its shareholders, its stock will decrease less than the drop in NAV, thus increasing the premium. There are several difficulties with this argument in the context of listed private equity funds. First, higher NAV returns in periods when the fund is collecting dividends depend on the fund’s ability to revalue its portfolio according to the difference between dividends received and the change of the portfolio company’s share price. This can be difficult if there is no market price for portfolio companies, as is the case with private equity funds. In regressions similar to the ones shown in table 3, we do not find a seasonality in NAV returns. Second, dividends would have to be simply too large to account for the difference in returns, which is about 4% between the first and third quarter.

The second explanation could be tax-loss-selling. This theory holds that at the end of the year, investors sell stocks which have experienced losses to realize these losses and thereby reduce their taxable income. Brauer and Chang (1990) document a “January effect” in closed-end funds, which they interpret as evidence of tax-loss selling. They show that fund prices increase in January, although their net asset values do not. We also find significantly higher January returns in listed private equity funds. However, tax-loss-selling does not account for the surprisingly low returns in the second and third quarter.

Bilo (2002, p.63) finds a similar return pattern in her sample of listed private equity funds, investment companies and other organizational structures. Stock returns are highest in the first two quarters and below-average from July to December. She argues that information about underlying portfolios is mainly disseminated by annual reports, which are published within the first few months of each year. Fund investors then use this information to update their valuation. In private equity, there is usually no other way for investors to gain knowledge about the fair value of the fund's portfolio companies.

Such an effect would suggest a fundamental difference of audited annual reports compared to interim reports. The U-shaped pattern of returns can be explained to a large extent by reporting dates. 47 % of our sample funds report in the last quarter, 27 % in the first quarter and 13 % in the second and third quarter each. If reports are published in the quarter following the balance sheet date, we should expect impact on returns in the first and second quarter, which is exactly what we find.

To confirm this hypothesis, we construct a variable that measures the time distance of an observation from the last reporting date. Tables 3, 4 and 5 reveal that stock returns of listed private equity funds are 3.1 % to 3.9 % higher in quarters when annual reports are published. Even if information was generated by annual reports only, their impact on returns should be symmetrical. This pattern of returns thus indicates some informational inefficiency, whose causes we can only speculate about.

Determinants of listed private equity premia

Premia and global equity markets seem to move together, as indicated by figure 1. While it could be fruitful to regress premia on market indices, the difficulty of non-stationarity arises. Premia are stationary over the medium term for economic reasons, but index levels have no upper boundary. Our aim is to test cross-sectional as well as time-series properties of premia. Econometric solutions to non-stationarity problems usually involve first differencing of dependent and independent variables. We follow this approach and include first differ-

enced variables where appropriate to explain changes in premia. Unfortunately, variables that are constant over time (most fund-specific attributes) drop out of the equation when differencing. To keep these variables, we estimate models for premia levels explained by levels of market indices. Although clearly not stationary over longer terms, market indices might nevertheless be stationary over time periods spanning only a few years. Variables that are almost integrated of order one are strongly autocorrelated, which must be taken into account in estimation and considered carefully when interpreting results.

Regressions using differenced and original variables as shown in tables 7 and 8 yield largely similar results.

[Insert table 7 about here]

The age effect found in the descriptive analysis is also present in multivariate analyses. During the first year after the IPO, funds show a 9.9% above-average premium which declines to 5.7% above the long-term average in the second year. This two-year adaptation period might be caused by the long investment period of private equity funds, which go public with a portfolio consisting almost entirely of cash that is invested in portfolio companies over time. Cash levels can therefore act as a proxy for the fund's investment degree. There is, however, no influence of the fund's investment degree on its premium in our data (see model 3 in tables 7 and 8). If we construct a cash ratio based on market value instead of total assets, we find a negative relation between cash and premia where there should be a positive one. Since market value enters the equation on both sides, the effect is likely caused by endogeneity. Although the age effect can be explained by managerial ability (discovery of ability over the first few years) as well as investor sentiment (price deterioration after hot issue markets), the missing relation between premia and the fund's investment degree challenge managerial ability as the sole explanation.

Investor sentiment as an explanation for premia plays a dominant role in the literature on closed-end fund discounts. Funds issued at premia and rising premia in hot markets as well as a general discount on closed-end funds are all attributed to the presence of irrational investors. We find partial support for this hypothesis in listed private equity funds. Premia are related to market indices, small-cap indices, IPO volume, and commitments to traditional private equity funds. However, the age effect cannot be explained entirely by these variables, and ownership structure does not seem to determine NAV premia either.

Average discounts in listed private equity funds are similar in shape to the time pattern observed in closed-end mutual funds. While U.K. and U.S. closed-end mutual funds are issued at a premium, the average IPO premium in our sample is negative. This should not be interpreted as a smaller sensitivity to investor sentiment, since premia are about 10% lower over the funds' lifetime, not just shortly after its IPO. If investor sentiment was a driver of premia, they would be correlated with small-cap indices. If funds are issued when investor sentiment is positive, the resulting decline in premia would simply be a consequence of market timing. Any unexplained age effects would then have to be attributed to some other cause.

Movements in equity markets are strongly related to NAV premia in all subsamples and all models. MSCI World returns are the last variable to lose significance if the sample size is reduced. If small-cap indices for U.K., U.S., and continental European markets added to the regressions, they have no individual power in explaining premia (regressions not reported here). A factor constructed from these indices is, however, significantly but negatively correlated with premia. At the same time, the market index is significant with the opposite sign, which is an indication of collinearity ($\rho = 0.63$). We therefore construct a factor from small-cap indices to eliminate collinearity between them. Residuals from regressions of this small-cap factor on market returns capture the variation in small-cap stocks not already incorporated in market returns. Significant coefficients for these small-cap residuals in our results suggest the presence of investor sentiment in listed private equity funds.

We use commitments to unlisted private equity funds and the volume of international IPOs as proxies for hot markets that indicate positive investor sentiment. Coefficients for both variables are both statistically and economically significant in most models. Despite their common variation, fund commitments and IPO volume add individual explanatory power to our models. Although IPO numbers of listed private equity funds follow the general trend, adding these two sentiment indicators does not seem to reduce the age effect.

[Insert table 8 about here]

Institutional ownership, which can also proxy for noise trader risk, does not seem to determine premia. The concentration of ownership is similar, but also proxies for the potential of owners to extract private benefits. Although there is some correlation with premia ($\rho=-10.5$, $p<0.01$), we find no influence on premia in a multivariate setting. Institutional ownership and ownership concentration share a large part of their variation, which can lead collinearity problems, if both are included in a model. A single factor constructed from both variables becomes slightly significant as shown in table 7. Ownership information is not available for all funds in our sample, which leaves us in doubt about the influence of ownership structures on NAV premia.

While independent indicate investor sentiment to some degree, simply the premium's size could reflect the greater importance of investor sentiment in private equity funds compared to closed-end mutual funds. Average premia are about 10 % lower than in closed-end mutual funds over the funds' lifetimes. It is unlikely that these larger discounts can be explained by the illiquidity of the fund's holdings. The opportunity to trade portfolios of illiquid assets should rather be accompanied by higher premia as is the case in closed-end mutual funds that offer access to foreign (segmented) markets. Instead, lower premia in listed private equity funds possibly are a sign of higher arbitrage costs. Most portfolios are not only held privately

– which is the very nature of private equity – but are also majority-owned by the private equity fund, making arbitrage almost impossible. Rational investors facing these obstacles cannot easily buy the listed private equity vehicle at a discount and sell the portfolio. Noise trader risk is thus amplified, which increases discounts.

We conclude that investor sentiment seems to influence premia, although decreasing post-IPO premia cannot be explained entirely by changes in investor sentiment. If fund age is excluded from the regressions, however, R^2 drops by less than 0.5%. Albeit small, the unexplained age effect lends some support to the management ability hypothesis by Berk and Stanton (2007).

Pontiff (1995) finds a positive relation between bid-ask spreads and expected returns, which is dominated by the even stronger ability of premia to predict returns. This effect of both variables predicting returns could be the result of collinearity between premia and bid-ask spreads, which is indicated by our results in table 8. If low premia represent financial risk that is only in part explained by bid-ask spread, premia could be a more reliable predictor of returns than bid-ask spreads. However, bid-ask spreads could still be the economic cause of premia, as we propose here. This direction of causality seems more plausible than a causation of bid-ask spread by premia or by a third unobserved variable.

As another proxy for liquidity, we include in our analysis the percentage of active trading days within each quarter. The expected relation is positive, if illiquidity causes discounts. However, we find a negative relation across all model specifications in table 8. Although bid-ask ratios and trading days are negatively correlated ($\rho=-0.56$), one of them remains significant with the same sign as before, if the other is excluded from the regression. It turns out that the effect becomes insignificant if we exclude severely illiquid observations with less than 5 trading days per quarter. If we assume that zero trades are data errors and impute the sample average of 41 trading days instead, the effect for trading days disappears. To the contrary, the effect does not disappear if we impute 4 trading days (4 days maximize the significance of trading activity). The negative trading activity effect thus appears to be

nonlinear and strongest in quarters with only a couple of trades. Adding a dummy variable that measures if there are up to 15 trading days per quarter yields a small, but positive coefficient ($b = 0.031$), which is only partially significant ($p = 0.071$). We do not find a reasonable explanation for this negative effect of trading activity within our dataset, which suggests that results might be due to data errors or an unobserved variable.

Interest rates have a mixed effect on premia, whereas the yield spread between government and corporate debt contributes inversely to NAV premia. We observe a positive relation between U.K. long term interest rates and premia. Because interest rates are strongly correlated between U.S., U.K. and continental European markets, their common variation can be used to construct a replacement variable by factor analysis. When used instead of individual interest rates, the interest factor is significant in models explaining premia levels (see table 8). Changes in interest rates, however, are negatively related to changes in premia but remain insignificant.

The effect of yield spread on premia is consistently negative. This result could imply that changes in spreads have a stronger influence on market prices than on net asset values. Pontiff and Schall (1998) provide an explanation built on arguments put forward by Ball (1978) and Berk (1995). Berk reminds us that a firm's market value does not cause its capital cost to be high but that rising discount rates lead to a lower lower market capitalization. Pontiff and Schall argue that book value proxies for future cash flows and therefore dividing a cash flow proxy by a concurrent market price produces a variable that is correlated with future returns. This is because dividing an expected cash flow proxy (net asset values in our case) by a price level (market value) yields a discount rate proxy. This approach is very general, since it holds whether or not discount rates are generated by a specific model or are influenced by stochastic or irrational factors. However, Pontiff and Schall's explanation depends on the ability of book value to proxy for cash flow. Turning this argument around, the common variation in premia and yield spread in our results supports the hypothesis that book value proxies for cash flow.

It seems to be the difference in yield between corporate debt and government debt that shows a relation to premia, not the interest level. This suggests that changes in interest rates are reflected in both net asset values and market prices. Our result is consistent with the hypotheses by Kaplan and Strömberg (2009) and Axelson et al. (2009) who suggest a dependence of private equity valuations particularly on yields of high-yield bonds.

Moreover, we document an inverse relation between premia and systematic risk, represented by Dimson beta in an international capital asset pricing model. Since portfolio betas are just the weighted sum of its assets' betas, net asset values and fund prices should move together. The difference between the two should therefore not depend on systematic risk. The effect we observe in our data is suggestive of mispricing of net asset values or fund prices. The former is more likely because of the management's discretionary power when estimating net asset values. For high-beta funds, net asset values seem too high, and vice versa.

Further insights into the nature of fund premia might come from grouping funds according to legal systems. In particular, private benefits could be extracted more easily in some jurisdictions than in others. We use the exchange which a fund's stock is traded on to distinguish between common law and other legal systems. There are 76 funds in common law countries whose premia are about 10 % higher on average. Since there are 25 venture capital trusts in our sample that offer tax advantages, we control for this fact, but find no different results. This finding is consistent with the view that protection of investors in publicly listed companies is higher in countries of English legal origin (La Porta et al., 1998).

[Insert table 6 about here]

Fund focus shows a surprisingly large effect in our sample. Venture capital funds and funds of funds have premia that are 10–11 % higher than in buyout funds. Could it be that there is less value creation in buyout funds? If funds are issued at net asset value, there must be

either a faster appreciation of net asset values in buyout funds or a drop in fund prices after the IPO. Interestingly, buyout funds start with a premium of 3.04%, whereas venture capital funds and funds of funds are issued at premia of -6.85% and -6.64%, respectively. This suggests that buyout fund prices depreciate even faster relative to their NAVs. We perform a regression of fund returns on the usual risk factors and fund age and find a negative abnormal return for the first year (see table 6). The sum of the year dummies is significant at the 5%-level. There is no such effect in venture capital fund or fund of funds returns. If not for high investor sentiment, it remains a puzzle why investors should be willing to participate in buyout fund IPOs under these circumstances.

In line with the arguments by Lee et al. (1991), we find no correlation between management fees and premia. It might be argued that fund of funds' fees are double-layered because of the fees charged both at the portfolio fund level and by the fund of funds. Nevertheless, there is still no effect if the average management fee of funds is added to the funds of funds' fee.

5 Conclusion

This paper investigates the causes and consequences of discounts in listed private equity (LPE) funds. LPE funds share characteristics of closed-end mutual funds and traditional unlisted private equity funds and can therefore offer insights into both. The purpose of this paper is twofold: First, we test the hypotheses developed to solve the "closed-end fund puzzle" against the newly established LPE asset class. Second, we improve the understanding of premia in traditional private equity funds, whose market prices are typically unobservable.

In contrast to mutual funds, we find that LPE funds do not trade at a premium immediately after their IPO. They start with a negative premium of -2.5% instead. This premium takes much longer than in mutual funds – over 2 years – to adjust to the long-term average of -21%. Premia predict future stock returns after controlling for the book-to-market factor.

We interpret the negative correlation as mean reversion following Pontiff (1995).

We find a U-shaped seasonality in fund returns across different investment styles, which can neither be explained by different taxation of dividends and capital gains nor by tax-loss-selling. A substantial part of this pattern seems to be related to the fund's fiscal year. Returns are exceptionally high in quarters where annual reports are published, which is puzzling, since tax reasons offer no satisfactory explanation for the 3.5% return differential.

The fund's cash divided by total asset can proxy for its investment degree, but shows no relation to premia. If a fund's investment degree conveys information about the quality of its management by making it possible to judge the management by recent portfolio acquisitions, the missing relation between cash holdings and premia casts doubt on the management ability hypothesis. Investor sentiment, however, finds support in our results where proxies for small-cap stocks and hot IPO markets become significant.

We further confirm the positive relation between the fund's liquidity, measured by its bid-ask spread, and premia. Surprisingly, infrequently traded funds have exceptionally high premia. We find evidence that some information about the fund's portfolio is not reflected in net asset values but in market prices. Fund valuations depend on the long-term credit spread between government and corporate bonds. Premia are also higher in funds with low systematic risk, which suggests that systematic risk is not fully reflected in net asset values. This lends support to the hypothesis that net asset values proxy for future cash flow, which, if divided by discount rate proxies like beta or credit spread, yields a market price.

Another new effect in listed private equity funds is the apparent under-performance of buyout funds following their IPO. Buyout funds exhibit premia that are 10–11% lower than premia in other funds, which is almost entirely attributable to poor stock performance over the first few years of the funds' lifetime. These findings suggest that future research on fund premia might benefit from examining the drop in first-year premia and the informational content of private equity net asset values.

References

- Ammer, J., 1990. Expenses, yields, and excess returns: New evidence on closed-end fund discounts from the UK, Financial Markets Group Discussion Paper Series No. 108, London School of Economics.
- Anson, M. J., 2002. Managed pricing and the rule of conservatism in private equity portfolios. *The Journal of Private Equity* 5 (2), 18–30.
- Artus, P., Teiletche, J., 2004. Asset allocation and european private equity: A first approach using aggregate data. EVCA Research Paper.
- Axelson, U., Stromberg, P., Weisbach, M. S., 2009. Why are buyouts levered? The financial structure of private equity funds. *Journal of Finance* 64 (4), 1549–1582.
- Baker, M., Greenwood, R., Wurgler, J., 2003. The maturity of debt issues and predictable variation in bond returns. *Journal of Financial Economics* 70 (2), 261–291.
- Baker, M., Wurgler, J., 2000. The equity share in new issues and aggregate stock returns. *Journal of Finance* 55 (5), 2219–2257.
- Ball, R., 1978. Anomalies in relationships between securities' yields and yield-surrogates. *Journal of Financial Economics* 6 (2-3), 103–126.
- Baltagi, B. H., Wu, P. X., 1999. Unequally spaced panel data regressions with AR(1) disturbances. *Econometric Theory* 15, 814–823.
- Barclay, M. J., Holderness, C. G., Pontiff, J., 1993. Private benefits from block ownership and discounts on closed-end funds. *Journal of Financial Economics* 33 (3), 263–291.
- Berk, J. B., 1995. A critique of size related anomalies. *Review of Financial Studies* 8 (2), 275–286.
- Berk, J. B., Stanton, R., 2007. Managerial ability, compensation, and the closed-end fund discount. *Journal of Finance* 62 (2), 529–556.
- Bilo, S., 2002. Alternative asset class: Publicly traded private equity, performance, liquidity, diversification potential and pricing characteristics. Ph.D. thesis, University of St. Gallen.
- Bleaney, M., Smith, R. T., 2003. Prior performance and closed-end fund discounts, Working Paper, University of Nottingham.
- Bonser-Neal, C., Brauer, G., Neal, R., Wheatley, S., 1990. International investment restrictions and closed-end country fund prices. *Journal of Finance* 45 (2), 523–547.
- Boudreaux, K. J., 1973. Discounts and premiums on closed-end mutual funds: A study in valuation. *Journal of Finance* 28 (2), 515–522.
- Brauer, G. A., 1984. 'Open-ending' closed-end funds. *Journal of Financial Economics* 13 (4), 491–507.

- Brauer, G. A., Chang, E. C., 1990. Return seasonality in stocks and their underlying assets: Tax loss selling versus information explanations. *Review of Financial Studies* 3 (2), 255–280.
- Brickley, J., Manaster, S., Schellheim, J., 1991. The tax-timing option and the discounts on closed-end investment companies. *Journal of Business* 64 (3), 287–312.
- Brickley, J. A., Schallheim, J. S., 1985. Lifting the lid on closed-end investment companies: A case of abnormal returns. *Journal of Financial & Quantitative Analysis* 20 (1), 107–117.
- Charitou, A., Makris, A., Nishiotis, G. P., 2006. Closed-end country funds and international diversification. *Multinational Finance Journal* 10 (3/4), 251–276.
- Chay, J., 1992. The pricing of closed-end funds: Discounts and managerial performance. Ph.D. thesis, State University of New York at Buffalo.
- Chay, J., Trzcinka, C. A., 1999. Managerial performance and the cross-sectional pricing of closed-end funds. *Journal of Financial Economics* 52 (3), 379–408.
- Chen, N.-F., Zhang, F., 1998. Risk and return of value stocks. *Journal of Business* 71 (4), 501–535.
- Cherkes, M., Sagi, J., Stanton, R., 2008. A liquidity-based theory of closed-end funds. *Review of Financial Studies* 22 (1), 257–297.
- Chordia, T., Subrahmanyam, A., Anshuman, V. R., 2001. Trading activity and expected stock returns. *Journal of Financial Economics* 59 (1), 3–32.
- Constantinides, G. M., 1984. Optimal stock trading with personal taxes: Implications for prices and the abnormal January returns. *Journal of Financial Economics* 13 (1), 65–90.
- Cumming, D., Fleming, G., Johan, S. A., 2010. Institutional investment in listed private equity, Working Paper, Available at SSRN: <http://ssrn.com/abstract=1541502>.
- Datar, V. T., Naik, N. Y., Radcliffe, R., 1998. Liquidity and stock returns: An alternative test. *Journal of Financial Markets* 1 (2), 203–219.
- De Long, J. B., Shleifer, A., Summers, L. H., Waldmann, R. J., 1990. Noise trader risk in financial markets. *Journal of Political Economy* 98 (4), 703–738.
- Dimson, E., 1979. Risk measurement when shares are subject to infrequent trading. *Journal of Financial Economics* 7, 197–226.
- Dimson, E., Minio-Kozerski, C., 1999. Closed-end funds: A survey. *Financial Markets, Institutions and Instruments* 8 (2), 1–41.
- Dimson, E., Minio-Kozerski, C., 2001. The closed-end fund discount and performance persistence, Working Paper, London Business School.

- Emery, K., 2003. Private equity risk and reward: Assessing the stale pricing problem. *Journal of Private Equity* 6 (2), 43–51.
- Fama, E. F., French, K. R., 1992. The cross-section of expected stock returns. *Journal of Finance* 47 (2), 427–465.
- Fama, E. F., French, K. R., 1993. Common risk factors in the returns on stocks and bonds. *Journal of Financial Economics* 33 (1), 3–56.
- Fama, E. F., French, K. R., 1995. Size and book-to-market factors in earnings and returns. *Journal of Finance* 50 (1), 131–155.
- Fama, E. F., French, K. R., 1998. Value versus growth: The international evidence. *Journal of Finance* 53 (6), 1975–1999.
- Fama, E. F., French, K. R., 2004. New lists: Fundamentals and survival rates. *Journal of Financial Economics* 73, 229–269.
- Gompers, P. A., Lerner, J., 2000. Money chasing deals? The impact of fund inflows on private equity valuation. *Journal of Financial Economics* 55, 281–325.
- Guo, S., Hotchkiss, E. S., Song, W., 2008. Do buyouts (still) create value?, Working Paper, Boston College.
- Hardouvelis, G. A., La Porta, R., Wizman, T. A., 1993. What moves the discount on country equity funds?, nBER Working Paper No. 4571.
- Kadapakkam, P.-R., Misra, L., Yildirim, S., 2005. Open-ending of closed-end funds: An analysis of discount reduction, Working Paper, University of Texas.
- Kaplan, S. N., Schoar, A., 2005. Private equity performance: Returns, persistence and capital flows. *Journal of Finance* 60, 1791–1823.
- Kaplan, S. N., Stein, J. C., 1993. The evolution of pricing and financial structure in the 1980s. *Quarterly Journal of Economics* 108 (2), 313–357.
- Kaplan, S. N., Strömberg, P., 2009. Leveraged buyouts and private equity. *Journal of Economic Perspectives* 23 (1), 121–146.
- Kaserer, C., Diller, C., 2004. European private equity funds – A cash flow based performance analysis. In: *Performance Measurement and Asset Allocation of European Private Equity Funds*. EVCA Research Paper, Brussels, pp. 27–68.
- Kim, C.-S., 1994. Investor tax-trading opportunities and discounts on closed-end mutual funds. *Journal of Financial Research* 17 (1), 65–75.
- Kothari, S., Shanken, J., 1997. Book-to-market, dividend yield, and expected market returns: A time-series analysis. *Journal of Financial Economics* 44 (2), 169–203.

- Kumar, R., Noronha, G. M., 1992. A re-examination of the relationship between closed-end fund discounts and expenses. *Journal of Financial Research* 15 (2), 139–147.
- La Porta, R., Lopez-de Silanes, F., Shleifer, A., Vishny, R. W., 1998. Law and finance. *Journal of Political Economy* 106, 1113–1154.
- Lahr, H., Herschke, F. T., 2009. Organizational forms and risk in listed private equity. *The Journal of Private Equity* 13 (1), 89–99.
- Lakonishok, J., Shleifer, A., Vishny, R. W., 1994. Contrarian investment, extrapolation and risk. *Journal of Finance* 44 (5), 1541–1578.
- Lee, C. M., Shleifer, A., Thaler, R. H., 1990. Anomalies: Closed-end mutual funds. *Journal of Economic Perspectives* 4 (4), 153–164.
- Lee, C. M., Shleifer, A., Thaler, R. H., 1991. Investor sentiment and the closed-end fund puzzle. *Journal of Finance* 46 (1), 75–109.
- Levis, M., Thomas, D. C., 1995. Investment trust IPOs: Issuing behavior and price performance. Evidence from the london stock exchange. *Journal of Banking and Finance* 19 (8), 1437–1458.
- Loughran, T., 1997. Book-to-market across firm size, exchange, and seasonality: Is there an effect? *Journal of Financial & Quantitative Analysis* 32 (3), 249–268.
- Malkiel, B. G., 1977. The valuation of closed-end investment-company shares. *Journal of Finance* 32 (3), 847–859.
- Petkova, R., Zhang, L., 2005. Is value riskier than growth? *Journal of Financial Economics* 78 (1), 187–202.
- Phalippou, L., Gottschlag, O., 2009. The performance of private equity funds. *Review of Financial Studies* 22 (4), 1747–1776.
- Piotroski, J. D., 2007. Discussion of 'The book-to-price effect in stock returns: Accounting for leverage'. *Journal of Accounting Research* 45 (2), 469–479.
- Pontiff, J., 1995. Closed-end fund premia and returns – Implications for financial market equilibrium. *Journal of Financial Economics* 37 (3), 341–370.
- Pontiff, J., Schall, L. D., 1998. Book-to-market ratios as predictors of market returns. *Journal of Financial Economics* 49 (2), 141–160.
- Pratt, E. J., 1966. Myths associated with closed-end investment company discounts. *Financial Analysts Journal* 22 (4), 79–82.
- Thompson, R., 1978. The information content of discounts and premiums on closed-end fund shares. *Journal of Financial Economics* 6 (2/3), 151–186.

Weiss, K., 1989. The post-offering price performance of closed-end funds. *FM: The Journal of the Financial Management Association* 18 (3), 57–67.

Zweig, M. E., 1973. An investor expectations stock price predictive model using closed-end fund premiums. *Journal of Finance* 28 (1), 67–78.

Appendix

Table 9: Correlation between premia and covariates

Figures are Pearson product-moment correlation coefficients. P-values are in parentheses.

	1	2	3	4	5	6	7	8
1 NAV premium (Ln)								
2 Fund age (Ln)	-0.157 (0.00)							
3 Bid-ask spread (Ln)	-0.057 (0.02)	-0.115 (0.00)						
4 Trading days (Ln)	-0.078 (0.00)	0.161 (0.00)	-0.563 (0.00)					
5 Beta	-0.142 (0.00)	0.057 (0.00)	-0.095 (0.00)	0.156 (0.00)				
6 Common law	0.178 (0.00)	0.062 (0.00)	0.317 (0.00)	-0.288 (0.00)	-0.047 (0.00)			
7 VCT	0.081 (0.00)	-0.065 (0.00)	0.599 (0.00)	-0.693 (0.00)	-0.088 (0.00)	0.324 (0.00)		
8 Managment fee	-0.015 (0.53)	-0.025 (0.17)	0.262 (0.00)	-0.263 (0.00)	-0.076 (0.00)	-0.071 (0.00)	0.419 (0.00)	
9 Cash / Total Assets	0.037 (0.17)	-0.273 (0.00)	0.087 (0.00)	-0.069 (0.00)	-0.019 (0.35)	0.009 (0.65)	-0.044 (0.03)	0.124 (0.00)
10 Cash / Market value	-0.099 (0.00)	-0.164 (0.00)	0.092 (0.00)	-0.030 (0.18)	-0.002 (0.91)	0.056 (0.01)	-0.035 (0.09)	0.140 (0.00)
11 Inst. Ownership (Ln)	0.030 (0.37)	0.122 (0.00)	-0.379 (0.00)	0.385 (0.00)	0.018 (0.49)	-0.097 (0.00)	-0.664 (0.00)	-0.305 (0.00)
12 Ownership conc. (Ln)	-0.105 (0.00)	0.069 (0.01)	-0.393 (0.00)	0.487 (0.00)	0.093 (0.00)	-0.272 (0.00)	-0.687 (0.00)	-0.361 (0.00)
13 Commitments (Ln)	0.063 (0.01)	0.088 (0.00)	-0.211 (0.00)	0.023 (0.24)	0.108 (0.00)	0.000 (1.00)	0.000 (1.00)	0.000 (1.00)
14 Commitments change	0.061 (0.01)	-0.018 (0.32)	0.001 (0.98)	0.039 (0.05)	-0.037 (0.00)	0.000 (1.00)	0.000 (1.00)	0.000 (1.00)
15 Small cap residuals	0.108 (0.00)	-0.001 (0.97)	0.112 (0.00)	-0.040 (0.04)	0.002 (0.86)	0.000 (1.00)	0.000 (1.00)	0.000 (1.00)
16 MSCI World	0.297 (0.00)	-0.048 (0.01)	0.042 (0.03)	0.022 (0.26)	-0.076 (0.00)	0.000 (1.00)	0.000 (1.00)	0.000 (1.00)
17 Interest rate UK	0.160 (0.00)	-0.106 (0.00)	-0.060 (0.00)	0.126 (0.00)	-0.133 (0.00)	0.000 (1.00)	0.000 (1.00)	0.000 (1.00)
18 Interest factor	0.172 (0.00)	-0.131 (0.00)	-0.027 (0.16)	0.138 (0.00)	-0.129 (0.00)	0.000 (1.00)	0.000 (1.00)	0.000 (1.00)
19 Spread UK	-0.408 (0.00)	0.112 (0.00)	-0.086 (0.00)	-0.048 (0.01)	0.123 (0.00)	0.000 (1.00)	0.000 (1.00)	0.000 (1.00)
20 Spread factor	-0.387 (0.00)	0.097 (0.00)	-0.067 (0.00)	-0.049 (0.01)	0.153 (0.00)	0.000 (1.00)	0.000 (1.00)	0.000 (1.00)
21 IPO volume (Ln)	0.361 (0.00)	-0.007 (0.69)	-0.165 (0.00)	0.089 (0.00)	0.017 (0.17)	0.000 (1.00)	0.000 (1.00)	0.000 (1.00)
22 IPO volume change	0.247 (0.00)	-0.035 (0.05)	0.022 (0.25)	0.023 (0.24)	-0.031 (0.01)	0.000 (1.00)	0.000 (1.00)	0.000 (1.00)

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Table 9 – continued from previous page

	9	10	11	12	13	14	15	16	
9	Cash / Total Assets								
10	Cash / Market value	0.878 (0.00)							
11	Inst. Ownership (Ln)	-0.039 (0.24)	-0.080 (0.02)						
12	Ownership conc. (Ln)	0.056 (0.06)	0.068 (0.03)	0.889 (0.00)					
13	Commitments (Ln)	0.028 (0.17)	0.019 (0.35)	0.138 (0.00)	0.089 (0.00)				
14	Commitments change	-0.032 (0.11)	-0.031 (0.14)	0.002 (0.95)	-0.009 (0.73)	0.006 (0.65)			
15	Small cap residuals	0.039 (0.05)	0.027 (0.19)	-0.057 (0.03)	-0.021 (0.40)	0.034 (0.01)	0.108 (0.00)		
16	MSCI World	0.007 (0.74)	-0.018 (0.39)	0.014 (0.59)	-0.001 (0.97)	-0.094 (0.00)	0.105 (0.00)	0.000 (1.00)	
17	Interest rate UK	-0.120 (0.00)	-0.124 (0.00)	-0.063 (0.02)	-0.061 (0.02)	-0.784 (0.00)	0.236 (0.00)	-0.110 (0.00)	0.155 (0.00)
18	Interest factor	-0.120 (0.00)	-0.130 (0.00)	-0.124 (0.00)	-0.086 (0.00)	-0.762 (0.00)	0.250 (0.00)	-0.078 (0.00)	0.142 (0.00)
19	Spread UK	-0.028 (0.16)	0.042 (0.04)	0.053 (0.05)	0.040 (0.11)	0.205 (0.00)	-0.019 (0.12)	-0.026 (0.03)	-0.499 (0.00)
20	Spread factor	-0.010 (0.63)	0.049 (0.02)	0.024 (0.38)	0.026 (0.29)	0.412 (0.00)	-0.122 (0.00)	-0.012 (0.34)	-0.625 (0.00)
21	IPO volume (Ln)	-0.004 (0.83)	-0.047 (0.02)	0.050 (0.06)	0.035 (0.16)	0.603 (0.00)	-0.106 (0.00)	-0.022 (0.07)	0.168 (0.00)
22	IPO volume change	0.014 (0.50)	-0.019 (0.37)	-0.004 (0.87)	-0.005 (0.83)	0.064 (0.00)	0.171 (0.00)	-0.126 (0.00)	0.392 (0.00)
		17	18	19	20	21			
17	Interest rate UK								
18	Interest factor	0.983 (0.00)							
19	Spread UK	-0.270 (0.00)	-0.288 (0.00)						
20	Spread factor	-0.517 (0.00)	-0.489 (0.00)	0.893 (0.00)					
21	IPO volume (Ln)	-0.364 (0.00)	-0.330 (0.00)	-0.229 (0.00)	-0.057 (0.00)				
22	IPO volume change	0.044 (0.00)	0.052 (0.00)	-0.324 (0.00)	-0.304 (0.00)	0.582 (0.00)			

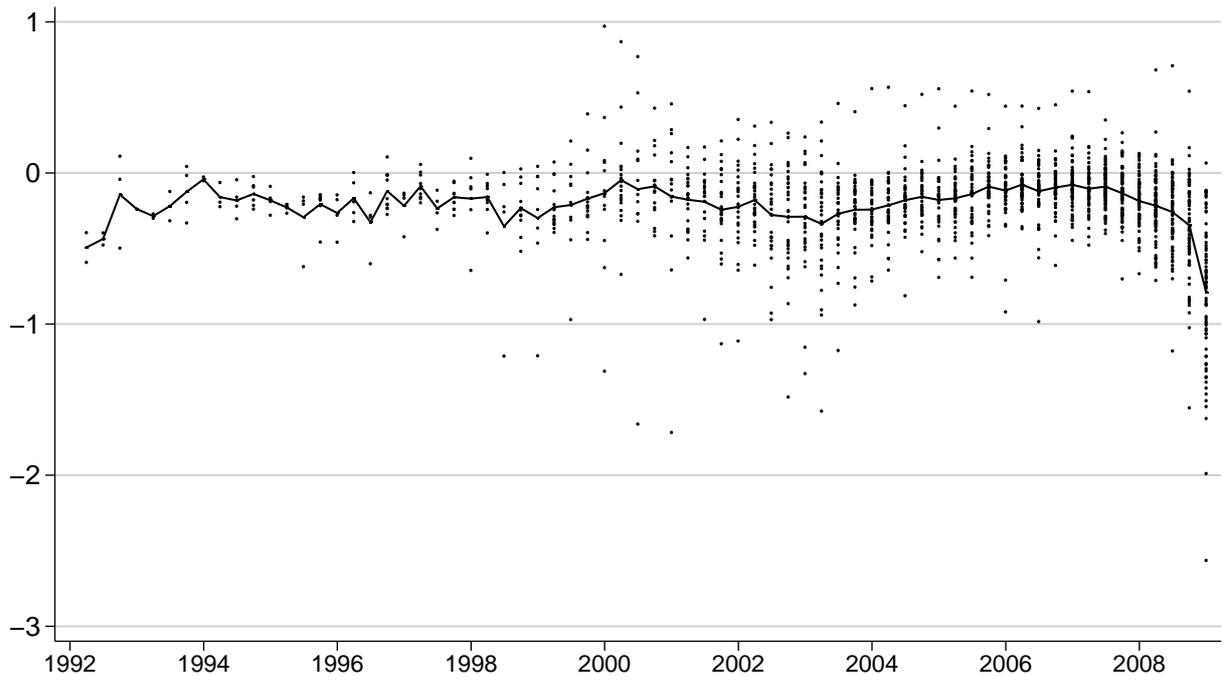


Figure 1: Premium in calendar time. Dots represent premium observations, the solid line is an equally weighted average of NAV premia.

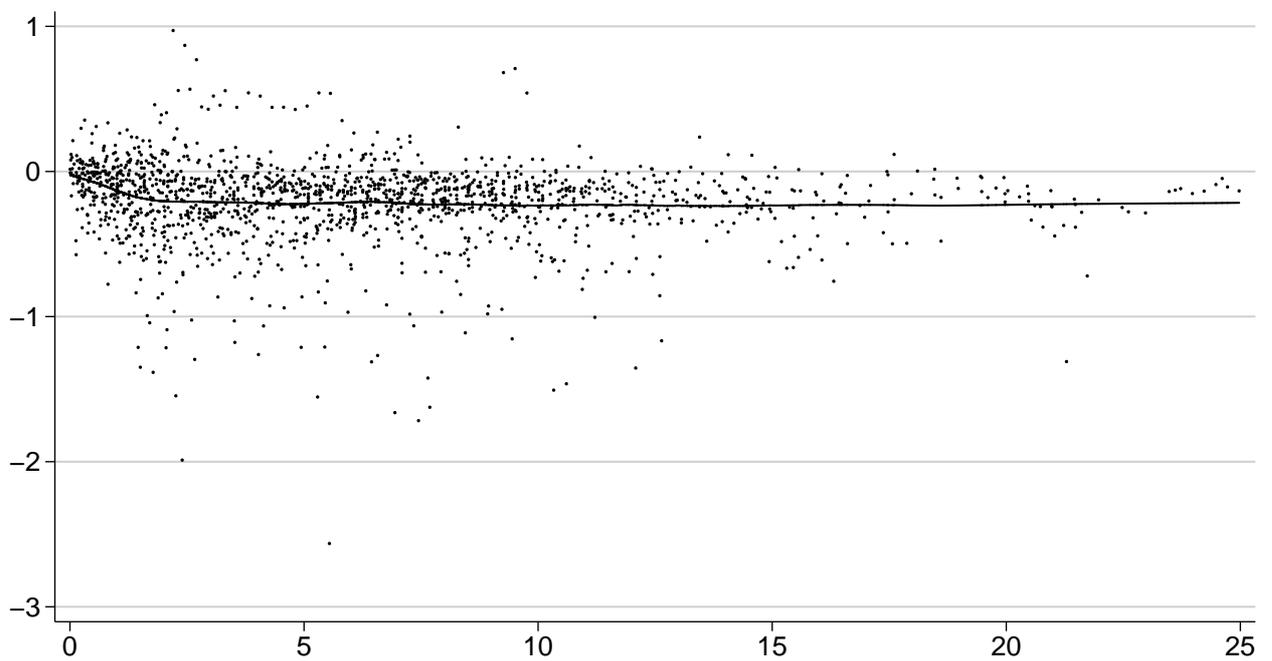


Figure 2: Premium in event time (years from IPO). The solid line represents the average premium estimated by locally weighted regression (Lowess) with bandwidth 0.25.

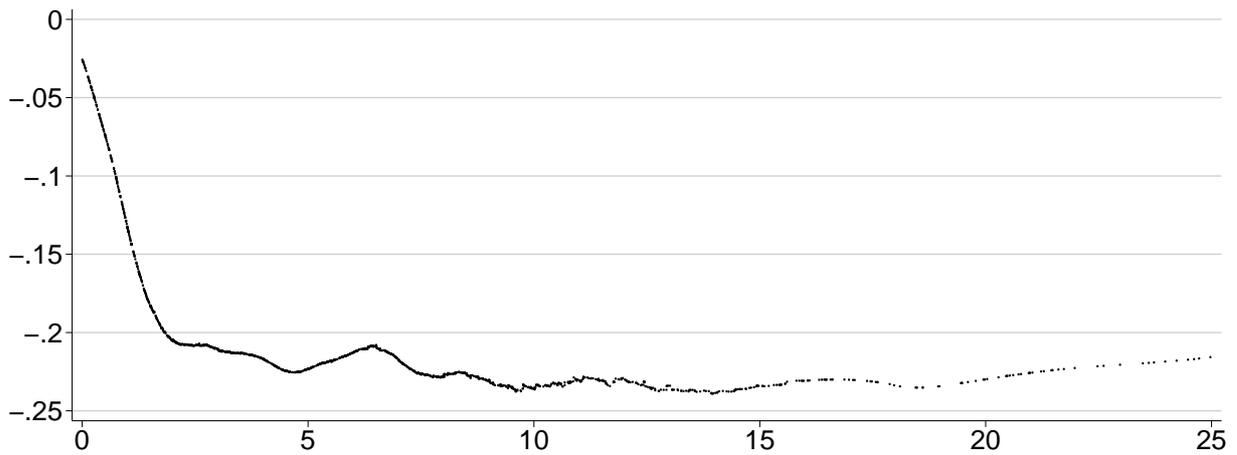


Figure 3: LOWESS prediction of premia (years from IPO). Locally weighted regression is performed with bandwidth 0.25.

Table 1: Summary statistics of independent and dependent variables

The "Panel" column denotes if data is available for cross-sections (i), time series (t), or both (p).

	Panel	Mean	SD	Min	25 %	Median	75 %	Max	N
NAV premium	p	-0.201	0.283	-2.564	-0.294	-0.154	-0.055	0.972	1792
Fund age (Ln)	p	6.571	5.511	0.005	2.295	5.466	9.096	32.619	1784
Bid-ask spread	p	0.020	0.031	-0.004	0.005	0.011	0.022	0.487	1792
Trading days	p	0.617	0.381	0.000	0.212	0.848	0.955	1.000	1785
Beta	p	0.653	1.893	-47.041	0.000	0.474	1.162	39.321	1792
Common law	i	0.701	0.458	0.000	0.000	1.000	1.000	1.000	1792
Venture capital trust	i	0.220	0.414	0.000	0.000	0.000	0.000	1.000	1792
Managment fee	i	0.017	0.005	0.004	0.014	0.018	0.020	0.035	1787
Cash / Total assets	p	0.111	0.153	0.000	0.015	0.052	0.141	1.000	1380
Cash / Market value	p	0.174	0.249	0.000	0.020	0.077	0.217	1.515	1377
Inst. ownership	p	0.319	0.255	0.005	0.112	0.254	0.500	1.150	877
Ownership conc.	p	0.048	0.090	0.000	0.003	0.017	0.050	0.766	977
Commitments (USD bn)	t	76.80	46.17	0.65	35.06	74.62	108.81	167.53	1792
Commitments change	t	0.121	0.898	-0.835	-0.239	-0.074	0.272	21.786	1790
MSCI excess return	t	-0.016	0.083	-0.211	-0.047	0.002	0.041	0.175	1790
Interest rate UK %	t	4.888	0.905	3.290	4.440	4.740	5.090	9.720	1792
Interest factor	t	-0.772	0.477	-1.696	-0.994	-0.834	-0.617	1.548	1792
Spread UK %	t	1.582	1.359	0.160	0.840	1.090	1.610	6.370	1792
Spread factor	t	0.553	1.208	-1.022	-0.252	0.169	1.075	4.562	1792
IPO volume (USD bn)	t	90.71	52.69	9.13	52.91	78.89	113.27	214.34	1792
IPO volume change	t	-0.127	0.691	-1.924	-0.586	-0.114	0.436	1.489	1790

Table 2: Post-IPO premia

A locally weighted regression with bandwidth 0.25 is performed on log premiums. The initial premium at day 0 is a linear extrapolation from 2 days after the IPO when the first premium observation occurred.

Years from IPO	0	0.5	1	1.5	2	3	4	5
Premium	-0.025	-0.073	-0.132	-0.181	-0.205	-0.210	-0.217	-0.223

Table 3: Return predictability

Reported are pooled OLS regressions of quarterly total stock returns with Newey-West standard errors using 4 lags. Model 3 is a pooled OLS regression with autocorrelation-adjusted variables using the Prais-Winsten transformation. “1st quarter” is a dummy variable equal to one if an observation is recorded in the first quarter of a calendar year, “Q1 after AR” is a dummy variable equal to one in the first quarter after annual reports are published.

Model	All		All, AR(1)	Buyout	Venture	FoF
	1	2	3	4	5	6
MSCI World	0.769***	0.768***	0.774***	0.746***	1.122***	0.630***
MSCI World Lag 1	-0.141	-0.139	-0.150	-0.131	-0.314	-0.056
MSCI World Lag 2	0.232***	0.234***	0.230***	-0.086	0.516**	0.277**
MSCI World Lag 3	0.267***	0.269***	0.264***	0.105	0.497**	0.286**
SMB	0.544***	0.542***	0.546***	0.287	1.240***	0.326*
SMB Lag 1	0.115	0.117	0.127	0.028	0.237	0.096
HML	0.019	0.018	0.019	0.122	-0.236	0.100
HML Lag 1	-0.353***	-0.351***	-0.358***	-0.117	-0.693***	-0.326**
GBP	-0.712***	-0.713***	-0.720***	-0.362	-1.360**	-0.684**
EUR	-0.188	-0.188	-0.193	-0.321	0.090	-0.215
JPY	0.229	0.231	0.232	0.455	0.101	0.148
NAV premium Lag 1	-0.074***	-0.074***	-0.068***	-0.042**	-0.120**	-0.068
NAV return Lag 1	0.091*	0.091*	0.107**	0.064	0.072	0.091
1st quarter	0.025**	0.007	0.007	0.054***	0.028	0.003
2nd quarter	-0.003	-0.007	-0.008	0.019	-0.038	0.004
3rd quarter	-0.020	-0.027**	-0.027*	-0.017	-0.014	-0.025
Q1 after AR		0.035**	0.035**			
Q2 after AR		0.010	0.010			
Q3 after AR		0.016	0.016			
Constant	0.007	-0.001	0.000	0.001	0.003	0.010
adj. R ²	0.295	0.299	0.318	0.233	0.419	0.286
N	967	967	967	320	260	387
Funds	67	67	67	23	23	21

*** $p < .01$; ** $p < .05$; * $p < .1$ two-side significance.

Table 4: Return predictability - adjusted for autocorrelation

Reported are fixed effects regressions of quarterly total stock returns for Cochrane-Orcutt transformed variables. Model 3 is a pooled OLS regression with autocorrelation-adjusted variables using the Prais-Winsten transformation for comparison with table 3. "1st quarter" is a dummy variable equal to one if an observation is recorded in the first quarter of a calendar year, "Q1 after AR" is a dummy variable equal to one in the first quarter after annual reports are published.

Model	All		All, AR(1)	Buyout	Venture	FoF
	1	2	3	4	5	6
MSCI World	0.797***	0.792***	0.774***	0.791***	1.075***	0.675***
MSCI World Lag 1	-0.092	-0.093	-0.150	-0.058	-0.258	0.007
MSCI World Lag 2	0.282***	0.284***	0.230***	0.013	0.502***	0.332***
MSCI World Lag 3	0.277***	0.276***	0.264***	0.204*	0.328*	0.339***
SMB	0.586***	0.593***	0.546***	0.267	1.394***	0.365**
SMB Lag 1	0.060	0.060	0.127	0.065	0.143	0.010
HML	0.033	0.028	0.019	0.175	-0.328	0.134
HML Lag 1	-0.376***	-0.375***	-0.358***	-0.233*	-0.678***	-0.294**
GBP	-0.793***	-0.798***	-0.720***	-0.600**	-1.167**	-0.761***
EUR	-0.180	-0.176	-0.193	-0.238	0.025	-0.189
JPY	0.198	0.193	0.232	0.378*	0.070	0.148
NAV premium Lag 1	-0.129***	-0.126***	-0.068***	-0.139***	-0.142***	-0.142***
NAV return Lag 1	0.092**	0.097**	0.107**	0.005	0.034	0.108*
1st quarter	0.028**	0.008	0.007	0.067***	0.032	0.004
2nd quarter	-0.001	-0.009	-0.008	0.031	-0.041	0.006
3rd quarter	-0.023*	-0.031**	-0.027*	-0.021	-0.005	-0.027
Q1 after AR		0.039***	0.035**			
Q2 after AR		0.016	0.010			
Q3 after AR		0.020	0.016			
Constant	0.000	-0.009	0.000	-0.008	-0.001	-0.001
R ² within	0.340	0.349		0.329	0.482	0.342
R ² total	0.327	0.335	0.318	0.270	0.486	0.327
ρ	-0.050	-0.040	-0.043	-0.211	-0.075	-0.072
N	900	900	967	297	237	366
Funds	66	66	67	23	22	21

*** $p < .01$; ** $p < .05$; * $p < .1$ two-side significance.

Table 5: Return predictability - variable CAPM coefficients

Reported are pooled OLS regressions of residuals from fund-specific three-factor CAPM regressions on seasonal dummy variables. Standard errors are Newey-West errors using 4 lags. Fama-French CAPM regressions are estimated by $R_t = \alpha + \sum_{k=0}^3 \beta_k M_{t-k} + \lambda_1 SMB_t + \lambda_2 SMB_{t-1} + \lambda_3 HML_t + \lambda_4 HML_{t-1} + \gamma_1 GBP_t + \gamma_2 EUR_t + \gamma_3 JPY_t + \phi_1 PREM_{t-1} + \phi_2 RNAV_{t-1} + \epsilon_t$ where R_t and M_t are the respective excess fund and market returns, SMB and HML are size and book-to-market factors, GBP , EUR , and JPY are excess returns on currency portfolios, $PREM$ is the NAV premium and $RNAV$ is the NAV return. Model 3 is a pooled OLS regression with autocorrelation-adjusted variables using the Prais-Winsten transformation. “1st quarter” is a dummy variable equal to one if an observation is recorded in the first quarter of a calendar year, “Q1 after AR” is a dummy variable equal to one in the first quarter after annual reports are published.

Model	All		All, AR(1)	Buyout	Venture	FoF
	1	2	3	4	5	6
1st quarter	-0.007	-0.023	-0.018	0.025	-0.049	-0.007
2nd quarter	-0.044***	-0.048***	-0.048***	-0.034**	-0.104***	-0.011
3rd quarter	-0.023**	-0.033**	-0.034**	-0.014	-0.076***	0.004
Q1 after AR		0.031*	0.032**			
Q2 after AR		0.009	0.010			
Q3 after AR		0.020	0.022			
Constant	-0.002	-0.009	-0.010	-0.009	0.037	-0.020*
adj. R ²	0.011	0.013	0.017	0.017	0.042	-0.006
N	967	967	967	320	260	387
Funds	67	67	67	23	23	21

*** $p < .01$; ** $p < .05$; * $p < .1$ two-side significance.

Table 6: Age effect in buyout fund returns

Reported are OLS-coefficients for quarterly total stock returns with Newey-West standard errors using 4 lags. Only buyout funds are included.

MSCI World	0.698***	NAV return Lag 1	0.049	adj. R ²	0.237
MSCI World Lag 1	-0.093	1st quarter	0.060***	N	320
SMB	0.266	2nd quarter	0.012	Funds	23
HML	0.084	3rd quarter	-0.012		
GBP	-0.231	Age < 1 year	-0.036***		
EUR	-0.407	1 year ≤ Age < 2 years	-0.012		
JPY	0.446	2 years ≤ Age < 3 years	-0.015		
NAV premium Lag 1	-0.036*	Constant	0.009		

*** $p < .01$; ** $p < .05$; * $p < .1$ two-side significance.

Table 7: Regression of differenced premia

The dependent variable is logarithmic premium returns. Models 1 to 4 are pooled OLS regressions, where model 1 includes all variables where sufficient data is available and model 2 includes only significant variables. Pooled OLS models 5 to 7 use padded values for net asset values if they are missing in some quarters. Model 8 to 11 are random effects regressions assuming AR(1) errors. The estimated error correlation is reported as ρ . Small-cap residuals are residuals from a regression of a small-cap factor that is composed of UK-, US-, and European small capitalization indices, regressed on MSCI World returns.

Model	Pooled OLS				Padded NAV, pooled OLS			AR(1)		Padded NAV, AR(1)	
	1	2	3	4	5	6	7	8	9	10	11
MSCI World	0.378***	0.207***	0.418***	0.386***	0.308***	0.207***	0.474***	0.394***	0.340***	0.316***	0.221***
Small-cap residuals	0.042*	0.017	0.046*	0.042	0.026*	0.017	0.013	0.044*	0.049**	0.025	0.016
SMB	0.270	0.084	0.214	0.314	0.012	0.084	0.359**	0.261	0.173	0.016	0.077
SMB Lag 1	-0.372***	-0.354***	-0.378***	-0.427***	-0.300***	-0.354***	-0.347***	-0.359**	-0.385***	-0.295***	-0.367***
HML	0.152	0.085	0.169	0.241*	0.138*	0.085	0.079	0.156	0.160*	0.137*	0.098
HML Lag 1	-0.548***	-0.238***	-0.459***	-0.506***	-0.350***	-0.238***	-0.292**	-0.549***	-0.450***	-0.352***	-0.241***
1st quarter	0.002	0.030**	-0.003	-0.015	0.033	0.030**	0.037	0.000	-0.006	0.033*	0.028**
2nd quarter	0.052***	0.029***	0.032**	0.036**	0.046***	0.029***	0.027*	0.052***	0.045***	0.047***	0.030***
3rd quarter	0.006	0.020	0.001	-0.017	0.024	0.020	0.018	0.005	0.004	0.023	0.019
Age (Log)	0.011**	0.010***	0.006	0.006	0.012***	0.010***	0.008*	0.011	0.010*	0.012**	0.010**
Δ IPO volume (Log)	0.029	0.040***	0.029	0.039*	0.030**	0.040***	0.031	0.029	0.045***	0.031***	0.040***
Δ IPO volume Lag 1	0.070***	0.028***	0.046**	0.074***	0.030**	0.028***	0.028*	0.071***	0.069***	0.032**	0.030***
Δ Cash / Total assets			0.006								
Δ Ownership factor				-0.032*			-0.018				
Δ Commitments (Log)	0.030				0.030**			0.030		0.030**	
Δ Beta	-0.006*	-0.005***	-0.004***	-0.006**	-0.008*	-0.005***	-0.008**	-0.007**	-0.004***	-0.008***	-0.005***
Δ Interest factor	-0.040				-0.036			-0.046		-0.043	
Δ Spread factor	-0.078***	-0.066***	-0.051***	-0.064***	-0.075***	-0.066***	-0.059***	-0.079***	-0.059***	-0.076***	-0.064***
Δ Bid-ask spread (Log)	0.005				0.014			0.006		0.016	
Δ Days traded (Log)	0.006				-0.004			0.006		-0.005	
Constant	-0.031*	-0.038***	-0.017	-0.013	-0.050***	-0.038***	-0.037**	-0.029	-0.025*	-0.050***	-0.038***
R ² within								0.382	0.369	0.218	0.178
R ² total	0.388	0.196	0.312	0.397	0.238	0.196	0.289	0.388	0.375	0.238	0.196
ρ								0.034	0.031	-0.064	-0.096
N	849	2362	781	623	1788	2362	1018	849	1012	1788	2362
Funds	66	99	52	43	99	99	59	66	68	99	99

*** $p < .01$; ** $p < .05$; * $p < .1$ two-side significance.

Table 8: Regression results for NAV premia

This table reports regressions logarithmic NAV premia. Models 1 to 7 are random effects regressions using the Baltagi and Wu (1999) GLS method. Model 8 and 9 are OLS random effects and fixed effects regressions, and model 10 is a pooled OLS regression with Prais-Winsten transformed variables to account for AR(1) errors. “Small-cap residuals” are residuals from regressing a small-cap factor on MSCI World excess returns. This small-cap factor is constructed from U.K., U.S., and European small-cap index excess returns. “Interest factor” and “Spread factor” are the main common factors of U.K., U.S., and Euro interest rates and yield spreads, respectively.

Model	GLS							RE, AR(0)	FE, AR(0)	Pooled, AR(1)
	1	2	3	4	5	6	7	8	9	10
Age < 1 year	0.099 ***	0.080 ***	0.083 **	0.095 **	0.104 **		0.103 ***	0.132 ***	0.183 ***	0.081 ***
1 year ≤ Age < 2 years	0.057 **	0.042 *	0.064 **	0.071 *	0.073 **		0.058 **	0.090 ***	0.131 ***	0.050 **
2 years ≤ Age < 3 years	0.025	0.011	0.038 *	0.036	0.028		0.027	0.047 **	0.074 ***	0.020
Age (Log)						-0.030 ***				
Bid-Ask Spread (Log)	-0.055 ***	-0.081 ***	-0.049 ***	-0.072 ***	-0.073 ***	-0.057 ***	-0.057 ***	-0.073 ***	-0.076 ***	-0.049 ***
Days traded (Log)	-0.038 ***	-0.030 ***	-0.031 ***	-0.027	-0.033 **	-0.036 ***	-0.037 ***	-0.057 ***	-0.052 ***	-0.039 ***
Beta	-0.006 **	-0.007 ***	-0.005 *	-0.012 ***	-0.012 ***	-0.006 **	-0.006 **	-0.003	-0.002	-0.008 ***
Common law	0.139 ***	0.151 ***	0.135 ***	0.158 ***	0.152 ***	0.132 ***	0.141 ***	0.131 ***		0.176 ***
VCT	-0.020	-0.001	-0.006	-0.014	0.028		-0.016	-0.027		-0.054 *
Venture fund	0.105 **	0.127 ***	0.089 *	0.095	0.103 *	0.099 ***	0.105 **	0.104 **		0.141 ***
Fund of funds	0.106 **	0.109 ***	0.103 **	0.132 **	0.127 **	0.098 **	0.107 **	0.122 ***		0.106 ***
Management fee	1.776	1.695	0.751	0.467	-0.510		1.824	2.164		0.336
Cash / Total assets			0.044							
Inst. ownership (Log)				-0.002						
Ownership conc. (Log)					-0.005					
Commitments (Log)	0.065 ***		0.060 ***	0.063 **	0.054 **	0.066 ***	0.054 ***	0.075 ***	0.078 ***	0.066 ***
IPO volume (Log)	0.041 ***		0.032 **	0.037 *	0.042 **	0.041 ***	0.044 ***	0.048 ***	0.052 ***	0.033 **
MSCI World	0.020	0.163 **	0.103	0.088	0.080		0.175 **	0.004	0.027	0.031
Small-cap residuals	0.072 ***	0.061 ***	0.066 ***	0.107 ***	0.094 ***	0.072 ***	0.078 ***	0.071 ***	0.065 ***	0.083 ***
Interest factor	0.080 ***	0.085 ***	0.073 ***	0.089 **	0.091 **	0.077 ***		0.070 ***	0.060 ***	0.087 ***
Interest UK							0.041 ***			
Spread factor	-0.079 ***	-0.083 ***	-0.064 ***	-0.092 ***	-0.077 ***	-0.080 ***		-0.078 ***	-0.073 ***	-0.080 ***
Spread UK							-0.060 ***			
Constant	-1.776 ***	-0.694 ***	-1.579 ***	-1.752 ***	-1.714 ***	-1.698 ***	-1.909 ***	-2.077 ***	-1.987 ***	-1.682 ***
R ² within	0.400	0.331	0.321	0.461	0.428	0.391	0.402	0.408	0.411	
R ² total	0.339	0.289	0.271	0.379	0.362	0.334	0.341	0.333	0.256	
ρ	0.528	0.556	0.581	0.557	0.553	0.536	0.526			
N	1458	1458	1211	720	812	1463	1458	1458	1458	1458
Funds	98	98	80	58	64	99	98	98	98	98

*** $p < .01$; ** $p < .05$; * $p < .1$ two-side significance.