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Listed Private Equity Returns: The Forecasting Power of Premiums and Discounts

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by
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Abstract

In this paper, I assess the ability of premiums and discounts to predict future listed private equity returns. I hypothesize that the premiums and discounts of the net asset value of the listed private equity funds with monthly lags hold forecasting power. I use four distinct listed private equity indices and their respective NAV P/D values for my research. To ensure my analysis is realistic in scope, I incorporate a variety of macroeconomic variables that have been proven to influence listed private equity returns. I structure my time-period analysis around the 2008-09 financial crisis. I generally find that a two-month lag has a negative relation with LPE returns and is significant for the whole time period, but a one-month lag has a negative relation and is significant for the time period after the financial crisis, although there are discrepancies between the four indices. My findings indicate the ability of premiums and discounts to forecast LPE returns with either a one- or two-month lag. I propose explanations for the divergence in lags. I conclude that at the moment, a one-month lag of the premiums and discounts is most effective in forecasting LPE returns.

Keywords: listed private equity, premiums, discounts, financial crisis

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Acknowledgements

I would like to first and foremost thank Michel Degosciu of the LPX Group in Switzerland for his guidance and support throughout my thesis process. I looked forward to our weekly Thursday morning meetings where I knew he would provide critical, constructive feedback for me every step of the way. Michel offered me a look behind the curtain of financial institutions in Europe and around the world, and for that I cannot thank him enough. I would also like to thank my thesis reader, Professor Nishant Dass, the newly minted "full" Professor of Finance, who provided the inspiration for my topic.

I am grateful for my parents and sister, who looked at me with puzzled faces as I explained my thesis topic to them. As long as they read the Abstract, I'll be content. Their indirect support pushed me through long nights in the Ryal computer lab and frustrated moments staring at a spinning color ball that had become my mouse cursor in Excel.

Finally, I would like to thank my friends at CMC. Thesis is a journey, and one which I was fortunate enough to bring my friends along for the ride.

Cheers.

- Daniel

1. Introduction

1.1 Listed Private Equity Index

Listed private equity indices provide a benchmark that track the performance of publicly traded private equity companies or funds. The indices offer a way to measure the performance of listed private equity markets, either as a whole or in specific segments of the market. The indices track the performance of companies that typically invest in private businesses. These private equity companies typically pursue goals of acquiring a controlling stake in the respective business in order to increase their value. Private equity companies can provide capital through financing or investing.

There exist a number of listed private equity indices that track exchange-traded private equity companies. The one I will be using, the LPX Listed Private Equity Index Series, is one of the most widely followed listed private equity indices. The index provides a benchmark for investors to evaluate the performance of private equity investments. The LPX Index is based on a global list of private equity companies. I explore the module containing the following private equity investment styles: LPX Buyout, LPX Direct, LPX Venture, and LPX50. The indices are weighted stock indices based on market-capitalization. The indices are updated daily, providing up-to-date data for customers. The portfolios are updated twice per year, although there are typically only 1-2 changes per index per update. Each index caps the weight of individual companies. For all but the Venture Index, which uses a cap of 10%, the cap is 7.5%. This ensures an even distribution of weight amongst the companies. I use these indices to look at whether LPE discounts and premiums can predict future LPE returns.

1.2 Investment Styles

Listed private equity companies provide capital through styles of financing or investing. The former consists of providing equity, mezzanine or debt capital, while the latter consists of making buyout, growth, or venture capital investments, to name a few. I will be focusing on buyout and venture capital investments. Buyout investments involve buying a controlling stake in a company, typically with the intention of restructuring the company to sell at a later date. Venture capital investments involve investing in a company with a goal of developing a product or service. Companies that pursue venture investments typically receive a share of the company to promote incentives. Venture investments are betting on a company being profitable in the future. Various styles of investing carry various risks and rewards and attract different types of investors.

Of the LPX established private equity indices, I will analyze the predictive power of premiums and discounts for the LPX Buyout, LPX Direct, LPX Venture, and LPX50. These indices offer insight on various investment styles and firm sizes. Discrepancies in the results will shed light on the potential returns associated with each. The LPX50 Index represents the global performance of the 50 most highly capitalized and liquid listed private equity companies. This index considers all regions and investment styles to purely focus on the size of the companies. The LPX Buyout Index considers listed private equity companies that invest with a buyout investment strategy. The index consists of the 30 most highly capitalized and liquid companies. The LPX Direct Index considers companies that pursue direct investment strategies, as opposed to investing in other private equity companies or third party capital. Again, this index considers 30 of the most highly capitalized and liquid companies. Finally, the LPX Venture Index considers

companies that pursue venture strategies, which typically involves investments in start-ups and early-stage companies. There is some overlap between the indices. For the study, I make use of a novel LPE dataset collected by LPX to analyze the power of premiums and discounts to forecast future returns.

1.3 Premiums and Discounts

Premiums and discounts describe the difference between the market price of an asset and its intrinsic value. A premium occurs when a stock trades at a higher price than its intrinsic value. In the world of stocks, the buyer pays more than the stock is worth. A discount, on the other hand, occurs when a stock trades at a lower price than its intrinsic value. Likewise, a seller receives less than the stock is worth. With regard to listed private equity indices, the premiums and discounts may offer valuable insight on the future returns of the index; they offer indication of under and overvalued companies. A premium may forecast a future index return in one, two, or three months. I consider the premiums and discounts of the net ass value, or NAV, which represents the total value of a company's assets minus its liabilities. In other words, the valuation of the company's investments. The market price for the various investment portfolios of the LPE firms in the private companies can be above or below the NAV. The NAV has the power to provide a valuation of a company by being a sound indication of a company's financial health. The NAV of an LPE firm is the sum of the valuations of its investments plus other net assets minus its total liabilities. There exists a premium when the market price is above the NAV and a discount when the market price is below the NAV. Fluctuations in NAV discounts and premiums ought to provide an indication of the current and future performance of the company.

1.4 LPE During a Recession

I explore the returns of LPE funds during various time periods: before, during, and after the 2008-09 financial crisis. LPE companies may be affected by a recession in various ways depending on the specific market conditions and investment strategies of the fund. Generally, some effects include volatility in valuations, reduced exit opportunities, and changes in leverage. In a recession, the value of private companies may decline, which negatively impacts the valuation of the LPE firms holding said private companies. This results in lower stock prices for the LPE companies. During a recession or time of financial instability, there may also be fewer buyers for private companies. Because LPE companies generate returns by selling their investments, a lack of potential buyers harms the exit opportunities of the firms, stalling the selling process.

The effects of a financial crisis on LPE companies vary based on the investment style of the companies. Buyout and Venture investments take on various risks, and the companies at the end of each investment may be affected differently by a financial crisis or economic downturn. For instance, an LPE company specializing in Buyout investments may suffer due to reduced access to debt and equity. On the other hand, with an economic downturn come numerous companies in distress, which LPE Buyout companies can jump on to turn around. However, an LPE company specializing in Venture investments, which involves investing in early-stage and potential high-growth companies, can have severe fluctuations in performance. Again, there is reduced access to financing, but there is also great opportunity as companies crumble and others

rebuild. The discrepancies between the various investing styles becomes clear through my analysis, in which I analyze the effects of the financial crisis on the distinct LPE funds.

I explore whether the LPE discounts and premiums of the to NAV can predict future LPE returns. These findings shed light on index values and future fund performances for LPE firms and potentially other investment firms. In addition, I consider how macroeconomic factors affect LPE returns. Together, I hope to partially explain the fluctuations behind ever-changing LPE returns.

2. Literature Review

I model my regression and research off of Michel Degosciu's work for the LPX Group, a Swiss based financial institution. The group collects data on indices and sells them to private equity companies and other financial groups to provide insight on returns and investment decisions. Michel Degosciu's work, titled *Private Equity Discounts* from 2013, uses a novel data set of LPE valuations to analyze discounts and premiums of LPE companies and how they can predict LPE returns. He looks at various capital investments, applying regression analysis to all. He also looks at whether discounts and premiums fluctuate based on macroeconomic factors, and how they directly and indirectly affect returns. He looks at term spread, credit spread, TED spread, and GDP. He uses a variety of lags for his regression to determine how far into the future the discounts and premiums forecast returns. He concludes that using two lags, which more or less look at the NAV discount from the month prior in comparison to the return of the current month, provides the clearest results. He finds a negative relation between LPE returns and LPE discounts and premiums with two lags - the key takeaway of his research. With one lag, he finds a positive relation. I build off his findings by using three lags to determine how far the premiums and discounts forecast returns. As for the macroeconomic factors, Degosciu finds that stock market returns and GDP have a positive effect on the discounts from the index. Credit, TED, and term spread have a negative effect. I further build off his findings by studying the effects of interest rates on discounts and premiums and how they affect returns in a more recent time period with different macroeconomic variables.

My work closely mirrors Degosciu's for much of the econometric analysis. However, my data set will be newer, and therefore hold novel implications. I will also apply more lags and

consider a variety of macroeconomic factors. Degosciu's work provides a framework off which I base my analysis, but I will look to add features as well.

Lahr & Kaserer (2009) explain how LPE funds do not typically begin with a premium, but they show a negative premium months later. Not only that, but the negative relation is stable across specifications. To build off their findings, I apply various lags to determine the forecasting period of NAV premia and discounts. I also consider novel data and apply macroeconomic factors both as independent and control variables. Soulignac (2012) concludes that purchasing assets at a discount to NAV is a high benefit of transacting in the secondary market. The analysis also finds a positive correlation between NAV discounts and fund performance, which I will be exploring in more depth.

Berggrun et al. (2021) explore a similar topic to my research, but with closed-end funds rather than listed private equity. Their findings offer an opportunity to explore comparisons between listed private equity and closed-end fund returns. The growing premiums in the market can predict future behavior as they indicate a potential decrease in share price returns for the next one or two periods. In other words, a negative relation between premiums and share price. The predictive power of premiums is clear. Fortin et al. (2019) consider the long-term link between discounts and premiums and valuations in closed-end funds as well. The authors have a variety of findings but conclude that discounts and premiums have uncertain impacts on closed end funds' performance.

Döpke et al. (2018) use data directly from the LPX Group to look at the effect of global risk factors, such as inflation rate, on LPE returns. By incorporating various risk factors such as the change in a currency basket, the G-7 industrial production, term spread, inflation rate, and a newly suggested measure of economic policy uncertainty, a multifactor model successfully

determines the expected returns on a broad range of LPE investments. It is clear that global risk factors have an impact.

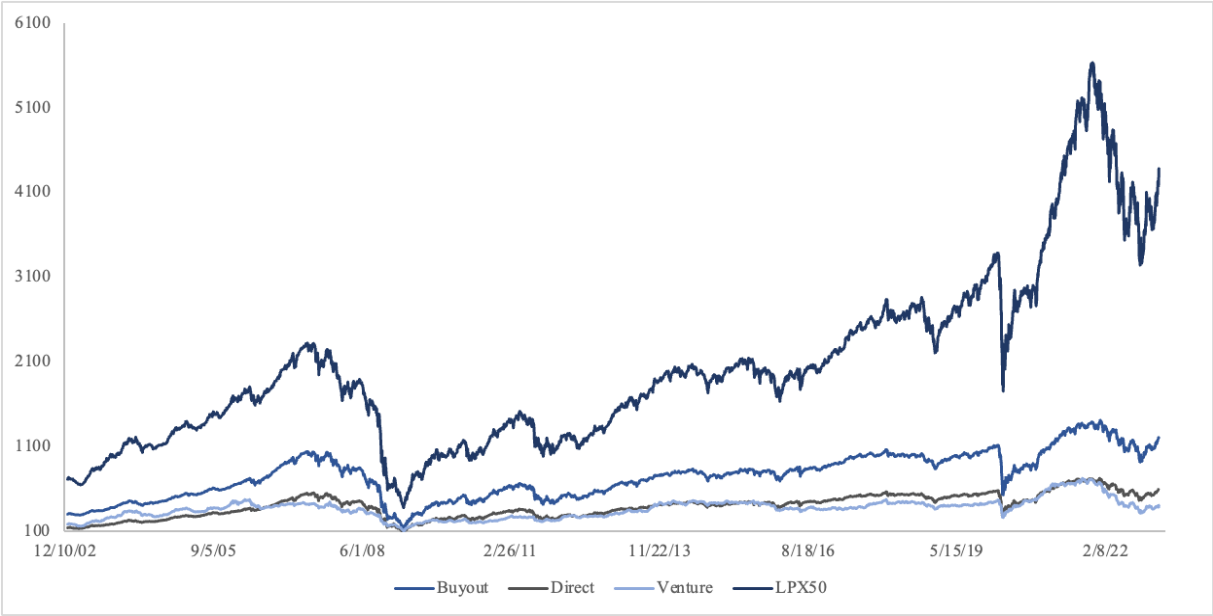
Castilho et al. (2019) look at venture capital and private equity funds and how their capital structures at the time of initial public offering (IPO) reduce the underpricing of shares. They find that the involvement of VC/PE funds has the potential to alleviate the impact of information asymmetry on managers and shareholders, which ultimately leads to a decrease in the underpricing of companies during their IPO. Tegtmeier (2023) provides recent analysis on the volatilities in LPE markets. He finds that understanding the conditional volatilities of LPE returns and identifying the transmission of this volatility among the various LPE markets can assist in making asset allocation decisions, especially related to risk management and portfolio allocation. Dharni & Kaur (2022) explore the effect that association rules have on global stock indices. They conclude that association rules have the potential to provide returns for said global stock indices.

My analysis considers the effects of the 2008-09 financial crisis on the ability of premiums and macroeconomic factors to forecast LPE returns. Bernstein et al. (2019) explore the relationship between private equity and financial fragility during a crisis. They focus on the 2008 financial crisis. They find that companies backed by PE firms decreased their investments less than companies that were not PE-backed. In essence, PE-backed companies performed better with regard to equity and debt inflows, as well as generally higher asset growth and market share. In fact, during a financial crisis, PE firms were found to spend more time with their portfolio companies, developing a sounder relationship while outperforming companies not backed by PE firms. Despite the fragility of the situation, PE firms take time during crises to reassure their portfolio companies.

3. Empirical Description

I use the LPX equity index and LPX NAV P/D index series for four distinct indices: LPX Direct, LPX Buyout, LPX Venture, and LPX50. All values are in U.S. dollars. The four are displayed below.

Figure 1: Index Values 2003-2023

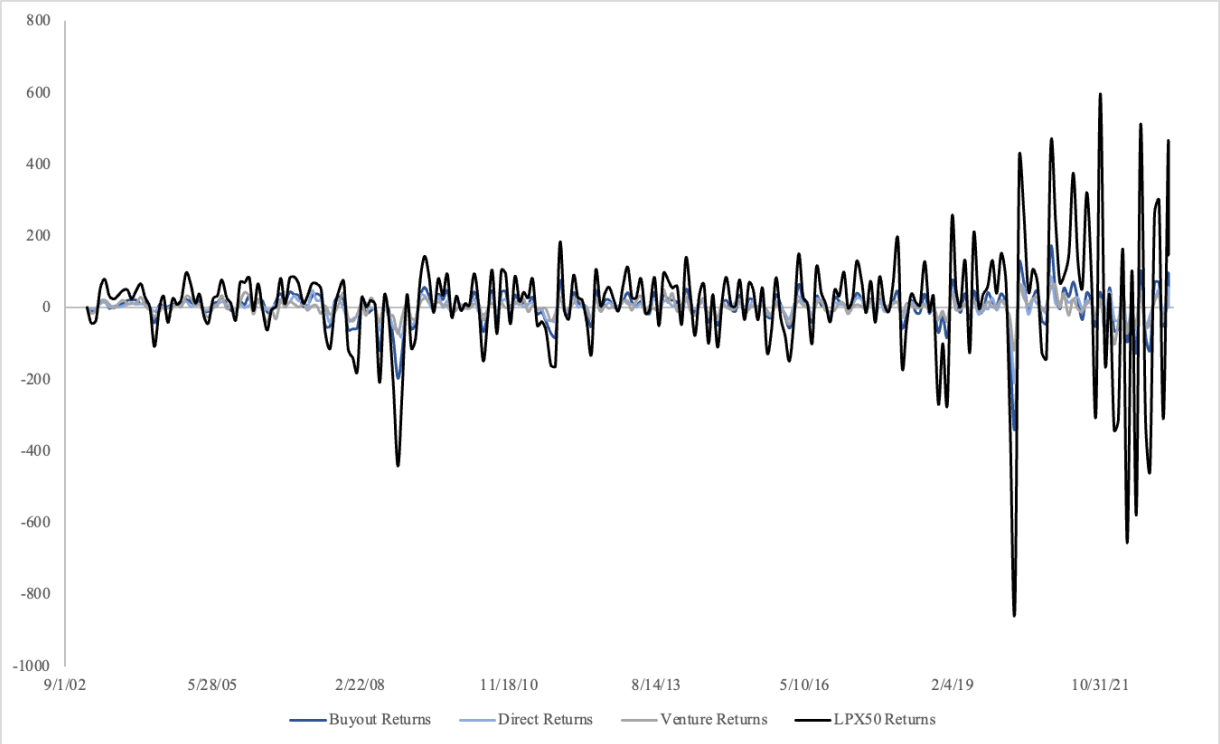


Source: LPX 2023

All the indices date back to 2003 except for the Venture Index, which dates back to 2004. The indices closely follow one another in direction, although there are clear discrepancies in magnitude. The LPX50 Index is the greatest, followed by the Buyout, Direct, and Venture Indices. Of note is the evident dip in value leading up to and during the financial crisis of 2008-09. The recovery from the crisis was slow, taking over five years for most of the Indices to

return to their pre-financial crisis value. It is for this reason that it is worth studying the time periods during and surrounding the financial crisis. The COVID-19 pandemic introduced another decline in Index value, although this was far sharper. The indices also all recovered far faster, and even exceeded their pre-COVID values by large margins. Due to the prolonged effects of the financial crisis, I focus my analysis on the time periods surrounding 2008-09. That being said, the evidence from the COVID-19 pandemic may affect the regression results in which the pandemic occurred. To more closely map the returns of each index, I plot the monthly returns from 2003 to 2023.

Figure 1: Index Values 2003-2023

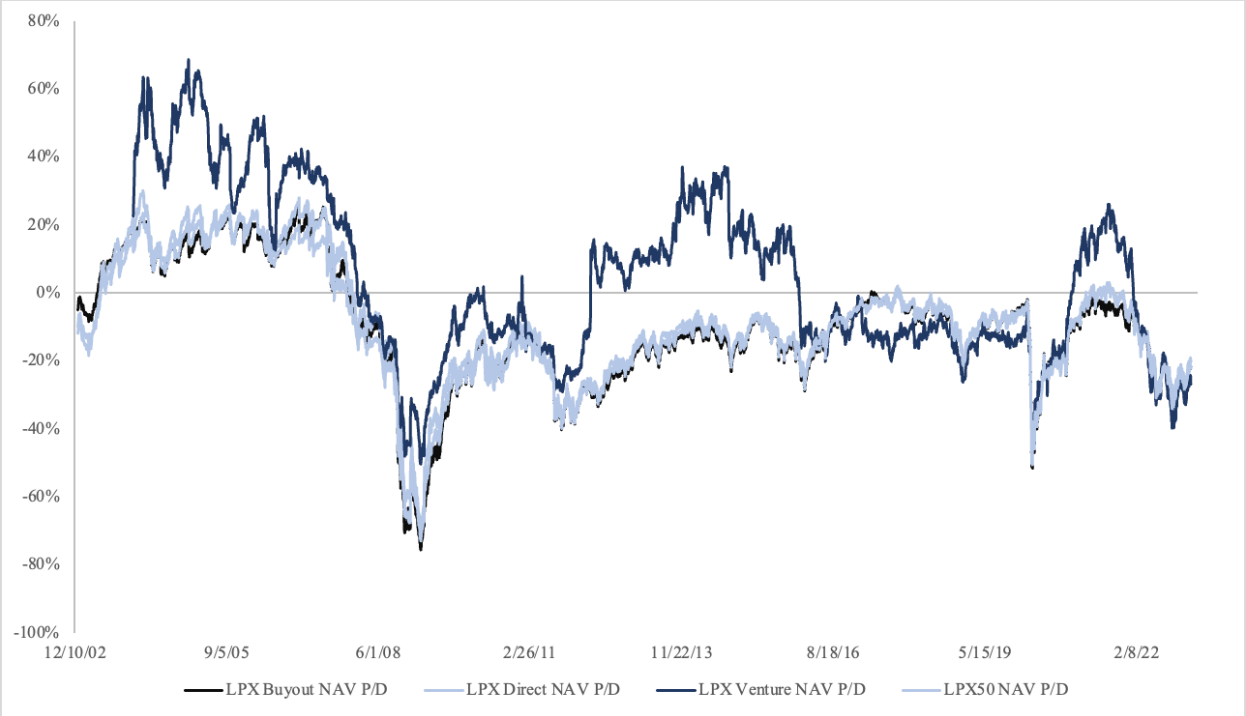


Source: LPX 2023

The returns follow similar patterns to the index values, with the LPX50 returns having the largest changes due to the size of the index. Despite this, the LPX50 index appears to have the greatest variation in returns in times of crisis. On the other hand, the Venture returns appear to be more stable.

The index series measures the share price while the LPX NAV P/D series tracks the premium and discount of the LPE funds; discounts and premiums can also be interpreted as the book to market ratio. Book to market ratio is a measure of a company's value and financial health. A higher book to market equity ratio indicates that a company is undervalued, while a lower ratio indicates that it is overvalued. The NAV P/D values, or premiums and discounts are displayed below:

Figure 2: NAV P/D Values 2003-2023



Source: LPX 2023

The NAV P/D values follow a similar pattern as the Index value with respect to direction, although the Venture NAV P/D has on consistently positive premiums between 2012 and 2015 while the other three funds have consistently negative premiums. The risk associated with venture investments may explain the positive premium associated with the Venture NAV P/D. The higher risk of the venture investments requires higher potential returns - hence, the higher premium. The Venture NAV P/D fluctuates in relation to the other values throughout the time period, although it most clearly mirrors the other values during the 2008-09 financial crisis. A potential reason for the discrepancy following the crisis is the increased valuation due to interest rates. Interest rates dropped significantly between 2012 and 2016. As a result, the market expectation may have indicated further decreases in the interest rates. This would lead to higher valuations, boosting the premiums of Venture investments. The Venture premiums and discounts are more sensitive to interest rates than the other indices.

For macroeconomic factors, I incorporate the Credit Spread, Federal Funds Rate (FFR), 4-week Treasury Bill, 6-month Treasury Bill, TED Spread, Global GDP Returns, S&P 500 Returns, and U.S. CPI. I analyze all data on a monthly basis so as to mirror the indices and NAV P/D values and returns. I group the Credit Spread, Federal Funds Rate (FFR), 4-week Treasury Bill, 6-month Treasury Bill, and TED Spread under the title “interest rate variables” so as to distinguish between the macroeconomic factors.

I explore the four LPE indices to investigate whether fluctuations in their premiums or discounts forecast future returns. In addition, I consider macroeconomic factors that influence LPE funds. The data consists of monthly LPE returns for the respective indices as well as the LPX NAV P/D values dating back to the start of 2003. The NAV P/D values measure the premiums and discounts over time through the price to book ratio. For the purpose of realistic

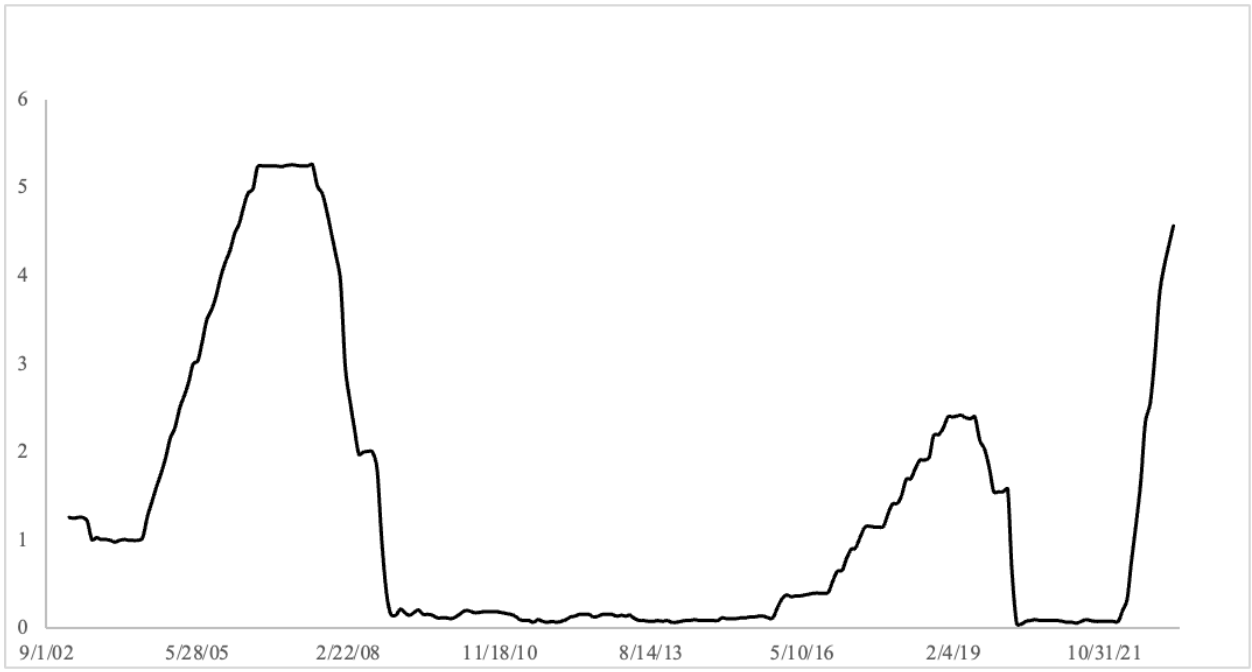
forecasting, I condense the data to only display monthly values at the *end* of each month. Daily fluctuations in index levels offer opportunities for too great of noise, and the forecasting would be inaccurate. To calculate the monthly index returns, I subtract the logarithm of the previous month from that of the current month. In order to implement the forecasting capabilities premiums and discounts, I lag the NAV P/D values for the four indices. One month corresponds to the NAV P/D value one month prior to the value of the return. I create multiple lags to analyze the forecasting power of premiums and discounts months in advance.

In addition to analyzing how the NAV P/D values forecast returns, I incorporate a variety of macroeconomic factors deemed to influence the premiums and discounts. These factors both control for the analysis of the NAV P/D as well as offer novel insights as causal variables on index returns. For the study, I considered the federal funds rate, 4-week and 6-month treasury bills, the GDP Index of 20 of the largest nations, U.S. interest rates, U.S. 5-year interest rates, U.S. CPI, and the S&P 500. I will briefly describe the potential significance of each macroeconomic factor.

The federal funds rate, or the interest rate at which banks can borrow and lend money to each other, influences the economy by encouraging or discouraging borrowing and spending. A low federal funds rate does the former, which has the potential to stimulate economic growth. LPE companies can benefit from higher stock prices and overall lower costs of borrowing. Furthermore, the federal funds rate may affect the cost of debt financing for LPE firms. Changes in the federal funds rate dictate interest rates LPE companies must pay on their debt, again lowering the cost of borrowing and encouraging investments or buyouts. The FFR since 2003 is shown below. There was a steep plummet of the FFR just before and during the financial crisis,

as is evident in the graph. Similarly, there was a fall of the FFR during the COVID pandemic from 2020. Recently, the FFR has been steadily hiking upward as interest rates have increased.

Figure 3: Federal Funds rate 2003-2022



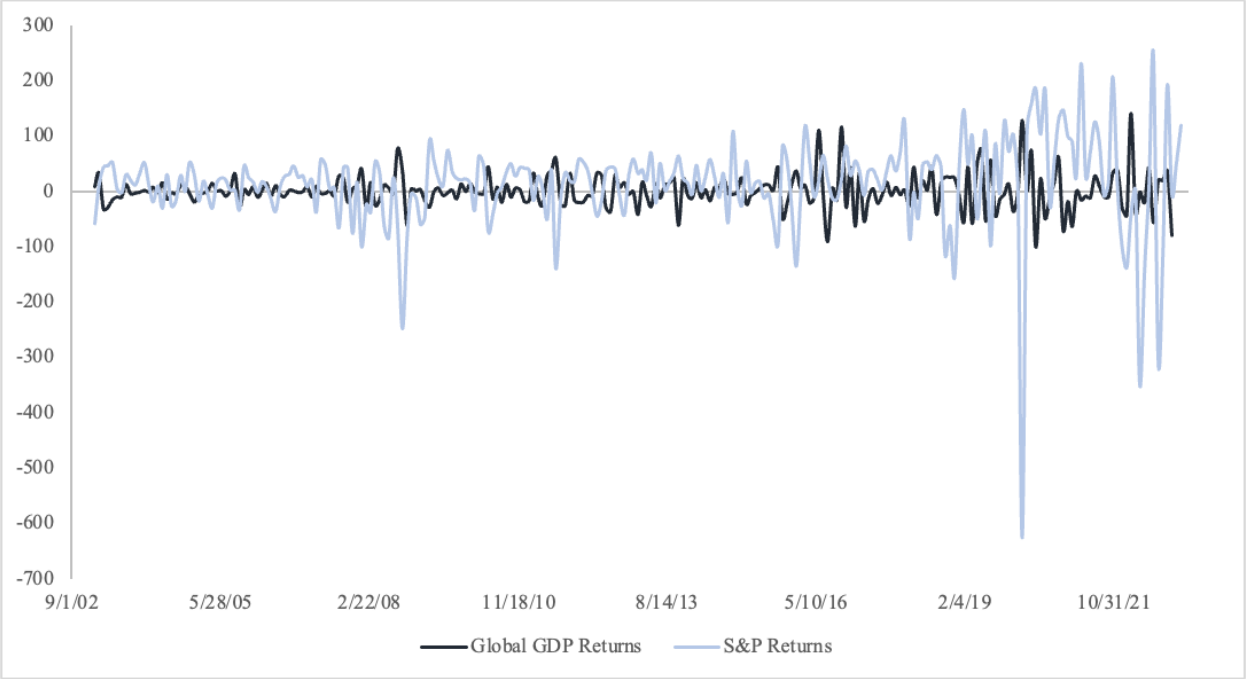
Source: Federal Reserve Economic Data, Federal Reserve Bank of St. Louis

Fluctuations in interest rates may have similar effects to the federal funds rate fluctuations. Low interest rates encourage investors to pay more for future earnings, potentially raising stock prices. As a result, LPE portfolios may grow. The opposite is true of high interest rates. Negative interest rates offer an intriguing proposition as well.

Treasury bills can indicate the overall health of the economy. Therefore, changes in the treasury bill rates, whether that be 4-week or 6-month, may signal changes in economic conditions that impact the performance of LPE funds. GDP, U.S. CPI, and the S&P 500 are also indicators of the overall health of the economy. These factors influence the performance and

returns of the LPE funds, and thus the types and levels of investments the LPE funds are willing to make. The Credit Spread measures the difference in risk premia of BAA-AAA, where BAA and AAA are distinct corporate bond rates based on Moody's Bond Indices. The Global GDP Index considers the GDP of the 20 largest nations. A visualization of the GDP and S&P 500 returns is displayed below in Figure 4.

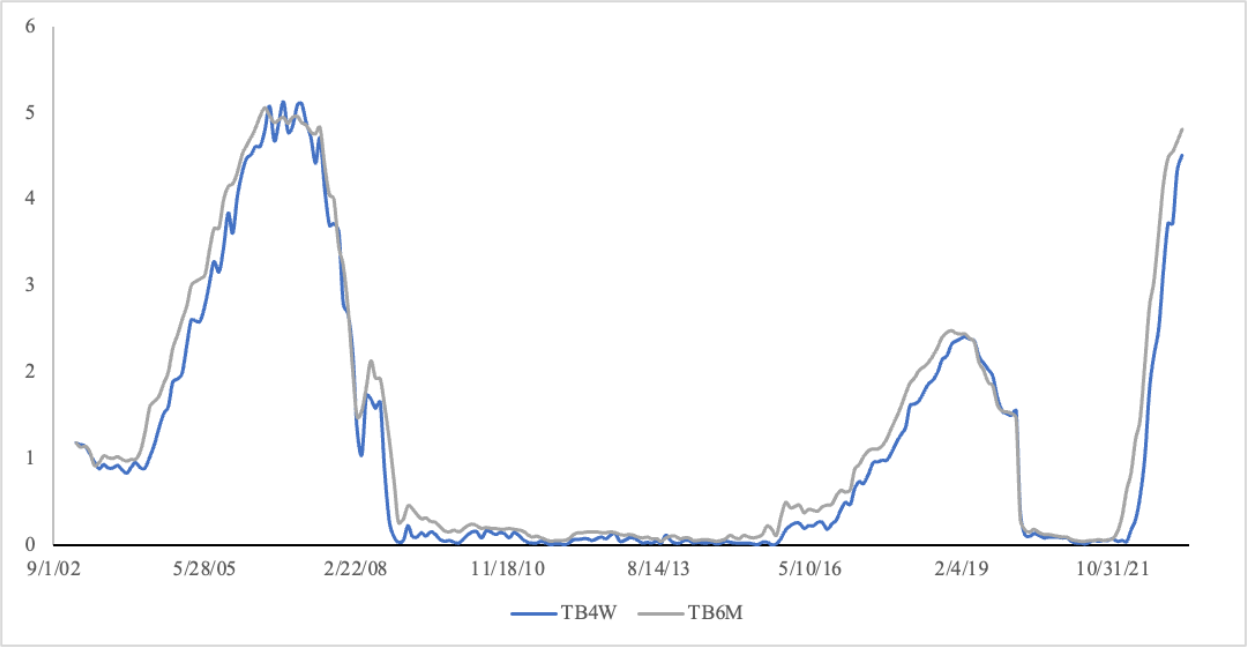
Figure 4: GDP and S&P 500 Returns 2003-2022



Source: Federal Reserve Economic Data, Federal Reserve Bank of St. Louis

Figure 4 visualizes the fluctuating nature of the GDP index and S&P 500 return values. The greatest fluctuations have come in recent years, especially with the S&P 500, which saw significant fluctuations around the start of the pandemic. A visual representation of the 4-week and 6-month treasury bill values is displayed in Figure 5. The two mirror each other and the FFR closely.

Figure 5: Treasury Bills 2003-2022



Source: Federal Reserve Economic Data, Federal Reserve Bank of St. Louis

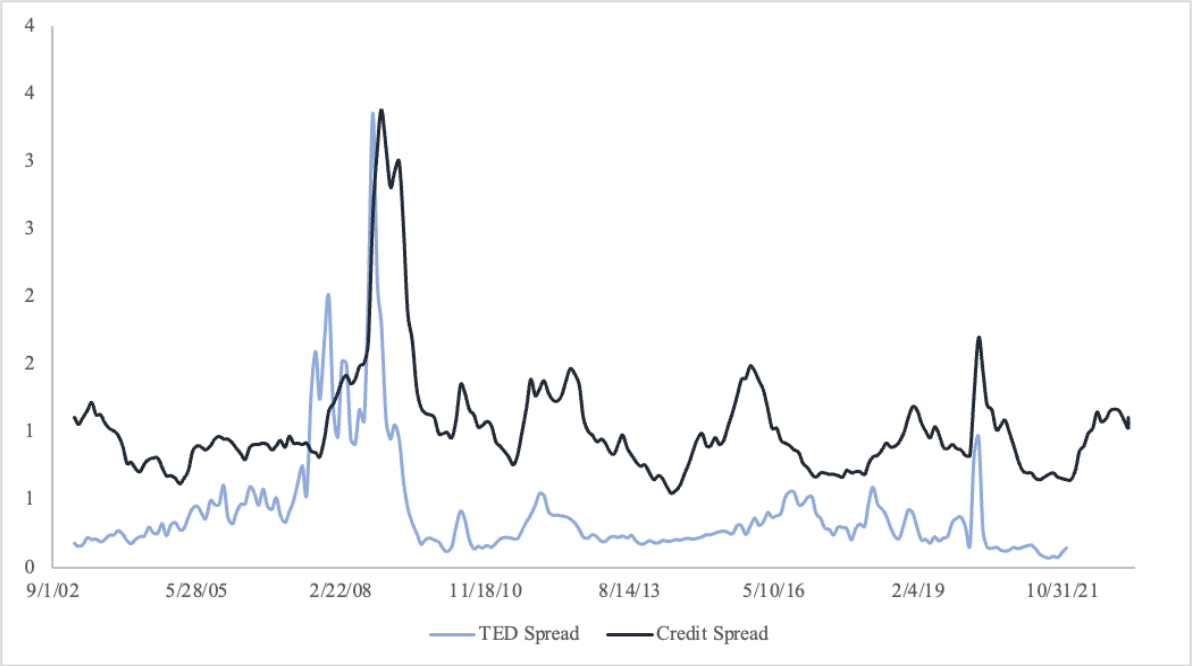
The TED spread and credit spread are valuable indicators of credit risk and market sentiment. As aforementioned, the TED spread measures the difference between the interest rates on interbank loans and the yield on short-term U.S. government debt. A widening TED spread is typically seen as an indicator of increased credit risk and a higher likelihood of financial distress. Hence, there is a widening TED spread during the financial crisis of 2008-09. The credit spread measures the difference between the yields on corporate bonds and government bonds of similar maturity. I use Moody's Bond Indices values to calculate the credit spread. A widening credit spread typically indicates a higher perceived risk of default for corporate bonds. Both of these spreads can have an impact on listed private equity funds, as they reflect the overall level of risk

in the financial markets. Typically, a higher spread for either indicates risk in the financial markets.

Additionally, higher levels of credit risk can lead to a decline in overall market sentiment, which can affect the performance of listed private equity funds. Investors may become more risk-averse and more hesitant to invest in private equity, which could lead to a decline in demand for these types of funds. Overall, the TED spread and credit spread can be useful indicators for investors to monitor, as they can provide insights into the overall level of credit risk and market sentiment. However, it is important to note that the impact of these spreads on listed private equity funds can vary depending on the specific companies and investments held by the funds.

The spread rates from 2003 are displayed below in Figure 6. The credit spread has a consistently higher value than the TED spread, although the two mirror each other closely. During the financial crisis, the two were more closely aligned, with the TED spread being larger than the credit spread for a short period of time as well. The high value of both during the financial crisis indicates the risky nature of investments during that time period.

Figure 6: Spread Rates 2003-2022

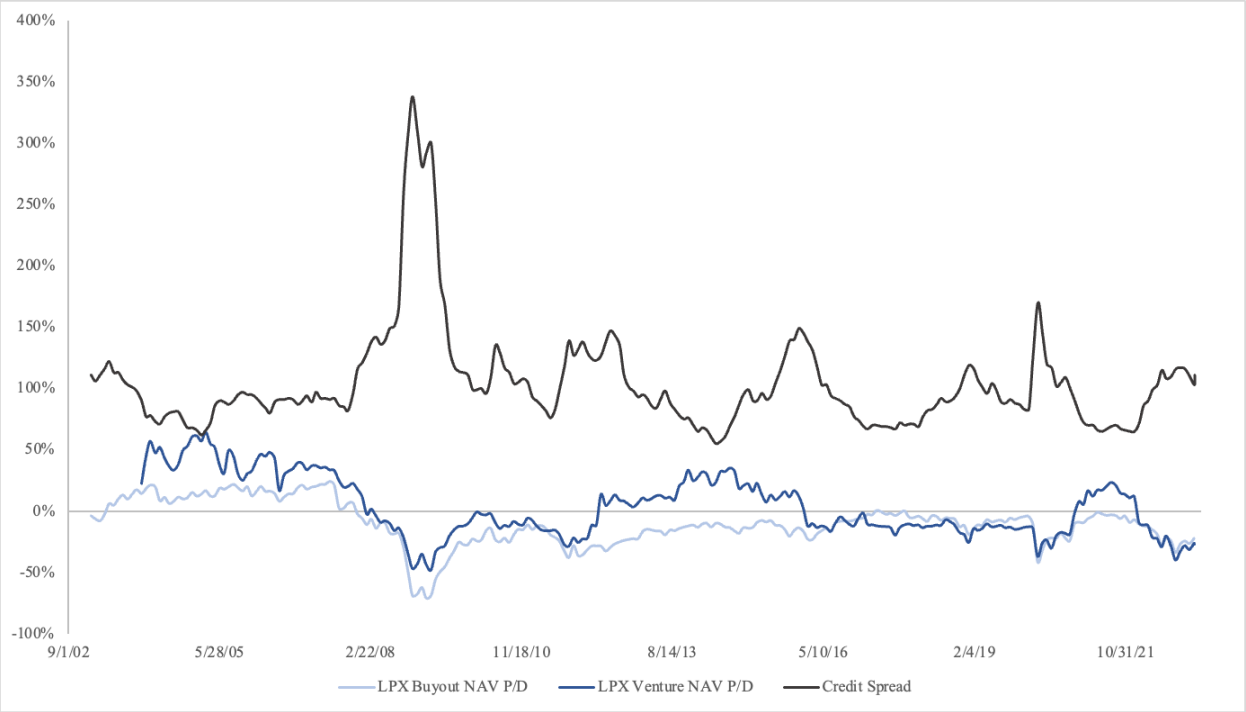


Source: Federal Reserve Economic Data, Federal Reserve Bank of St. Louis

The complete monthly data from 2003 to 2022 results in 240 observations. However, there is a minor discrepancy between the values, lags, and macroeconomic factors that is important to point out. The index values are at the end of each month, whereas most of the macroeconomic factors are the values at the beginning of each month. I pair the end of one month with the start of the following month, so the discrepancy is only one business day. All data except for the TED spread, as is visible in Figure 6, date through 2022.

To demonstrate the significance of interest rates on the premiums and discounts associated with the indices, I plot the Buyout and Venture NAV P/D values along with the Credit Spread:

Figure 7: Credit Spread and Premiums/Discounts 2003-2023



Source: Federal Reserve Economic Data, Federal Reserve Bank of St. Louis & LPX 2023

Figure 7 clearly indicates the inverse relationship between the credit spread and the premiums and discounts. During the financial crisis, when interest rates were in turmoil and the credit spread rocketed up, the indices had negative premiums. The relationship holds throughout the time period. Interestingly, the Venture premiums and discounts appear to react more to the credit spread than the Buyout premiums and discounts.

4. Methodology

I regress the index returns on the three lags, five interest rate variables, and three additional macro-economic factors. First, I establish the logarithmic return variables on which I will base my regressions. The monthly return of the LPX50 is measured as log LPX50 (t) - log LPX50 (t-1). I perform the same logarithmic calculation for the four funds. I incorporate the lags of the NAV P/D, and represent them through the variables LPED(x), wherein x represents the number of monthly lacks for the respective NAV P/D variable. The basic regression with only the lags appears as follows:

$$c + \beta_1 LPED(-1) + \beta_2 LPED(-2) + \beta_3 LPED(-3) + \varepsilon_t$$

Wherein LPED represents the LPE discounts and premiums, and the number within the parentheses represents the number of lags. To incorporate the interest rate variables, I use the following regression:

$$c + \beta_1 LPED(-1) + \beta_2 LPED(-2) + \beta_3 LPED(-3) + \beta_3 CS_t + \beta_4 FFR_t + \beta_5 TB4W_t + \beta_6 TB6M_t + \beta_7 TED_t + \varepsilon_t$$

Where CS represents the Credit Spread, FFR the Federal Funds Rate, TB4W the 4-week Treasury Bill, TB6M the 6-month Treasury Bill, and TED the TED Spread. The final regression looks as follows:

$$c + \beta_1 LPED(-1) + \beta_2 LPED(-2) + \beta_3 LPED(-3) + \beta_3 CS_t + \beta_4 FFR_t + \beta_5 TB4W_t + \beta_6 TB6M_t + \beta_7 TED_t + \beta_8 GDP_t + \beta_9 SP_t + \beta_{10} CPI_t + \varepsilon_t$$

Where GDP represents the Global GDP Returns, SP the S&P 500 Returns, and CPI the U.S. CPI.

I run the two latter regressions for the four distinct LPE funds for four time periods. This totals 32 regressions, each with various implications and key takeaways. In addition to the 32 regressions, I run two final regressions for only the LPX50 data dating back to 1994. For these specific regressions, I run identical regressions to the ones above, except I remove the 4-week Treasury Bill variable from the interest regression and the 4-week Treasury Bill and GDP Returns from the regression with all variables.

5. Results

5.1 Data Relation: NAV Discounts and Lags

After the data is incorporated in log form based on monthly returns, the data can be analyzed and compared. To begin, it's important to assess the level of correlation between the four index fund returns. The LPX50 and Direct indices have the highest level of correlation at 96.5%, and the Direct and Venture indices have the lowest level at 75.6%. LPE firms who invest in one of the two are investing in a different stage of the company with different risk profiles, potential returns, and overall investment size. As for the NAV P/D discounts and premiums, there are high levels of correlation (>99%) for all indices except for the Venture index, which has an 80.7% correlation level with the Direct index, its highest correlation level. Venture investing, or investing in startups by providing capital, is distinct from the other indices. Monitoring its results will be essential to a thorough investigation of the index returns.

The lag regressions are an integral part of determining whether the NAV discounts and premiums can forecast future index returns. Before incorporating the control variables, I run a regression with six monthly lag variables to isolate the lags. Beginning with the LPX index, a simple OLS regression of the NAV P/D values indicates a positive coefficient and high statistical significance. However, the lag regressions yield more compelling results with regard to forecasting ability. When incorporating six lags, one for each month, the coefficients and statistical significance of each level vary. Lags of one and three months yield positive coefficients, while lags of two, four, five, and six months yield negative coefficients. A negative coefficient indicates that the more negative the discounts, the more positive the returns. On the other hand, a positive coefficient indicated the more negative the discounts, the more negative

the returns. Only the LPE discounts and premiums with one and three lags, the two positive ones, were statistically significant at a 5% level. This may indicate the predictive power of the discounts and premiums, although the extent of the lags is great and introduces much noise. Therefore, I narrow down the number of lags to three before incorporating macroeconomic factors.

5.2 Data Results: Macro Factors

After incorporating the monthly returns in log form, I run a regression incorporating macroeconomic factors. Index returns are subject to fluctuations in markets, interest rates, and treasury bills, to name a few. To recount, my study considers treasury bills (4-week and 6-month), the federal funds rate, TED spread, GDP index, interest rates, S&P 500, and U.S. CPI data. For the treasury bill rates, the inputs consisted of 4-week and 6-month. The bills are based on secondary market rates dating back to the start of 2003 to match the index funds data. Treasury bills are short-term debt securities that are sold at discount from their face value and mature at their face value, with the difference representing the return. The length of the T-bill indicates the time until maturity. A longer maturity period typically offers a higher yield, but that is coupled with heightened risk. Generally, T-bills are considered to be a low-risk investment, and there are little fluctuations in their monthly changes. The interest rate data consists of the credit spread. The Federal Funds data consists of the effective federal funds rate in the United States on a monthly basis. The current price adjusted gross domestic product model consists of national EPU indices for 20 of the largest economies around the world**.** The U.S. CPI, or Consumer Price Index, is calculated by taking the weighted average of prices for a specified

basket of goods or services. The CPI is often used to benchmark for inflation and is an important indicator of economic growth, decline, and stability. As aforementioned, all of the macro economic factors are incorporated as monthly returns so as to account for autocorrelation interference.

I create three monthly lags based on the NAV P/D. This provides sufficient forecasting ability up to one quarter. Any lags beyond three indicate increasing levels of insignificance. I run two regressions with the three lags for each index: one with only the interest rate variables and one with all macro-economic factors. The interest rate variables are the Credit Spread, FFR, 4-week T-Bill, 6-month T-Bill, and TED Spread. The remaining macro-economic variables are Global GDP Returns, S&P 500 Returns, and U.S. CPI. The data is broken into four time series: pre-financial crisis (2003-2007), financial crisis (2008-2009), post-financial crisis (2010-2022), and the entire time period (2003-2022). For each time period, there are two regressions per LPE index. I select the important takeaways from each. All regressions are run on the log of the selected index.

5.3 Pre-Financial Crisis

I begin with pre-financial crisis results, starting with the LPX50 Index. The regression with all three lags indicate levels of significance for the first and second lag, but not the third. The coefficient of the first lag is positive, whereas the second lag is negative. A positive coefficient indicates the more negative the discounts, the more negative the returns. On the other hand, a negative coefficient indicates the more negative the discounts, the more positive the returns. When running a regression with the three lags and the five interest variables, the only significant

variable is the second lag, indicating a two-month lag has a negative relation with LPX50 index returns two months into the future. When running a regression with the three lags and all eight variables of interest, there are more takeaways. Now, both the first and second lags indicate levels of significance, and they have the same relation as aforementioned. Global GDP Returns (-), 6-month T-Bill (-), and the US CPI (-) are also all significant, although the 6-month T-Bill is only so at a 10% level. The sign in the parentheses indicates the sign of the respective coefficient. The fact that the second lag remains significant between the three regressions is important regarding its negative coefficient. For the LPX50 index prior to the financial crisis of 2008-2009, there is a negative relation between a two-month lag of the transformed NAV P/D value and LPE returns. Other significant variables will be important to keep in mind when comparing across indices and time periods.

The Buyout Index results are similar but have discrepancies. Prior to incorporating other variables, only the second lag is significant, again with a negative coefficient. As for the regression with the five interest variables, the second lag remains the only significant variable, although at a 10% level. However, the regression with all eight variables indicates more significance amongst the variables. Now, none of the lags are significant, but the Credit Spread (-), Global GDP Returns (-), 6-month T-Bill (-), and US CPI (-) variables are. Apart from the lags, the variable results are similar to that of the LPX 50 Index. The lack of lag significance indicates that the Buyout Index may have been more variable with regard to NAV P/D prior to the financial crisis.

The Direct Index results re-emphasize the negative relation between two lags and index returns. A regression with the three lags indicates a level of significance only for the second lag, again with a negative coefficient. As for the regression with the lags and interest variables, the

second lag, Credit Spread, and TED Spread variables are all significant, although the second lag is significant only at a 10% level. The Credit Spread and TED Spread are important factors in direct LPE investments. As for the regression with the eight variables and three lags, there is significance across eight inputs: the second lag, Credit Spread (-), FFR (+), Global GDP Returns (-), S&P 500 Returns (+), 6-month T-Bill (-), TED Spread (-), and US CPI (-). The negative second coefficient is worth highlighting again. The effect of variables on the Direct Index prior to the financial crisis is clear.

Finally, the results of the Venture Index are as follows. Running the regression with only the three lags yields no significance across all variables. However, the incorporation of the interest variables results in significance for the second lag as well as the Credit Spread, although the former is only significant at a 10% level. The Credit Spread is a logical significant variable for all indices, but especially so for Venture funds if they take out a loan as opposed to employing existing equity. With all eight variables, the second lag, Credit Spread (-), Global GDP Returns (-), and US CPI (-) are significant. Again, the two-month lag stands out as the only significant lag variable, indicating a two-month forecasted return is most accurate.

The pre-financial crisis results have several key takeaways. To begin, the two-month lag stands out as the most, and oftentimes only, significant lag value of the three. Its consistent negative coefficient indicates a negative relation between the two-month lagged NAV P/D value and LPE returns before the financial crisis; in other words, the more positive the discounts, the more negative the returns. As for the other significant variables, most yield negative coefficients as well. The Credit Spread and Global GDP Returns are consistent significant variables with negative coefficients, indicating that a decrease in either is accompanied by an increase in LPE returns, with no lags of course. When FFR and S&P 500 Returns are significant, as is only the

case with the Direct Index, they yield positive coefficients. In other words, an increase in the FFR or positive S&P 500 Return is accompanied by an increase in the Direct LPE Index return.

5.4 Financial Crisis

The data for the financial crisis contains fewer observations – only 24 from 2008 to 2009. This can affect the regression results through increased uncertainty, overfitting, outliers, and overall greater inaccuracies. While there are fewer significant variables across the four indices, the variables that *are* significant are worth exploring.

Beginning with the LPX50 Index, a simple regression with three monthly lags yields no significance. When the regression is run with the interest variables, only the Credit Spread (-) is significant. The turbulence of the financial crisis would indicate that credit spread values held increased significance. With all eight variables, only the Credit Spread (-) and S&P 500 Returns (+) are significant. Their coefficients are similar to those from the pre-financial data. The lack of significance may be largely due to the small size of the data set in question.

The Buyout Index yields similar results. The regression with only the three lags yields no significance. However, the regression with the interest variables shows the first lag and Credit Spread (-) to be significant. The first lag has a negative coefficient, indicating that a decrease in the NAV P/D premium yields an increase in the LPE returns. Between the pre-financial and financial dataset, this is the first indication of a significant lag of one month. The chaotic nature of the financial crisis may have resulted in a condensed time frame as far as LPE forecasting. Similar to the pre-financial data, the coefficient is negative. However, the discrepancy in two

versus one month is worth noting. Interestingly, the regression with all eight variables and the lags only yields significance for the Credit Spread (-); the first lag is no longer significant.

The Direct Index, for the regression with only the interest variables, yields a first lag that is highly significant and has a negative coefficient, whereas the second lag has a positive coefficient. The second lag loses its significance when the regression is run with all eight variables. The high level of significance for the one-month lag in the first regression is noteworthy. Similar to with the Buyout Index, it may be that the chaotic nature of the financial crisis resulted in forecasts taking on shorter time periods. As a result, a one-month lag is significant enough to forecast Direct Index returns. Again, the coefficient is negative, indicating consistency with the pre-financial data.

Finally, the Venture index continues to yield similar results. When incorporating only the interest variables, the first lag, Credit Spread (-), and TED Spread (+) are significant. The TED Spread has a positive coefficient but is only significant at the 10% level. The first lag is no longer significant when all eight variables are incorporated.

Although there are generally fewer variables of significance during the financial crisis most likely due to a smaller amount of data, the unpredictability of the time period may also be to blame. Regardless, the significant first lag for many of the indices indicated a negative relation between NAV P/D and LPE returns. It is worth building these findings off the pre- and post-financial crisis data with regard to the shortened time frame during the financial crisis.

5.5 Post-Financial Crisis

The post-financial crisis data set, spanning from 2010 through 2022, has 156 observations with a variety of significant variables.

To begin with the LPX50 Index, a simple regression with only the lag variables yields no significance across the board. However, a regression with the interest variables yields significance across six variables: one lag, Credit Spread (-), FFR (+), and 4-week T-Bill (-), 6-month T-Bill (+), and TED Spread (-). The lag with one month, Credit Spread, and TED Spread are highly significant. The lag has a negative coefficient, further strengthening the result from the previous time periods. However, the fact that the significant lag is the first month differs from the pre-financial crisis significant lag. The regression with all eight variables has identical results in terms of significance plus the U.S. CPI. Again, the first lag is significant with a negative coefficient: the more positive the NAV P/D premium, the more negative the LPE returns. What does this mean in light of the other time periods? The high level of significance across the board is promising, but also begs a handful of questions.

The Buyout Index in the post-financial crisis time period also produces numerous variables with high levels of significance. When running the regression with the interest variables, the first lag, Credit Spread (-), FFR (+), 4-week T-Bill (-), 6-month T-Bill (+), and TED Spread (-) are all significant at the 1% level. The results are the same for the eight variables, as none of the additional variables are significant. The negative coefficient of the first lag holds, and the other lags fail to yield significance. The high level of significance across the board indicates a unique feature to the Buyout Index; the effect of lags and macroeconomic factors is clear.

The Direct Index yields significant results. For the interest rate regression, every variable is significant, indicating high influence across the board (Credit Spread (-), FFR (+), 4-week T-Bill (-), 6-month T-Bill (+), TED Spread (-). The first and second lags have negative coefficients, while the third lag has a positive coefficient. The most significant lag, consistent with all post-financial crisis results, is the first, one-month, lag. For the regression with all variables, the same variables are significant except for the second lag. Global GDP Returns, S&P 500 Returns, and U.S. CPI are all insignificant.

Finally, the Venture Index for the post-financial crisis period yields similar results. For the regression with the interest variables, the first lag is significant with a negative coefficient again, and the Credit Spread (-) and TED Spread (-) are also significant. The same three variables are significant for the regression with all variables.

There are several key takeaways from the post-financial crisis data. The first, one-month lag is consistently significant with a negative coefficient. This is a change from the pre-financial crisis findings, where the second lag is consistently significant with a negative coefficient. Also, for the post-financial crisis period, the macro factors other than the interest variables tend to lack significance, whereas the pre-financial crisis data has consistent significance of the Global GDP Returns, S&P 500, and U.S. CPI. Despite discrepancies between the two time periods, one finding is clear: the negative relation between NAV P/D and the index returns. The key discrepancy is of the number of lacks: two for the pre-financial crisis time period, and one for the post-financial crisis time period.

5.6 Cumulative Period

The comparison between the time periods is noteworthy, but it is also worth running analysis for the entire time period from 2003 through 2022. Such regressions produce results that are, in many ways, a combination of the time period results. With all the data, there are now 240 observations of monthly data. Running the regressions for the LPX50 Index yields no significance for the lags for both the interest and all macro factors regressions. The Credit Spread (-), FFR (+), 4-week T-Bill (-), and TED Spread (-) are significant across both regressions. The S&P 500 Returns and U.S. CPI are also significant. The Buyout Index yields significance for the first lag with a negative coefficient across both regressions, although there is greater significance in the regression with all macro factors. The negative first lag mirrors the post-financial crisis results. The Direct Index results are the same for the first lag. The second and third lags are both insignificant. Finally, the Venture Index finds no significance of any lags, although the negative coefficient of the first lag remains. Overall, the results over the entire time period mirror the post-financial crisis ones. This begs the question as to whether the pre-financial crisis significant second lag with a negative coefficient is an anomaly, or whether the financial crisis altered the outlook of indices. Perhaps the financial crisis resulted in more short-sightedness with regard to index returns, and the NAV P/D with one lag as opposed to two reflects this.

After I run the regressions for the four indices for the aforementioned time periods, I run two final regressions with the LPX50 data dating back to 1994. My aim is to focus on the lags. I eliminate the 4-week T-Bill and Global GDP Index from the regression because the former was not introduced until 2001 and the latter's data did not stretch back to 1994. For the regression with the interest rate variable, there is statistical significance for one lag, two lags, the Credit

Spread (-), and TED Spread (-). The first lag has a positive coefficient, while the second lag has a negative coefficient. The one lag is only statistically significant at a 5% level, indicating once again that the negative second lag is the most prominent outcome. The fact that the signs of the coefficient fluctuate is noteworthy.

As for the LPX50 regression dating back to 1994 for all variables, the first and second lag are again significant, this time both at a 1% level. Again, the coefficient for the first lag is positive, and the coefficient for the second lag is negative. These findings are consistent with data from the various time periods, although none have high levels of significance for *both* the first and second lag. Despite the added time period dating back to 1994, the regressions from 2010 to 2022 likely yield the most relevant results due to being after the financial crisis. Including the older data simply provides an additional level of analysis and takeaways.

5.6 Compiled Results

The results of all the interest variables regressions are displayed below in Tables 1 through 4. For all the tables, */**/*** indicates significance at the 10%, 5%, and 1% level, respectively.

Table 1 OLS regressions of LPX50 returns (interest variables)

Variable	LPX50	LPX50	LPX50	LPX50	LPX50
Start date:	2003 01	2008 01	2010 01	2003 01	1994 01
End date:	2007 12	2009 12	2022 12	2022 12	2022 12
Lag1	0.074	-0.912	-0.212 ***	-0.055	0.070 **
Lag2	-0.156 **	0.326	-0.032	-0.079	-0.137 ***
Lag3	-0.44	-0.126	0.06	0.018	0.026
CS	-0.021	-0.183 **	-0.058 ***	-0.029 ***	-0.022 ***
FFR	-0.007	0.002	0.069 **	0.041 ***	-0.001
TB4W	0.011	0.016	-0.097 ***	-0.058 ***	----
TB6M	0.000	0.021	0.035 *	0.024 *	0.002
TED	-0.015	0.0627	-0.077 ***	-0.049 ***	-0.018 ***

Table 1 shows the pooled OLS regressions of the monthly returns for the LPX50 Index for the interest variables. As noted, the significant lag changes from the second, two-month lag to the first, one-month lag before and after the financial crisis. For the entire period, both are significant. After the financial crisis, all of the interest variables are significant, indicating a heightened emphasis on interest rate factors in forecasting potential financial downturns. The high level of significance for the lags with negative coefficients is key.

Table 2 OLS regressions of LPX Buyout returns (interest variables)

Variable	LPX Buyout	LPX Buyout	LPX Buyout	LPX Buyout
Start date:	2003 01	2008 01	2010 01	2003 01
End date:	2007 12	2009 12	2022 12	2022 12
Lag1	-0.015	-1.146 **	-0.233 ***	-0.083 *
Lag2	-0.100 *	0.522	-0.04	-0.061
Lag3	0.028	-0.145	0.044	0.019
CS	-0.0213	-0.222 **	-0.060 ***	-0.031 ***
FFR	-0.007	-0.074	0.095 ***	0.050 ***
TB4W	0.0256	-0.065	-0.138 ***	-0.067 ***
TB6M	-0.0152	0.194	0.053 ***	0.026 **
TED	-0.014	0.062	-0.089 ***	-0.053 ***

Table 2 shows the pooled OLS regressions of the monthly returns of the Buyout Index for the interest variables. The findings mirror those of the LPX50 results. The high level of significance with a negative coefficient for the first lag post-financial crisis is arguably the most important takeaway. After the financial crisis, all of the interest rate variables become highly significant.

Table 3 OLS regressions of LPX Direct returns (interest variables)

Variable	LPX Direct	LPX Direct	LPX Direct	LPX Direct
Start date:	2003 01	2008 01	2010 01	2003 01
End date:	2007 12	2009 12	2022 12	2022 12
Lag1	-0.029	-1.405 ***	-0.240 ***	-0.097 **
Lag2	-0.110 *	0.793 **	-0.098 *	-0.047
Lag3	0.002	-0.253	0.087 *	0.023
CS	-0.052 **	-0.224 **	-0.065 ***	-0.023 **
FFR	0.026	-0.063	0.107 ***	0.063 ***
TB4W	-0.009	-0.152	-0.154 ***	-0.093 ***
TB6M	-0.013	0.259	0.057 ***	0.039 ***
TED	-0.039 ***	0.046	-0.101 ***	-0.062 ***

Table 3 shows the pooled OLS regressions of the monthly returns of the Direct Index for the interest variables. The regression of post-financial crisis yields significance for all variables, including the lags. The negative coefficient of the statistically significant first lag for all periods except the pre-financial crisis is consistent with the other indices.

Table 4 OLS regressions of LPX Venture returns (interest variables)

Variable	LPX Venture	LPX Venture	LPX Venture	LPX Venture
Start date:	2003 01	2008 01	2010 01	2003 01
End date:	2007 12	2009 12	2022 12	2022 12
Lag1	-0.016	-0.942 ***	-0.098 ***	-0.043
Lag2	-0.100 *	0.0241	0.044	0.004
Lag3	-0.032	-0.022	-0.009	0.008
CS	-0.107 **	-0.169 ***	-0.023 **	-0.008
FFR	-0.028	-0.124	0.015	0.028 *
TB4W	0.003	0.244	-0.028	-0.030
TB6M	0.030	-0.091	0.007	0.004
TED	0.002	0.102 *	-0.084 ***	-0.040 ***

Table 4 shows the pooled OLS regressions of the monthly returns of the Venture Index for the interest variables. Across the board, the regressions of the Venture returns have fewer statistically significant variables. However, the significant one-month lag with a negative coefficient remains.

The compiled results of the regressions of all macroeconomic variables are below in Tables 5 through 8. The trends are similar to the regressions of only the interest variables.

Table 5 OLS regressions of LPX50 returns (all variables)

Variable	LPX50	LPX50	LPX50	LPX50	LPX50
Start date:	2003 01	2008 01	2010 01	2003 01	1994 01
End date:	2007 12	2009 12	2022 12	2022 12	2022 12
Lag1	0.090 *	-0.457	-0.229 ***	-0.057	0.086 ***
Lag2	-0.126 **	-0.173	-0.029	-0.086	-0.136 ***
Lag3	0.0154	0.090	0.044	0.020	0.019
CS	-0.020	-0.184 **	-0.570 ***	-0.039 ***	-0.019 ***
FFR	0.038 **	-0.158	0.094 ***	0.026 **	-0.001
TB4W	-0.005	0.030	-0.133 ***	-0.033 *	----
TB6M	-0.021 *	0.165	0.044 **	0.013	0.001
TED	0.000	0.119	-0.070 ***	-0.032 ***	-0.013 **
GDP	-0.000 ***	0.000	0.000	0.000	----
SP	0.000	0.001 *	0.000	0.000 ***	0.000 ***
CPI	-0.003 **	-0.002	0.000 **	-0.000 ***	0.000

Table 5 shows the pooled OLS regressions of the monthly returns of the LPX50 Index for all macroeconomic variables, including the time period from 1994 through 2022. There are discrepancies between the distinct time period results. The time period from 1994 to 2022 most yields a positive coefficient for the first lag and negative coefficient for the second lag. It may be that the exclusion of the 4-week T-Bill or GDP Index strongly alters the results of the 1994-2022 regression. Due to the turbulent nature of the financial crisis, the time period after the financial crisis remains the most representative of the predictive nature of the NAV P/D to forecast returns.

It is also worth pointing out the abundance of coefficients with values close to zero, with several having high levels of significance.

Table 6 OLS regressions of LPX Buyout returns (all variables)

Variable	LPX Buyout	LPX Buyout	LPX Buyout	LPX Buyout
Start date:	2003 01	2008 01	2010 01	2003 01
End date:	2007 12	2009 12	2022 12	2022 12
Lag1	-0.003	-0.735	-0.249 ***	-0.102 **
Lag2	-0.071	0.142	-0.032	-0.066
Lag3	0.045	-0.012	0.033	0.022
CS	-0.030 *	-0.214 **	-0.060 ***	-0.0473 ***
FFR	0.022	-0.21	0.106 ***	0.032 **
TB4W	0.013	-0.035	-0.157 ***	-0.036 *
TB6M	-0.023 **	0.296	0.060 ***	0.012
TED	0.003	0.112	-0.087 ***	-0.033 ***
GDP	-0.000 **	0.000	0.000	0.000
SP	0.000	0.001	0.000	0.000 **
CPI	-0.003 ***	-0.002	0.000	-0.000 ***

Table 6 shows the pooled OLS regressions of the monthly returns of the Buyout Index for all macroeconomic variables. For this index, the only significant lags are the first lags of the post-financial crisis period and the entire time period. The high level of significance of the former lag is noteworthy. All significant variables of the post-financial crisis period are at the 1% level.

Table 7 OLS regressions of LPX Direct returns (all variables)

Variable	LPX Direct	LPX Direct	LPX Direct	LPX Direct
Start date:	2003 01	2008 01	2010 01	2003 01
End date:	2007 12	2009 12	2022 12	2022 12
Lag1	-0.014	-0.966 *	-0.248 ***	-0.120 **
Lag2	-0.084 *	0.0301	-0.092	-0.053
Lag3	0.045	-0.042	0.079 *	0.026
CS	-0.045 **	-0.256 **	-0.063 ***	-0.040 ***
FFR	0.054 ***	-0.137	0.117 ***	0.044 ***
TB4W	-0.019	-0.242	-0.171 ***	-0.062 ***
TB6M	-0.024 **	0.416	0.062 ***	0.026 *
TED	-0.023 *	0.116	-0.098 ***	-0.041 ***
GDP	-0.000 *	-0.001	0.000	0.000
SP	0.000 *	0.001	0.000	0.000 **
CPI	-0.003 **	-0.001	0.000	-0.000 ***

Table 7 shows the pooled OLS regressions of the monthly returns of the Direct Index for all macroeconomic variables. The pre-financial crisis period has several significant variables that are no longer significant during and after the financial crisis. For the entire period, all macroeconomic variables except for the GDP Index are significant. The negative coefficient of the significant lags is clear as well, emphasizing the relation between the NAV P/D and Index returns. Similar to the previous findings, the GDP Index, S&P 500, and U.S. CPI consistently have coefficients very close to zero. Nevertheless, some are still significant, and the U.S. CPI is highly significant for the entire time period.

Table 8 OLS regressions of LPX Venture returns (all variables)

Variable	LPX Venture	LPX Venture	LPX Venture	LPX Venture
Start date:	2003 01	2008 01	2010 01	2003 01
End date:	2007 12	2009 12	2022 12	2022 12
Lag1	0.000	-0.67	-0.097 ***	-0.05
Lag2	-0.128 **	-0.065	0.047	0.001
Lag3	-0.006	0.122	-0.011	0.005
CS	-0.076 *	-0.180 **	-0.025 **	-0.018 **
FFR	0.044	-0.205	0.013	0.016
TB4W	-0.019	0.195	-0.022	-0.007
TB6M	-0.006	0.041	0.004	-0.009
TED	0.005	0.137 *	-0.081 ***	-0.027 **
GDP	-0.001 ***	0.000	0.000	0.000
SP	0.000	0.001	0.000	0.000 **
CPI	-0.005 **	-0.003	0.000	-0.000 ***

Finally, Table 8 shows the pooled OLS regressions of the monthly returns of the Venture Index for all macroeconomic variables. The Venture Index has consistently differed from the others throughout the analysis, and this is no different for the regressions with all variables. There is a change in the significant lag from the second to the first one before and after the financial crisis. Credit Spread and TED Spread are the only significant macroeconomic variables post-financial crisis. There is a lack of significance for any lags over the entire time period.

For all time periods and across all indices, most of the significant variables have negative coefficients. The negative relation indicates the inverse relationship of the lags and macroeconomic variables with the LPE fund returns. One exception to this is the federal funds rate, which has consistently positive coefficients for the significance observations.

6. Discussion

The nature of the negative coefficients surrounding the premiums and discounts with relation to the LPE returns warrants discussion. Not only that, but all time periods yield significance in the one-month lag *except* for the pre-financial crisis time period, which yields significance in the two-month lag. The negative relation of my results mirrors the findings of Lahr & Kaserer (2009), although I use novel data. My findings are also similar to Berggrun et al. (2021), who study closed-end funds and find a negative relation between premia and returns as well. I am also pleased to note that my results replicate and expand upon Degosciu's (2013) work.

The macro economic factors, although mostly employed as controls, yield noteworthy results as well. After the financial crisis, all the interest variables are significant. This indicates a potential heightened relationship between LPE funds and interest rate variables in the last decade. This trend is likely to continue, especially in the current era of turbulent interest rates.

For the time period prior to the financial crisis, there is consistent significance of the second lag with a negative coefficient. After the financial crisis, there is consistent significance of the first lag with a negative coefficient. The negative coefficient indicates a negative relation; the lower the premium or discount of the LPE Index, the higher the expected return. However, what may have caused this change in significant lags? The answer may extend beyond this study, but it may be that markets have become more efficient after the financial crisis. After the financial crisis, a one month lag becomes significant enough to forecast returns. This may also be explained by general caution in the financial market; markets may have processed information differently after the financial crisis.

LPX50 data dating back to 1994 promotes much of the same. The second lag is negative and significant across the time period, and the first lag is negative and significant for the time

period after the financial crisis. Again, the time period after the financial crisis may be more reliable in terms of future forecasting due to the changes that may have occurred after the crisis. With that in mind, moving forward, in order to forecast returns based on the NAV P/D, I recommend focusing on a one-month lag with a negative relation between premia and returns of the LPE Index.

7. Conclusion

There are several areas for potential further study to build off the findings I present. First, it will be worth exploring the reason behind the change in significant lags from two-month to one-month. I offer potential explanations, but surely other plausible explanations exist. Next, it may be noteworthy to study the recent effects of interest rates on LPE funds. I focus my attention on the 2008-09 financial crisis, but the last three years have provided great fluctuations in markets and indices around the world. It may be that in the next few years, the lag with the highest level of significance alters again. This will be worth monitoring.

I hope that my findings assist and inspire financial institutions in their relentless pursuit of profits in a turbulent age. Premiums and discounts *do* have predictive power with regard to LPE returns.

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