CONTRIBUTORS OF RETURN IN A PRIVATE EQUITY CONTEXT – IN SEARCH OF THE "PREVAILING WINDS"

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ABSTRACT

This paper analyzes the potential determinants of internal rates of return generated by US private equity funds. It uses a dataset of individual fund returns collected by Thomson Financial on the US venture capital and buyout capital (the "Private Equity") sectors for the periods from 1980 to 2005. It is the aim of this paper to document potential factors that serve as "*prevailing winds*" within the private equity sector. We build on work completed by Gompers and Lerner (2000), Cumming and Walz (2004), as well Kaserer and Diller (2004) in identifying and measuring the potential impact of certain economic factors on the private equity industry's internal rates of return (IRR). The research looks beyond the traditional reliance on 'manager skill', in an effort to develop insights that are supportive to General Partners and their Limited Partners. The paper presents OLS-regression and WLS-regression models that are able to explain the variation in private equity returns. The results presented are for use by private equity fund managers as well as their institutional investors in helping better understand the impact certain macroeconomic factors can have on their potential investment returns.

Keywords: Private equity, determinants of return, regression analysis, S&P500, Thomson Financial VentureXpert®, Horizon IRR Returns.

DEDICATION

This project is dedicated to our respective families, who have been very supportive in our efforts in pursuing our post-graduate educations. We would also like to dedicate this thesis to the faculty of the Global Asset and Wealth Management MBA Progra,m for their support in bringing out the best in us.

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CHAPTER 1: INTRODUCTION

The private equity industry, represented by venture capital and buyout capital, continues to expand at a record pace with over $370.3 billion of new private equity capital raised in the United States between 2002 and 2006[1]. According to statistics provided by the National Venture Capital Association ("NVCA") the total amount of US private equity capital has grown from US$5billion in 1995 to over US$679billion in 2005[2]. The largest allocations of capital on a total capital basis, is to buyout capital, which is capital used to fund the acquisition of, or investment in a mature and established private company. Buyout capital investments are usually deemed to be lower risk than venture capital, given the later stage of companies that buyout capital investors invest in. In contrast, venture capital is deemed to be of high risk, given that many of the companies invested in have limited track records, no revenues and/or profits. Venture capital investments are subject to substantial execution risk and risk of business failure resulting in a potential complete loss of investment. Despite the risks of private equity, recently published figures indicate that institutional investors continue to add to their allocation to private equity as can be seen through the successful completion of several $10 billion plus private equity buyout fund raises completed in 2005 and 2006.[3]

Against this flood of capital into private equity, many Limited Partners are starting to ask traditional performance measurement and attribution analysis questions in regards to their new and increasing allocations to private equity. Questions such as, "how to appropriately

[1] NVCA and Thomson Financial
[2] NVCA
[3] see KKR, the Carlyle Group, and Texas Pacific recent buyout funds raised.

and accurately measure risk and return in a private equity context, when the traditional performance measurement frameworks (i.e. mean-variance and/or the Capital Asset Pricing Model (CAPM)), cannot be easily applied?" Or questions on, "how to determine, measure, and assess the key potential contributors and factors that directly affect risk and returns in private equity?" And finally, "how much of a private equity manager's (the "General Partners") returns are due to *management skill*, and how much of their returns are due to supportive macroeconomic factors?"

At the same time that Limited Partners are assessing their private equity investments and the associated performance of their private equity sub managers, many General Partners are continuing to search out ways to develop an edge in a highly competitive investment environment. Many General Partners are looking for ways to develop and establish competitive advantages relative to their peers in an effort to differentiate themselves. If successful the General Partners win by first earning superior internal rates of return for their Limited Partners. Second they establish themselves with investee companies as a quality partner to work with that can add value beyond just capital investment. Third, their increased returns result in larger General Partner performance carries. And finally, should they successfully identify sustainable competitive advantages, the General Partners will ensure that they are better positioned to attract greater commitments of capital for future follow-on funds. Each of these benefits make the effort of understanding the contributors of return in a private equity context a worthy effort for General Partners.

Despite the increasing importance of private equity as an asset class there is still a limited understanding of the economic characteristics of the industry. Gompers and Lerner were the first to empirically analyze the return of private equity funds relative to investments in public equity (2000). Kaplan and Schoar (2003), and Ljungqvist and Richardson (2003) tackled the returns of private equity at the partnership level, and Cochrane (2001) examined

return properties on the investment/project level. They all conclude that private equity outperforms public markets gross of all fees on an aggregate level. Matthias M. Ick (2005) further investigated whether private equity investments generate a return premium over public stock markets on the project level gross of all externalities, with a look at whether the premium is adequate on a risk adjusted level. All studies completed to date have contributed to the general body of knowledge, but still leave many questions unanswered.

The challenge in answering many of the questions tied to private equity lies in the difficulties experienced in applying traditional approaches of performance measurement and attribution analysis to private illiquid equity investments, funds, and the industry. The challenge is further compounded by the selective information provided by the private equity community, which contributes significantly to the difficulty in determining the efficiency of returns, as well as more importantly, the key contributors and factors to private equity returns and their associated risks. With pension funds, insurance funds, corporations, and high net worth investors continuously seeking higher risk-adjusted returns, and the global private equity markets growing in size to become almost equal to that of the public equity markets, the ability to accurately measure and price risk and match the commensurate levels of return required within the private equity sector, has never been more important.

This paper looks to make a contribution by investigating the characteristics of performance in the US private equity industry, and specifically works to identify key potential macroeconomic factors that serve as '*Prevailing Winds*' for the industry's total aggregated returns. In identifying prevailing winds, we hope to introduce new support and empirical information that aids General Partners and Limited Partners in their investment decision-making process. We assemble an attribution framework to help determine the net effect of various economic and market factors on private equity returns at a US industry level. This framework can be used for additional studies that focus on specific geographic markets,

the different tiers of venture capital, or industry specializations. As well additional independent variables can be looked at, beyond those considered in this research.

To meet our objectives, we make use of a data set of private equity fund performance collected by Thomson Financial ("Thomson Financial").[4] The Thomson Financial dataset is drawn from the VentureXpert® database and is based on voluntary reporting of fund returns by US private equity firms (or General Partners) as well as their Limited Partners. Given the "sticky" nature of private equity returns, and the secrecy of General Partners in reporting their returns, we use Thomson Financials' dollar weighted horizon internal rates of return ("Horizon IRR") as our primary return series throughout our study. The Thomson Financial dataset allows us to focus our study on an area that has not been closely examined previously.

The paper is organized as follows: In section 2 we start with a review of the related literature on private equity. In section 3 we lay down our theoretical framework, methodology, and the background for our tests. Section 4 describes the dataset. In section 5 we present our results and discussion. Section 6 considers the limitations of our research and areas for future consideration. And Section 7 provides our summary and implications.

[4] We wish to thank Thomson Financial for making the extensive private equity dataset available.

CHAPTER 2: RELATED LITERATURE ON PRIVATE EQUITY

While most of the research in this area has looked to focus on returns relative to a selected index of publicly tradable securities, few studies have focused on the examination of either the components of risk, or the contributors of returns within a private equity context. Recently though a number of authors have entered the discussion choosing to either look at assembling more accurate private equity benchmark indices, or to start breaking down the components of risk and/or the contributors of returns. In each case the authors entering the discussion look to the risk premiums involved relative to other asset classes.

Sanjiv R. Das, Murali Jagannathan, and Atulya Sarin, in their paper titled, "Private Equity Returns: An Empirical Examination of the Exit of Venture-Backed Companies" (2003), make a starting contribution to the better understanding of risk premiums and the private company discounts involved with private equity, by looking back at the actual investor behaviour exhibited over a 20 year period. The authors' primary focus in the paper is to work at determining, on an empirical basis, the risk premium required for the valuation of private equity investments, with a secondary goal of working to determine the private company discounts involved at the initial investment stages. They take an empirical approach by examining 52,322 financings rounds in 23,208 unique firms. Their data is obtained from Thompson Financial Data's VentureXpert® database and their period of focus is from 1980 through to 2000. They further chose to restrict their study to investments made in US private firms over the period being studied, and follow each firm until there is an exit or until the end of 2000. With this data they estimate the probability of exit, the expected

multiples, and the gains from private equity investments, choosing to segment their data by time period, stage of investment, and industry sub sector.

Their analysis shows that the probability of exit, the valuation multiple, and the expected gains depend upon the industry, the stage of the firm being financed, and the prevailing market sentiment. They identify hot IPO periods, and that hot financing markets in private equity occur concurrently with hot IPO and acquisition markets. An interesting ancillary finding in their study is that there is a 94% correlation between the number of financing rounds in private equity and the number of IPO's being completed in a similar period. From their sample, the authors find that exits for private equity investments via an IPO are completed roughly 20-25% of the time, and that acquisitions are used as a method for exit approximately 10-20% of the time. The key finding in their study relating directly to the better understanding of risk premiums and equity discounts is that the financing of late-stage companies require equity discounts in the 11% range, and that equity discounts for early-stage companies fall in the 80% range on average. Their empirical study is a good contribution and a step forward in understanding the risk premiums required for the valuation of private equity investments, and the pricing of the risks involved.

Steve Kaplan and Antoinettte Schoar, in their paper, "Private Equity Performance: Returns, Persistence and Capital Flows" (2003) complete a similar empirical study by investigating the characteristics of fund performance in the private equity industry. They look back across a data set of past venture capital and private equity returns to gain a better understanding of the dynamics of fund returns, and the flow of capital into both the industry and individual funds overall. The study further looks at the relation of fund performance relative to capital flows, fund size, and overall fund survival. The data set they use is the individual fund returns collected by Venture Economics over a sample period from 1980 to 1997.

Kaplan and Schoar find that on average, fund returns net of fees, are roughly equal to those of the *S&P500*. When weighted by committed capital, the authors find venture funds outperform the *S&P500* while buyout funds do not. And when gross of fee returns are looked at, both types of private equity partnerships earn returns superior to the *S&P500*. A secondary finding in their study is that there seems to be persistence in fund performance in the private equity industry both for leveraged buyout and venture capital funds, and that there seems to be a large degree of heterogeneity among fund returns, with the most likely explanation of these results being a model of underlying heterogeneity in the skills of General Partner's. Returns persist across funds raised by individual private equity partnerships, and improve with partnership experience. The authors leave open for future research the causes of the heterogeneity across funds pointing, on a limited basis, to the possibility of superior human capital.

In working to further understand the components of risk and contributors of return, Alexander Ljungqvist and Matthew Richardson have published their paper, "The Cash Flow, Return and Risk Characteristics of Private Equity" (2003). In their study they are the first to analyze private equity returns and the risk characteristics of private equity using the actual cash flows of venture capital and buyout firms. They use detailed cash flow data for private equity funds raised over the period 1981 to 2001 in their analysis of the characteristics and performance of private equity. Their data allows them to document the degree of liquidity and the resulting compensation earned, if any, in terms of risk-adjusted returns provided to investors. The authors ask the following five questions:

i) what are the capital investment and return patterns of private equity throughout the life of the fund?

ii) what determines the speed with which funds invest their capital over time?

iii) how long does it take for returns to turn positive?

iv) what is the risk profile of private equity funds, both in terms of systematic and unsystematic risk? And

v) are private equity returns impressive relative to their risk profile and various benchmarks?

For the purposes of this literature review, we focus on the last two questions where Ljungqvist and Richardson find that private equity has generated excess returns over the time period of their study of close to six percent per annum. Internal rates of return on private equity over their testing period are reported at 19.81 percent, net of all fees, whereas an investment in the public stock market, as measured using the S&P500 index, under the identical time period is reported at 14.1 percent. The results presented are meaningful given that they are in direct contrast to the previously mentioned literature.

The authors go on to look at each fund's investments in detail, assigning industry betas to the portfolio companies in an effort to estimate each fund's risk. This approach is in contrast to the standard method of estimating the risk of a fund using standard time-series correlations with the market return. The reason for their different approach is to draw from their analysis on the timing of the realization of returns for private equity which usually only occurs upon a fund's wind up. The authors find that fund returns are still abnormally large even on a risk-adjusted basis.

Ljungqvist and Richardson use a unique set of data to analyze the cash flow, return, and risk characteristics of private equity. Given their unique data set they are able to precisely estimate performance, taking into account the exact timing of investment and capital return flows, rather than having to rely on fund manager's valuations. Through their

analysis they determine that private equity generates excess returns on the order of five to eight percent per annum relative to the aggregate public equity market. They submit that the excess returns are robust to assumptions about the timing of investments in the public equity market, to measures of risk across portfolio companies, and to various measurement methodologies. Although their approach is unique to other efforts, the authors are not able to determine with certainty the components of excess risk adjusted returns, and leave this area open for further research. They do suggest that the source of out-performance is not necessarily compensation for systematic risk, but that it may be related to the type of fund (buyout or venture) and/or the timing of the fund. The study is a substantial step forward given the data set, the potentially improved accuracy of the measurement of returns and associate risk.

In continuing on, and in an effort to better understand how assets are priced in a private equity context, Christoph Kaserer and Christian Diller have published their recent paper, "What Drives Cash Flow Based European Private Equity Returns? – Fund Inflows, Skilled General Partners, and/or Risk?" (2004). In their empirical study they look to analyze the potential determinants of returns generated by European private equity funds. They point to the theory put forward by Gompers and Lerner (2000) that suggests that venture deal valuations are driven by overall fund inflows into the industry, the "money chasing deals" phenomenon, and work to test the theory on a European dataset. Some secondary contributors of returns studied by Kaserer and Diller include market sentiment, the General Partner's skills, as well as idiosyncratic risk. Their dataset used is made up of 200 mature European private equity funds over the standard period 1980 to 2003 as provided by Thomson Financial, which they use to develop a WLS-regression model that they believe explains 47% of the variation of returns in private equity. Apart from the importance of fund flows, the authors show that market sentiment, the General Partner's skills, as well as the

idiosyncratic risk of a fund have a significant impact on returns. They close by studying the relationship between private equity returns and the general stock market as well as private equity returns and the general economy. Their analysis suggests that private equity returns seem to be unrelated to stock market returns and negatively correlated with the development of the economy as a whole. The paper continues the field of study specific to the area of determining the characteristics and determinants of private equity risk and return.

The remaining papers to be covered shift the discussion somewhat towards the measurement of performance in a private equity context. The measurement issues surrounding private equity allow us to look further into some of the components of risk and contributors of return in a private equity context. Susan E. Woodward in her paper titled, "Measuring Risk and Performance for Private Equity" (2004) looks at the correlation of returns between private equity (venture capital and buy out funds) and that of the public markets. She works to get at the facts of the true risk-adjusted rates of return for private equity, rather than relying on the common understanding held by most institutional investors that private equity can be characterized by its above-average performance and substantial power to diversify a portfolio beyond what is available in traded securities. Woodward works to show that the low estimates of risk and correlation result from a general failure to recognize that the values reported by General Partners are a mix of current and stale values, and then moves to propose an approach to measuring risk and performance with the returns reported by General Partners that deals with the stale values for some assets in the portfolio. In her paper, she reviews the various methods used by many to search out an appropriate proxy for a private equity index, and points out that if we guess too low of a 'beta', the estimate of 'alpha' will be too high.

Woodward concludes that investors receive too optimistic an impression from the standard analysis of performance of buyout and venture funds. She puts forward that the

reported correlations with the stock market are biased downward and risk-adjusted returns (alphas) are biased upward. Biases arise because the period over which the buyout or venture returns are measured are not the same as the periods over which the stock market returns are measured. The lack of synchronicity results in low estimated correlations, causing investors to get a false impression that buyout and venture investments are not very risk and that they out-perform other investments on a risk-adjusted basis. Her paper, in contrast, provides a simple and practical approach to measuring risk and assessing performance that corrects the bias arising from the reporting practices of General Partners. The author's approach is to include enough lagged returns on the index or benchmark, as independent variables in the standard performance regression, to capture all of the correlation between a broad stock market index and reported returns on the asset, and then summing the coefficients to get the risk measure. In the case of venture capital, the 'beta' measure of risk increases from 0.60 to 2.0 and the estimated 'alpha' is a misleading 1.8 percent of excess return per quarter in the uncorrected regression, and essentially zero in the corrected one.

Matthias M. Ick in his paper, "Performance Measurement and Appraisal of Private Equity Investments Relative to Public Equity Markets" (2005), carries the investigation of the risk-return relationship of private equity to that of public market equity further, in his analysis of the adequateness of private equity's return premium. The author looks to analyze the returns of private equity, specifically the cash flows on a gross of fee basis, in comparison to a simulated public market equity portfolio of investments that mimics the cash flow patterns of private equity investments. His aim is to investigate whether private equity investments generate a return premium over public stock markets on the project level gross of all externalities. A secondary aim of his paper is to assess whether the premium is adequate on a risk adjusted basis.

In his paper he uses a proprietary dataset made up of 86 private equity companies, 243 private equity funds, and their 5,991 investments in 4,819 different companies – focusing specifically on monthly realized cash flows between private equity funds and portfolio companies. The time period covers a span of 28 years from 1975 to 2003 and is global in that it covers 51 different countries. The key advantage to the dataset he uses is that it is similar to the one used by Ljungqvist and Richardson (2003) in that cash flow and write-off information is provided for each individual investment. This allows Ick to focus on pure investment returns prior to any pooling activity by private equity funds, providing for a cleaner comparison to the public market equity investment universe.

To answer the question whether private equity outperforms public equity, Ick applies and compares the performance measure concepts of excess return, based on the Internal Rate of Return (IRR), and Public Market Equivalent (PME). In developing his comparison of the cash flow pairs, he calculates IRRs and excess returns of private equity investments over various public benchmark indices. Prior to introducing a risk adjustment to their performance measure, he compares several risk measures and their suitability for private equity investments on the project level. The author appraises performance using the established concept of the Sharpe ratio, and then introduces alternative risk adjusted performance measures, such as a Modified Sharpe Ratio, and the universal performance measure Omega, first introduced by Keating/Shadwick, risk measures that are tailored to the characteristics of private equity investments.

Through his testing procedures, he generally finds that private equity, as an asset class, substantially outperforms public market investments. When applying alternative risk measures to a private equity framework, he finds that downside deviation and shortfall better describe the relative risk of private equity than does standard deviation, as positive deviations from the mean are opportunities rather than tracking error risk and returns are not normally

distributed. Converse to his original findings, he finds that private equity overall, underperforms relative to public equity if downside deviation is applied. When he applies Omega as an alternative risk adjusted performance measure it results in private equity and public equity almost matching each other. Overall he concludes that private equity investments earn adequate excess returns over public stock markets on a value-weighted and gross of fee basis.

CHAPTER 3: THEORETICAL FRAMEWORK AND METHODOLOGY

Our interest in this section is in developing an econometric framework that will allow us to identify, measure, and assess the potential determinants of the internal rate of return for private equity. We outline the base theoretical framework used to derive testable hypotheses for our empirical investigation.

The framework is designed to serve as a platform that can be applied to:

i) different geographic markets (i.e. US, Canada, Europe, etc.);

ii) different segments of the venture capital and private equity markets (i.e. venture capital, private equity, LBO, MBO, sub-debt, and mezzanine debt);

iii) different sizes of the venture capital and private equity markets (i.e. large, mid-size, and small funds); and finally

iv) to different industry segments of the venture capital and private equity markets (i.e. technology, industrial technology, publishing, media, etc.).

To investigate the potential determinants of private equity returns we establish a regression model that regresses 1-Yr, 5-Yr, and 10-Yr Horizon IRRs for Venture Capital, Buyout Capital, and All Private Equity for the period covered from 1980 – 2005, against a number of proposed independent variables.

Our framework involves running multiple regression to model the dependent variable using a linear combination of the independent variables. Multiple regressions helps us establish that a set of independent variables explains a proportion of the variance in a dependent variable at a significant level (through a significance test of p-value), and can establish the relative predictive importance of the independent variables. The multiple regression equation takes the form:

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \ldots + \beta_K X_{Ki} + \varepsilon_i$$

Where the β_k 's are the regression coefficients, representing the amount the dependent variable Y_i changes when the corresponding independent variable changes 1 unit, keeping other independent variables fixed k = 1,...,K. The β_0 is the constant, where the regression line intercepts the y axis, representing the amount the dependent y will be, when all the independent variables are 0. The standardized version of the β_k coefficients are the beta weights, and the ratio of the beta coefficients are the ratios of the relative predictive power of the independent variables. Associated with multiple regression is Adjusted R-squared, representing the percent of the dependent variable explained collectively by all of the independent variables.

Multiple regression shares the following assumptions: linearity of relationships, the same level of relationship throughout the range of the independent variable ("homoscedasticity"), interval or near-interval data, absence of outliers, and data whose range is not truncated. In addition, it is important that the model being tested is correctly specified. The exclusion of important causal variables or the inclusion of extraneous variables can change markedly the coefficents and hence the interpretation of the importance of the

independent variables. t-tests are used to assess the significance of individual β coefficients, specifically testing the null hypothesis that the regression coefficient is zero.

We initially apply ordinary least squares (OLS) to test the relationships between the independent and dependent variables and draw the best fit regression line: a line such that the sum of the squared deviations of the distances of all the points to the line is minimized. To determine which independent variables exhibit the best explanatory power, we apply stepwise multiple regression as a way of computing OLS regression in stages. In stage one, the independent variable best correlated with the dependent variable is included in the equation. In the second stage, the remaining independent variable with the highest partial correlation with the dependent variable, controlling for the first independent variable, is entered. This process was repeated, at each stage partialling for previously-entered independent variable, until the addition of a remaining independent variable does not increase R-squared by a significant amount (or until all variables are entered). We worked the process backwards, starting with all variables and eliminating independent variables one at a time until the elimination of one makes a significant difference in R-squared. Stepwise regression was used in the exploratory phase of the research, not for the testing of our theories.

To test the theory that certain economic factors contribute to private equity returns, we proceeded with Weighted Least Squares (WLS) tests of the OLS identified statistically significant independent variables. In using WLS we look to make adjustments for potential outliers in the return series used as well as for potential heteroskedasticity. Our empirical analysis is based on theoretical frameworks that provide a platform to derive testable hypotheses.

CHAPTER 4: DATA

4.1 Return Data

The return data for this study has been obtained from Thomson Financial and its VentureXpert® database. The data is completely anonymous, and for reasons of confidentiality, names of the funds, firms, etc., are not disclosed. The dataset is an aggregate series of returns, consisting of 1,861 funds representing $679.3 billion, and covering 26 years (1980 – 2005) of US Venture Capital, Buyout Capital, and All Private Equity returns respectively. The Thomson Financial VentureXpert® dataset is based on voluntary reporting of fund information by the General Partners as well as by their Limited Partners. Thomson Financial receives their return information from both the General Partners and Limited Partners and suggests that there is "little opportunity for inconsistent reporting." We cannot validate this statement given the private nature of the data, but would suggest that if any bias is present, it would be toward the over-reporting of returns by the better-performing funds. If present, this would create a potential upward bias in our results in regards to average returns.

Thomson calculates net IRRs directly from cash flows and Net Asset Values (NAVs) provided by both General Partners and Limited Partners. The universe of potential contributors is identified from the private equity and venture capital firms researched and included in the VentureXpert® database. A team updates the VentureXpert® database daily to ensure accuracy and completeness, and the NVCA regularly reconciles contact information to validate the survey universe. The performance data is collected from the largest sample of US private equity capital available. The data covers private equity, buyout capital, and

venture capital funds managed by General Partners located in the US, or investing in the US, irrespective of NVCA or national trade association membership. Because of the rapid growth of the industry in the 1990's, the earlier years contain fewer observations of funds than the later years. The VentureXpert® dataset for each fund includes the performance measures that were collected from General Partners and Limited Partners. These measures are the internal rate of return (IRR) for each fund, which are then aggregated at the industry level, and are inclusive of all private equity returns in the United States for the period under review. VentureXpert® also collects the cash flows in and out of each fund for the life of the fund or through the end of 2005. All these performance measures, as well as the cash flows, are reported net of management fees and carried interest.

The included funds are ones in which the General Partners:

- invest primarily in private companies;
- conduct direct investments; and
- use mainly equity financial instruments for investments.

Vehicles managed by the General Partner may be:

- private or listed;
- fixed life closed-ended, evergreen or open-ended; and/or
- independent or captive.

The performance statistics benchmarks are based on net internal rates of return calculated by VentureXpert® from cash flows provided directly by General Partners and Limited Partners. This approach of calculating returns directly from the cash flows and the

net assets values allows for the most consistent and accurate IRR figures as all returns are calculated on the same basis.

The following data is used to calculate the IRRs:

- cash flows into a fund;
- cash flows out of a fund; and
- Net Asset Value at the end of the reporting period.

VentureXpert® calculates the horizon return as an IRR calculation between points in time where the beginning point is variable and the end point is fixed. An example would be the 3-Yr, 5-Yr, and 10-Yr returns ending 12/31/99, with 12/31/99 as the end point. Industry convention for private equity funds is to measure and communicate their performance in terms of an annualized internal rate of return. The intuition of an IRR is that it represents the yield an investor receives on his capital currently invested. The IRR is the discount rate that would result in a net present value (NPV) of zero for a series of cash flows, both inflows and outflows. IRR as a standalone measure indicates whether an investment generates a profit or a loss.

The Horizon IRR that is measured by Thomson Financial is often termed as a "dollar-weighted" return in the investment industry. The measure that is most often used to calculate performance in other investments is a time-weighted return or "geometric mean return." Over the past 10 years, Thomson Financial has been reporting both dollar-weighted and time-weighted returns to their clients and has spent a considerable number of hours in evaluating the appropriateness of time-weighted returns versus dollar-weighted returns. In 1993, the CFA Institute (then known as AIMR) proposed performance measurement guidelines that recommended a time-weighted approach to presenting fund performance.

After some concerns were expressed by investors and fund managers, a special subcommittee of private equity industry investors and experts appointed by the CFA Institute studied the applicability of time-weighted returns to the private equity industry. They recommended that fund managers and intermediaries present their private equity performance results on a dollar-weighted IRR basis.

The primary rationale for recommending that the private equity industry present their performance results on a dollar weighted IRR basis falls from the nature of time-weighted returns and the challenges faced in applying a time-weighted approach to the private equity industry. Normally the best measure of the rate of return on an investment is generally the IRR since it takes into account an implied discount rate that factors in the time-value of money. However, in some cases the IRR is not indicative of performance especially when dealing with investment management performance. For that reason, other measures have been used to evaluate performance. The most common alternative measure is the time-weighted return.

The time-weighted return is calculated by calculating the rate of return between two or more periods and multiplying those returns together geometrically, then taking a geometric mean of the result. It is an approximation of the IRR.

In theory, dollar-weighted IRR's and time-weighted returns should give exactly the same return. This is true only under one condition: that you calculate a periodic return every time there is a cash flow in or out of a portfolio. That is, you would calculate a return whenever there was a capital call or a distribution. In a public equity portfolio, where prices are kept on a minute-by-minute basis, it is possible to calculate daily, monthly, hourly, or even minutely time-weighted returns. However, in a private equity portfolio, there is no real valuation performed at every transaction date. Therefore, there is a lack of precision because

there is only a value assigned to a portfolio at the end of each quarter, not at every transaction. In practice one can only calculate time-weighted returns when one has a complete and unbroken series of returns. This is available for publicly traded assets where a continuous return series is available by definition. However for private equity investing, where returns are characterized as "sticky", and General Partners report their returns infrequently, a dollar weighted Horizon IRR is more precise as it only requires portfolio values at the beginning and the end of the period being measured, not at every transaction. Accordingly, we have utilized Horizon IRRs as our principal return series throughout our study.

The specific dependent variables include the following different cross sections and associated time series:

A. 1-Yr Horizon IRRs for:

   a. Venture Capital from 1980 – 2005;

   b. Buyout Capital from 1983 – 2005; and

   c. All Private Equity from 1980 – 2005.

B. 5-Yr Horizon IRRs for:

   a. Venture Capital from 1980 – 2005[5];

   b. Buyout Capital from 1982 – 2005; and

   c. All Private Equity from 1980 – 2005.

[5] Note the time period is inclusive of data collected by Thomson Financial from 1980 to 2005, however the 5-year horizon return looks back over 5-year rolling periods. For a complete description of horizon returns, see Appendix 3: Terminology.

C. 10-Yr Horizon IRRs for:

a. Venture Capital from 1980 - 2005[6];

b. Buyout Capital from 1982 – 2005; and

c. All Private Equity from 1980 – 2005.

We apply the framework and run the 1-Yr, 5- Yr, and 10- Yr Horizon IRRs for each of Venture Capital, Buyout Capital, and All Private Equity to provide a complete review of the net impact of the different independent variables on the returns generated in the private equity industry.

Thomson Financial uses the term private equity to describe the universe of all venture investing, buyout investing, and mezzanine investing. In accordance with Thomson Financial we use the following type definitions: Venture capital funds represent the universe of venture vesting. It does not include buyout investing, mezzanine investing, fund-of-fund investing or secondaries. Angel investors or business angels are also not included in the definition. Buyout capital funds represent the universe of buyout investing and mezzanine investing.

4.2 Independent Variables

The independent variables utilized in the study were sourced primarily from Bloomberg, and in each case reach back to cover the period from 1980 to 2005, a period equal to that of the IRR series provided by VentureXpert®. The independent variables we use in search of potential "*prevailing winds*" include:

- Rolling 1-Yr S&P500 Index Returns;

[6] Note the time period is inclusive of data collected by Thomson Financial from 1980 to 2005, however the 10-yr horizon return looks back over 10-yr rolling periods. For a complete description of horizon returns, see Appendix 3: Terminology.

- Rolling 5-Yr S&P500 Index Returns;
- Rolling 10-Yr S&P500 Index Returns;
- Price-Earnings Ratios for the S&P500 Index;
- Interest Rate (1-Yr US T-Bills);
- US GDP Growth Rate;
- US CPI Growth Rate; and finally
- as a measure of funds flow into the private equity industry, a reporting of private equity capital raised for each year of the study.

The above listed independent variables cover the period from 1980 to 2005. The independent variables were identified and selected because: i) they have been included in past studies by other researchers; ii) they were identified through the authors' experience in private equity investing as being potential contributors; and iii) recommendations were made by members of the academic committee; or iv) some combination of i to iii.

Table 1: Definition of Variables

This table defines the variables considered in this paper. Summary statistics are presented in Tables 2 and 3.

Variable	Description and Source
Market Factors	
1. 1-Yr Rolling S&P500 Return	The 1-Yr Rolling S&P500 Index return over the period from 1980 to 2005. *Source: Bloomberg*
2. 5-Yr Rolling S&P500 Return	The 5-Yr Rolling S&P500 Index return over the period from 1980 to 2005. *Source: Bloomberg*
3. 10-Yr Rolling S&P500 Return	The 10-Yr Rolling S&P500 Index return over the period from 1980 to 2005. *Source: Bloomberg*
4. S&P500 PE	The annual Price-to-Earning Ratio of the Standard and Poor's Index over the period from 1980 to 2005. Measurement of valuation for S&P500. *Source: Bloomberg*
5. Interest Rate	The U.S. 1-year treasury bond return over the period from 1980 to 2005. *Source: U.S. Treasury*
6. GDPCH	The year-to-year change of real US GDP over the period from 1980 to 2005. *Source: Bureau of Economic Analysis, agency of the U.S. Department of Commerce*
7. CPICH	Annual changes in the prices paid by urban consumers for a representative basket of goods and services over the period from 1980 to 2005. *Source: Bureau of Economic Analysis, agency of the U.S. Department of Commerce*
8. $USD Capital Invested Ratio	Annual new private equity (all, venture capital, and buyout) capital raised in the United States each year for 1980 to 2005, using the amount of capital invested in 1980 as a base. *Source: Thompson Financial*

CHAPTER 5: RESULTS AND DISCUSSION

5.1 Summary Statistics

First, mean, median, maximum, minimum, and standard deviations for all return series used in this study were calculated for 1980 – 2005. The results are presented in Table 2. Statistics are provided to examine the shape and distribution of internal rates of return for 1-Yr, 5-Yr and 10-Yr time horizons. As shown in Table 2 the distribution of Venture Capital in the sample under study is much more variable, compared to Buyout Capital and All Private Equity statistics as a whole.

Table 2: Characteristics of Total Funds Sample 1980 – 2005[a]

Year	1 Year Horizon			5 Year Horizon			10 Year Horizon		
	Venture	Buyouts	All	Venture	Buyouts	All	Venture	Buyouts	All
Mean	21.17%	20.38%	18.12%	19.19%	16.83%	17.04%	17.72%	18.14%	16.81%
Median	15.70%	23.90%	17.90%	19.45%	17.30%	16.60%	16.45%	18.55%	16.95%
Maximum	184.80%	54.40%	71.30%	48.40%	40.60%	29.60%	30.20%	36.10%	23.30%
Minimum	-34.30%	-15.00%	-20.60%	-7.93%	0.50%	-0.05%	8.20%	3.60%	12.68%
Standard Deviation	39.16%	16.99%	19.00%	13.67%	11.43%	7.59%	6.98%	9.23%	2.51%

[a] Mean, median, maximum, minimum, and standard deviation of Horizon IRR for Venture Capital, Buyout Capital, and All Private Equity from January 1980 to December 2005.

Source: Thomson Financial

In summary, the results in Table 2 show that on average, Venture Capital realizes an IRR between -34.30% and 184.80% for a 1-Yr horizon, between -7.93% and 48.40% for a 5-Yr horizon, and between 8.20% and 30.20% for a 10-Yr horizon. The average return for short-term investments is moderately higher than the return required for long-term investments in our data. Similar patterns can be observed for Buyout Capital, and All Private Equity as well where the internal rate of return is more volatile for shorter 1-Yr return horizons, compared to 5-Yr and 10-Yr holding periods. The only exception is that the standard deviation for Venture Capital is lower than the Buyout Capital under the 10-Yr horizon.

5.2 Correlation Coefficients

In Tables 3 through 5, we measure the preliminary relationship between the proposed dependent variable(s) and the complete set of proposed independent variables. We use the correlation matrix to help identify potential relationships that can be studied further through the more complete parametric regression process. The highlighted items in each exhibit represent correlations that are deemed to be high as they are near or above the 40% level. The correlation tables and associated relationships are shown in their complete form in the exhibits that follow.

Table 3: Correlation Matrices for 1-Year Horizons

All Private Equity - 1 Year Horizon

	IRR	*SP500 1-Yr Rolling*	*SP500 5-Yr Rolling*	*SP500 10-Yr Rolling*	*SP500 PE*	*Interest Rate*	*GDPCH*	*CPICH*	*$ Invested*
IRR	1.0000								
SP500 1 Yr Rolling	**0.5660**	1.0000							
SP500 5 Yr Rolling	**0.4126**	**0.4539**	1.0000						
SP500 10 Yr Rolling	0.1986	0.2758	**0.5795**	1.0000					
SP500 PE	-0.2903	-0.2600	0.0041	**0.4846**	1.0000				
Interest Rate	0.1743	0.0702	0.2326	**-0.5262**	**-0.6289**	1.0000			
GDPCH	0.1421	-0.0305	0.0342	**-0.4642**	**-0.6082**	**0.6737**	1.0000		
CPICH	0.1203	0.0000	-0.1152	**-0.6673**	**-0.4768**	**0.7519**	**0.5372**	1.0000	
$ Invested	0.0231	-0.1995	0.0870	**0.3709**	**0.5729**	**-0.5178**	-0.2931	**-0.3841**	1.0000

Buyout Capital - 1 Year Horizon

	IRR	*SP500 1-Yr Rolling*	*SP500 5-Yr Rolling*	*SP500 10-Yr Rolling*	*SP500 PE*	*Interest Rate*	*GDPCH*	*CPICH*	*$ Invested*
IRR	1.0000								
SP500 1-Yr Rolling	**0.6791**	1.0000							
SP500 5-Yr Rolling	0.3143	**0.4810**	1.0000						
SP500 10-Yr Rolling	0.0099	0.3463	**0.7341**	1.0000					
SP500 PE	**-0.5081**	-0.3133	-0.0418	0.3238	1.0000				
Interest Rate	0.2198	0.1908	**0.4539**	0.0019	**-0.5513**	1.0000			
GDPCH	0.2858	0.1131	0.1376	-0.2747	**-0.6479**	**0.7044**	1.0000		
CPICH	-0.0299	-0.0498	0.0058	-0.1731	**-0.4390**	**0.6094**	**0.3989**	1.0000	
$ Invested	-0.1961	-0.1894	-0.0771	0.0604	**0.4902**	-0.5543	-0.2816	**-0.3815**	1.0000

Venture Capital - 1 Year Horizon

	IRR	*SP500 1-Yr Rolling*	*SP500 5-Yr Rolling*	*SP500 10-Yr Rolling*	*SP500 PE*	*Interest Rate*	*GDPCH*	*CPICH*	*$ Invested*
IRR	1.0000								
SP500 1-Yr Rolling	**0.3936**	1.0000							
SP500 5-Yr Rolling	**0.4951**	**0.4539**	1.0000						
SP500 10-Yr Rolling	**0.3822**	0.2758	**0.5795**	1.0000					
SP500 PE	-0.0611	-0.2600	0.0041	**0.4846**	1.0000				
Interest Rate	0.0785	0.0702	0.2326	**-0.5262**	**-0.6289**	1.0000			
GDPCH	0.0669	-0.0305	0.0342	**-0.4642**	**-0.6082**	**0.6737**	1.0000		
CPICH	0.0003	0.0000	-0.1152	**-0.6673**	**-0.4768**	**0.7519**	**0.5372**	1.0000	
$ Invested	0.2973	-0.2186	0.2604	**0.4321**	**0.4849**	-0.2826	-0.1883	-0.2557	1.0000

Table 4: Correlation Matrices for 5-Year Horizons

All Private Equity - 5 Year Horizon

	IRR	*SP500 1-Yr Rolling*	*SP500 5-Yr Rolling*	*SP500 10-Yr Rolling*	*SP500 PE*	*Interest Rate*	*GDPCH*	*CPICH*	*$ Invested*
IRR	1.0000								
SP500 1-Yr Rolling	0.2052	1.0000							
SP500 5-Yr Rolling	**0.6216**	**0.4539**	1.0000						
SP500 10-Yr Rolling	0.1313	0.2758	**0.5795**	1.0000					
SP500 PE	-0.1391	-0.2600	0.0041	**0.4846**	1.0000				
Interest Rate	**0.6471**	0.0702	0.2326	**-0.5262**	**-0.6289**	1.0000			
GDPCH	0.3245	-0.0305	0.0342	**-0.4642**	**-0.6082**	**0.6737**	1.0000		
CPICH	**0.4199**	0.0000	-0.1152	**-0.6673**	**-0.4768**	**0.7519**	**0.5372**	1.0000	
$ Invested	-0.0920	-0.1995	0.0870	**0.3709**	**0.5729**	**-0.5178**	-0.2931	**-0.3841**	1.0000

Buyout Capital - 5 Year Horizon

	IRR	*SP500 1-Yr Rolling*	*SP500 5-Yr Rolling*	*SP500 10-Yr Rolling*	*SP500 PE*	*Interest Rate*	*GDPCH*	*CPICH*	*$ Invested*
IRR	1.0000								
SP500 1-Yr Rolling	0.2942	1.0000							
SP500 5-Yr Rolling	**0.5733**	**0.4802**	1.0000						
SP500 10-Yr Rolling	**0.4563**	0.2852	**0.6551**	1.0000					
SP500 PE	-0.2703	-0.3161	-0.0398	**0.3835**	1.0000				
Interest Rate	0.2897	0.1905	**0.3946**	-0.2205	**-0.5788**	1.0000			
GDPCH	0.1583	0.0985	0.1349	-0.1324	**-0.5622**	**0.4864**	1.0000		
CPICH	0.2212	-0.0144	0.0026	**-0.3790**	**-0.4811**	**0.7120**	0.1980	1.0000	
$ Invested	**-0.3658**	-0.1954	-0.0745	0.1497	**0.5146**	**-0.5768**	-0.2185	**-0.4285**	1.0000

Venture Capital - 5 Year Horizon

	IRR	*SP500 1-Yr Rolling*	*SP500 5-Yr Rolling*	*SP500 10-Yr Rolling*	*SP500 PE*	*Interest Rate*	*GDPCH*	*CPICH*	*$ Invested*
IRR	1.0000								
SP500 1-Yr Rolling	-0.0714	1.0000							
SP500 5-Yr Rolling	0.2511	**0.4539**	1.0000						
SP500 10-Yr Rolling	0.2153	0.2758	**0.5795**	1.0000					
SP500 PE	**0.3759**	-0.2600	0.0041	**0.4846**	1.0000				
Interest Rate	0.1533	0.0702	0.2326	**-0.5262**	**-0.6289**	1.0000			
GDPCH	-0.0312	-0.0305	0.0342	**-0.4642**	**-0.6082**	**0.6737**	1.0000		
CPICH	0.0747	0.0000	-0.1152	**-0.6673**	**-0.4768**	**0.7519**	**0.5372**	1.0000	
$ Invested	**0.5737**	-0.2186	0.2604	**0.4321**	**0.4849**	-0.2826	-0.1883	-0.2557	1.0000

Table 5: Correlation Matrices for 10-Year Horizons

All Private Equity - 10 Year Horizon

	IRR	*SP500 1-Yr Rolling*	*SP500 5-Yr Rolling*	*SP500 10-Yr Rolling*	*S&P 500 PE*	*Interest Rate*	*GDPCH*	*CPICH*	*$ Invested*
IRR	1.0000								
SP500 1-Yr Rolling	0.0596	1.0000							
SP500 5-Yr Rolling	**0.5162**	**0.4539**	1.0000						
SP500 10-Yr Rolling	0.2518	0.2758	**0.5795**	1.0000					
SP500 PE	-0.0330	-0.2600	0.0041	**0.4846**	1.0000				
Interest Rate	**0.4519**	0.0702	0.2326	**-0.5262**	**-0.6289**	1.0000			
GDPCH	0.2608	-0.0305	0.0342	**-0.4642**	**-0.6082**	**0.6737**	1.0000		
CPICH	0.0600	0.0000	-0.1152	**-0.6673**	**-0.4768**	**0.7519**	**0.5372**	1.0000	
$ Invested	0.0583	-0.1995	0.0870	**0.3709**	**0.5729**	**-0.5178**	**-0.2931**	**-0.3841**	1.0000

Buyout Capital - 10 Year Horizon

	IRR	*SP500 1-Yr Rolling*	*SP500 5-Yr Rolling*	*SP500 10-Yr Rolling*	*SP500 PE*	*Interest Rate*	*GDPCH*	*CPICH*	*$ Invested*
IRR	1.0000								
SP500 1-Yr Rolling	0.2082	1.0000							
SP500 5-Yr Rolling	**0.4212**	**0.4802**	1.0000						
SP500 10-Yr Rolling	**0.4147**	0.2852	**0.6551**	1.0000					
SP500 PE	-0.1999	-0.3161	-0.0398	**0.3835**	1.0000				
Interest Rate	0.0861	0.1905	0.3946	-0.2205	**-0.5788**	1.0000			
GDPCH	0.0157	0.0985	0.1349	-0.1324	**-0.5622**	**0.4864**	1.0000		
CPICH	0.1065	-0.0144	0.0026	**-0.3790**	**-0.4811**	**0.7120**	0.1980	1.0000	
$ Invested	**-0.3606**	-0.1954	-0.0745	0.1497	**0.5146**	**-0.5768**	-0.2185	**-0.4285**	1.0000

Venture Capital - 10 Year Horizon

	IRR	*SP500 1-Yr Rolling*	*SP500 5-Yr Rolling*	*SP500 10-Yr Rolling*	*SP500 PE*	*Interest Rate*	*GDPCH*	*CPICH*	*$ Invested*
IRR	1.0000								
SP500 1-Yr Rolling	-0.2763	1.0000							
SP500 5-Yr Rolling	-0.3175	**0.4539**	1.0000						
SP500 10-Yr Rolling	-0.0692	0.2758	**0.5795**	1.0000					
SP500 PE	**0.4027**	-0.2600	0.0041	**0.4846**	1.0000				
Interest Rate	-0.2368	0.0702	0.2326	**-0.5262**	**-0.6289**	1.0000			
GDPCH	-0.0385	-0.0305	0.0342	**-0.4642**	**-0.6082**	**0.6737**	1.0000		
CPICH	-0.1523	0.0000	-0.1152	**-0.6673**	**-0.4768**	**0.7519**	**0.5372**	1.0000	
$ Invested	**0.6051**	-0.2186	0.2604	**0.4321**	**0.4849**	-0.2826	-0.1883	-0.2557	1.0000

Observations of significant correlations for 1-Yr Horizon IRRs across All Private Equity, Buyout Capital, and Venture Capital are as follows. The correlation of S&P500 returns with 1-Yr Horizon IRRs is significant across All Private Equity (0.5660), Buyout Capital (0.6791), and Venture Capital (0.3936). The positive correlation between stock market returns and rates of return on private equity is consistent with base expectations. Other observations for the 1-Yr Horizon IRRs include a negative correlation between PE multiples for the S&P500, and each of Interest Rates (-0.6289), GDPCH (-0.6082), and CPICH (-0.4768). This is consistent and is most likely due to the contribution of CPICH to each of GDPCH (0.5372) and Interest Rates (0.7519) respectively. Of additional interest is the relationship between $ Invested for All Private Equity, Venture Capital, and Buyout Capital, relative to each of the PE-multiple for the S&P500 (positive), Interest Rates (negative), GDPCH (negative), and CPICH (negative). The highest correlations between $ Invested and the other independent variables is for Buyout Capital, but the direction of correlation holds for all three types of investment. And finally, the correlation between 1-Yr Horizon IRRs and the PE multiple for the S&P500 is significant for Buyout Capital, but not for Venture Capital. This is important and is consistent with the expectation that multiples and capitalization rates play a more predominant role in determining returns for the buyout capital sector than they do for the venture capital sector.

In expanding to the 5-Yr and 10-Yr Horizon IRRs, the correlation relationships between each of the independent variables continue to hold in general, however the following additional observations can be made in regards to the correlations between the respective independent variables and the listed dependent variables. The correlation between the 5-Yr Horizon IRRs for All Private Equity, and Interest Rates (0.6471), and CPICH (0.4199) becomes significant, where it was not before for 1-Yr Horizon IRRs. The high level of positive correlation does not hold for Buyout Capital and Venture Capital, but is in place for All Private Equity.

Further to Gompers and Lerner (2000) findings, the correlation of returns for $ Invested in Buyout Capital (-0.3658), and Venture Capital (0.5737) with that of 5-Yr Horizon IRRs, becomes meaningful. Of interest is that the correlation is negative in direction for Buyout Capital, and positive for Venture Capital. The direction of the correlation relationship between the variables holds with 10-Yr Horizon IRR, but is less meaningful for Buyout Capital (-0.3606), and more meaningful for Venture Capital (0.6051). This finding somewhat contradicts the "money chasing deals" premise as initially studied by Gompers and Lerner for venture capital as the positive correlation would suggest that more capital adds to the returns in the venture capital sector. In contrast, the negative correlation between capital invested and rates of return for buyout capital seems to hold with the "money chasing deals" premise as it is negative, suggesting that as more capital is invested in the buyout capital sector, returns will move in an opposite direction.

5.3 Ordinary Least Squares

Following the initial review of the correlation relationships between the dependent variable(s) and the proposed independent variables, Ordinary Least Squares (OLS) was applied as a next step to measure the contributing value of each proposed independent variable. Table 6 presents the OLS regression results where all independent variables were included. At a p-value smaller than the 10% level a number of the independent variables can be identified as being significant. Of note the S&P500 1-Yr Rolling Returns show up for 1-Yr Horizon IRRs for each of Buyout Capital and All Private Equity, but fall off for each of 5-Yr, and 10-Yr horizon returns, with the exception of Venture Capital 10-Yr IRRs. The S&P500 5-Yr Rolling Returns show up for the 5-Yr and 10-Yr horizon returns for each of Venture Capital and Buyout Capital, but are not significant for any of All Private Equity. The S&P500 10-Yr Rolling Return shows up as significant for each of 10-Yr Venture Capital and All Private Equity, and then again for 5-Yr All Private Equity, however it was not

significant for any of the periods of Buyout Capital. The S&P500 PE Ratio is significant for the 5-Yr and 10-Yr Venture Capital Horizon IRRs as well as for the 1-Yr All Private Equity Horizon IRRs.

Interest Rates drop in at the 5-Yr Venture Capital, 10-Yr Buyout Capital, and 5-Yr and 10-Yr All Private Equity Horizon IRRs respectively. GDPCH play no role in determining any returns for any of Venture Capital, Buyout Capital, or All Private Equity, regardless of the time period studied. This is an area for further inquiry as some past studies have found GDPCH, or the general economic environment to be a contributor of private equity returns, while some studies have found GDPCH to be significant. Intuitively one would expect that the general economic climate would be a key determinant of any investment returns.

CPICH are minimally significant across the time series studied, and then only for the 10-year Horizon IRRs for each of Venture Capital and All Private Equity. Finally, $ Invested, representing new capital invested in the Venture Capital, Buyout Capital, or All Private Equity was significant across almost all the dependent variables, with its largest impact being observed on Buyout Capital where it was significant across each of the 1-year, 5-year, and 10-year Horizon IRRs. Beyond the significance or lack of significance of any one individual explanatory variable, the OLS process produced Adjusted R^2 scores ranging from 31.50% to 73.70%.

5.4 Backwards Elimination Process

Following the completion of the OLS preliminary selection regression procedure, the independent variables were dropped into a backwards elimination step-wise process. The results are presented in Table 7. The step-wise procedure maintained all those independent

variables that the OLS procedure identified as being significant with one exception, and then added eleven additional independent variables that were not identified as significant by the initial OLS procedure. The step-wise process of elimination added the following independent variables:

- S&P500 1-Yr Rolling Return for 1-Yr Venture Capital Horizon IRRs;
- S&P500 10-Yr Rolling Return for 10-Yr All Private Equity Horizon IRRs;
- S&P500 PE for each of 1-Yr Venture Capital, 1-Yr Buyout Capital, and 5-Yr All Private Equity Horizon IRRs;
- Interest Rate for 5-Yr Buyout Capital Horizon IRRs;
- CPICH for 5-Yr, and 10-Yr Buyout Capital Horizon IRRs; and
- $ Invested for 1-Yr Venture Capital and All Private Equity Horizon IRRs respectively.

The predictive capabilities of the regression models across all time series and cross section items studied were improved, as shown in the higher Adjusted R^2 scores. The Adjusted R^2 for Venture Capital ranged from 38.30% to 67.90%. The Adjusted R^2 for Buyout ranged from 42.60% to 54.60%, and the Adjusted R^2 for All Private Equity ranged from 42.20% to 76.20%. Overall, the results presented in Tables 6 and 7 suggest that General Partners and Limited Partners would benefit from looking to certain economic factors that help determine the direction of the current and future headwinds in private equity returns.

Table 6: OLS Regression Results with 'All' Proposed Independent Variables Included [a]

Coefficient (p-value; 2-sided)	Venture Capital			Buyout Capital			All Private Equity		
	One-Year Log(1+IRR)	Five-Year Log(1+IRR)	Ten-Year Log(1+IRR)	One-Year Log(1+IRR)	Five-Year Log(1+IRR)	Ten-Year Log(1+IRR)	One-Year Log(1+IRR)	Five-Year Log(1+IRR)	Ten-Year Log(1+IRR)
Constant	-0.1227	-0.3059	0.1318	0.4957	0.0729	0.2395	0.0355	-0.1566	0.0544
	(0.767)	*(0.069)*	*(0.041)*	*(0.058)*	*(0.624)*	*(0.080)*	*(0.887)*	*(0.024)*	*(0.047)*
1) S&P500 1-Yr Rolling	0.5491	0.1907	0.1638	0.5157	-0.1055	-0.1246	0.4610	0.0154	0.0070
	(0.181)	*(0.226)*	*(0.011)*	*(0.019)*	*(0.410)*	*(0.271)*	*(0.058)*	*(0.795)*	*(0.770)*
2) S&P500 5-Yr Rolling	0.7040	-0.9742	-0.5893	1.0303	1.0193	0.988	0.1845	-0.0356	(0.156)
	(0.638)	*(0.104)*	*(0.014)*	*(0.233)*	*(0.075)*	*(0.051)*	*(0.842)*	*(0.880)*	*(0.116)*
3) S&P500 10-Yr Rolling	2.5210	1.5120	-0.7687	-2.1400	*1.0510*	*0.365*	1.1760	1.3637	0.5083
	(0.409)	*(0.206)*	*(0.096)*	*(0.265)*	*(0.357)*	*(0.711)*	*(0.521)*	*(0.009)*	*(0.014)*
4) S&P500 PE	-0.0100	0.0064	0.0025	-0.0056	-0.0028	-0.0027	-0.0070	0.0014	0.0003
	(0.154)	*(0.023)*	*(0.020)*	*(0.157)*	*(0.270)*	*(0.226)*	*(0.104)*	*(0.186)*	*(0.476)*
5) Interest Rate	-0.9130	3.9640	0.7065	-2.1390	-2.3130	-3.0390	-0.2010	2.0899	1.0195
	(0.787)	*(0.007)*	*(0.165)*	*(0.410)*	*(0.142)*	*(0.034)*	*(0.927)*	*(0.002)*	*(0.000)*
6) GDPCH	0.4490	-0.2900	0.6576	0.6580	0.4390	0.1100	-0.0410	-0.1043	0.0206
	(0.884)	*(0.806)*	*(0.155)*	*(0.785)*	*(0.717)*	*(0.917)*	*(0.982)*	*(0.827)*	*(0.914)*
7) CPICH	2.7850	-0.4420	-1.1574	-1.5820	3.7080	3.2460	1.5080	0.6179	-0.3812
	(0.378)	*(0.714)*	*(0.020)*	*(0.655)*	*(0.117)*	*(0.117)*	*(0.419)*	*(0.203)*	*(0.059)*
8) $ Invested	0.0083	0.0054	0.0046	0.0000	-0.0002	-0.0002	0.0022	0.0003	0.0003
	(0.138)	*(0.017)*	*0.000*	*(0.021)*	*(0.067)*	*(0.029)*	*(0.182)*	*(0.436)*	*(0.047)*
N	26	26	26	23	24	24	26	26	26
Adjusted R^2	31.50%	44.50%	69.80%	48.60%	48.40%	38.80%	32.00%	73.70%	57.20%

[a] OLS Regression results for all independent variables. The dependent variable (1-year, 5-year, and 10-year IRR horizon returns for each of venture capital, buyout capital, and all private equity) is the logarithm of the realized IRR for the pooled dataset. Horizon IRR is calculated based on the actual cash flows of the funds (takedowns and distributions), as reported by Thomson Financial. US$ Invested is the total new capital invested in the sector. P-values are in parenthesis.

Table 7: Backwards Elimination Process with Significant Independent Variables from OLS Procedure Included [a]

	Venture Capital			Buyout Capital			All Private Equity		
Coefficient (p-value; 2-sided)	One-Year Log(1+IRR)	Five-Year Log(1+IRR)	Ten-Year Log(1+IRR)	One-Year Log(1+IRR)	Five-Year Log(1+IRR)	Ten-Year Log(1+IRR)	One-Year Log(1+IRR)	Five-Year Log(1+IRR)	Ten-Year Log(1+IRR)
Constant	0.1424 *(0.184)*	-0.1274 *(0.109)*	0.1720 *(0.005)*	0.2041 *(0.003)*	0.1165 *(0.070)*	0.1939 *(0.001)*	0.1667 *(0.011)*	-0.1334 *(0.001)*	0.0610 *(0.007)*
1) S&P500 1-Yr Rolling	0.9052 *(0.004)*		0.1402 *(0.024)*	0.5855 *(0.001)*	-	-	0.5839 *(0.002)*	-	-
2) S&P500 5-Yr Rolling	-	-	-0.3739 *(0.031)*	-	1.2001 *(0.000)*	0.9027 *(0.001)*	-	-	-0.1508 *(0.075)*
3) S&P500 10-Yr Rolling	-	-	-1.0240 *(0.023)*	-	-	-	-	1.1669 *(0.000)*	0.5358 *(0.005)*
4) S&P500 PE	-0.0086 *(0.070)*	0.0059 *(0.013)*	0.0021 *(0.042)*	-0.0047 *(0.042)*	-	-	-0.0062 *(0.038)*	0.0018 *(0.032)*	-
5) Interest Rate	-	2.1988 *(0.002)*	-	-	-2.2230 *(0.041)*	-2.6491 *(0.007)*	-	2.2496 *(0.000)*	0.9777 *(0.000)*
6) GDPCH	-	-	0.8197 *(0.079)*	-	-	-	-	-	-
7) CPICH	-	-	-0.8088 *(0.054)*	-	3.7160 *(0.078)*	3.3580 *(0.066)*	-	-	-0.3559 *(0.005)*
8) $ Invested Ratio	0.0121 *(0.012)*	0.0045 *(0.018)*	0.0044 *(0.000)*	-	-0.0003 *(0.014)*	-0.0003 *(0.006)*	0.0023 *(0.078)*	-	0.0004 *(0.010)*
N	26	26	26	23	24	24	26	26	26
Adjusted R^2	38.30%	46.80%	67.90%	54.60%	50.20%	42.60%	42.20%	76.20%	62.40%

[a] Backwards elimination process with those independent variables originally identified as being significant in the OLS procedure. The dependent variable (1-year, 5 year, and 10-year IRR horizon returns for each of Venture Capital, Buyout Capital, and All Private Equity) is the logarithm of the realized IRR for the pooled dataset. Horizon IRR is calculated based on the actual cash flows of the funds (takedowns and distributions), as reported by Thomson Financial. $ Invested Ratio is the total new capital invested in the sector. P-values are in parenthesis.

5.5 Weighted Least Squares (WLS)

In going beyond an initial OLS study, and in follow up to the backwards elimination process, we then took the resultant data and insights into a more complete Weighted Least Squares (WLS) analysis in an effort to remove any effects caused by outliers in our data series.

The results of the WLS procedures enhance the results generated by the OLS and backwards elimination step-wise procedures. In most cases the p-values of the originally OLS identified significant independent variables improved when WLS was applied. The WLS results are included as Figures 1 and 9 in Appendix 2.

CHAPTER 6: LIMITATIONS AND FUTURE RESEARCH

In working to uncover some of the potential *'prevailing winds'* that serve to enhance, or inhibit internal rates of return in a private equity context, we were required to complete an iterative process. And although we consider our research to be a step forward in better understanding some of the contributing factors that drive private equity returns, we are limited by our dataset and testing structures. First, some of the unexplained variance of our IRR measure is due to the 'aggregate' nature of our return series. To better understand how to account for the specific characteristics in the relationship between the private equity managers and their investment portfolios, access to the underlying investments made by each fund manager could be looked to. This level of inquiry would require full access to very detailed data, which was beyond the scope of the present analysis.

Second, as our work generally relies on fund valuation data collected by Thomson Financials' VentureXpert® service, it may suffer from three principal shortcomings: the return data is available only in aggregate form, rather than on a fund-by-fund basis (as mentioned above); the data is self-reported by the General Partner's and their Limited Partner's, and thus is potentially subject to selection biases; and finally, the data is based on unrealized as well as realized investments, which introduces noise and potential biases due to subjective accounting treatment. Despite the shortcomings, the body of analysis in regards to the potential macroeconomic contributors of return in a private equity context provides a foundation for further research.

CHAPTER 7: SUMMARY AND IMPLICATIONS

Our study utilizes a comprehensive dataset of US private equity fund returns to provide new and additional insights into certain economic and market factors that contribute to private equity returns – the so called '*prevailing winds*'. By using Thomson Financials' unique data set on the performance of US venture capital, buyout capital, and private equity investments, we investigate several predictive relationships and show their net and collective impact on private equity returns. The assembled model and associated insights can be used to help General Partners and their Limited Partners ensure that they are well positioned relative to the current and developing economic environment.

We would suggest that this paper extends the existing literature for the following reasons. First, in using Thomson Financials' proprietary VentureXpert® dataset made up of US private equity funds over the period 1980 – 2005, we are able to develop an OLS-regression model that explains more than 42.20% of the variation in All Private Equity returns. The combination of S&P500 Index Returns, general interest rates, and PE Multiples for the S&P500 work together to provide a high level of predictive power for private equity returns. Complimenting these contributing variables is the pace and size of capital invested in the private equity sector, further supporting Gomper and Learners "money chasing deals" premise. Our findings will hopefully encourage additional studies into the contributors of private equity returns, as well as highlighting the need for future work that aims to better understand the organizational structure of the private equity industry.

APPENDIX 1: SUMMARY STATISTICS

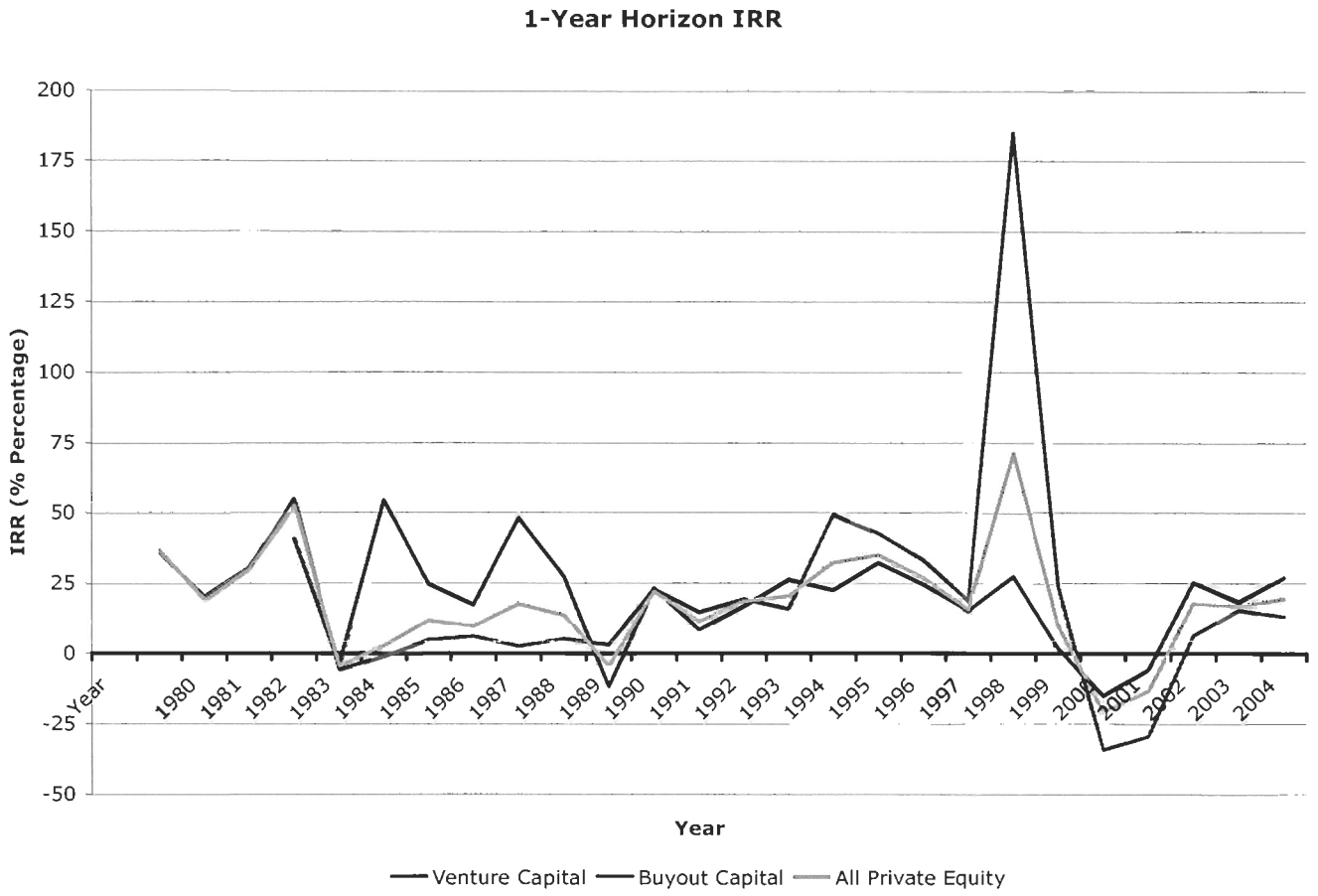


Figure 1: 1-Year horizon internal rates of return (IRR) for Venture Capital, Buyout Capital, and All Private Equity. The sample is obtained from Thomson Financials' VentureXpert database. The sample spans over the period 1980-2005 for Venture Capital and All Private Equity, and for the period 1983-2005 for Buyout Capital.

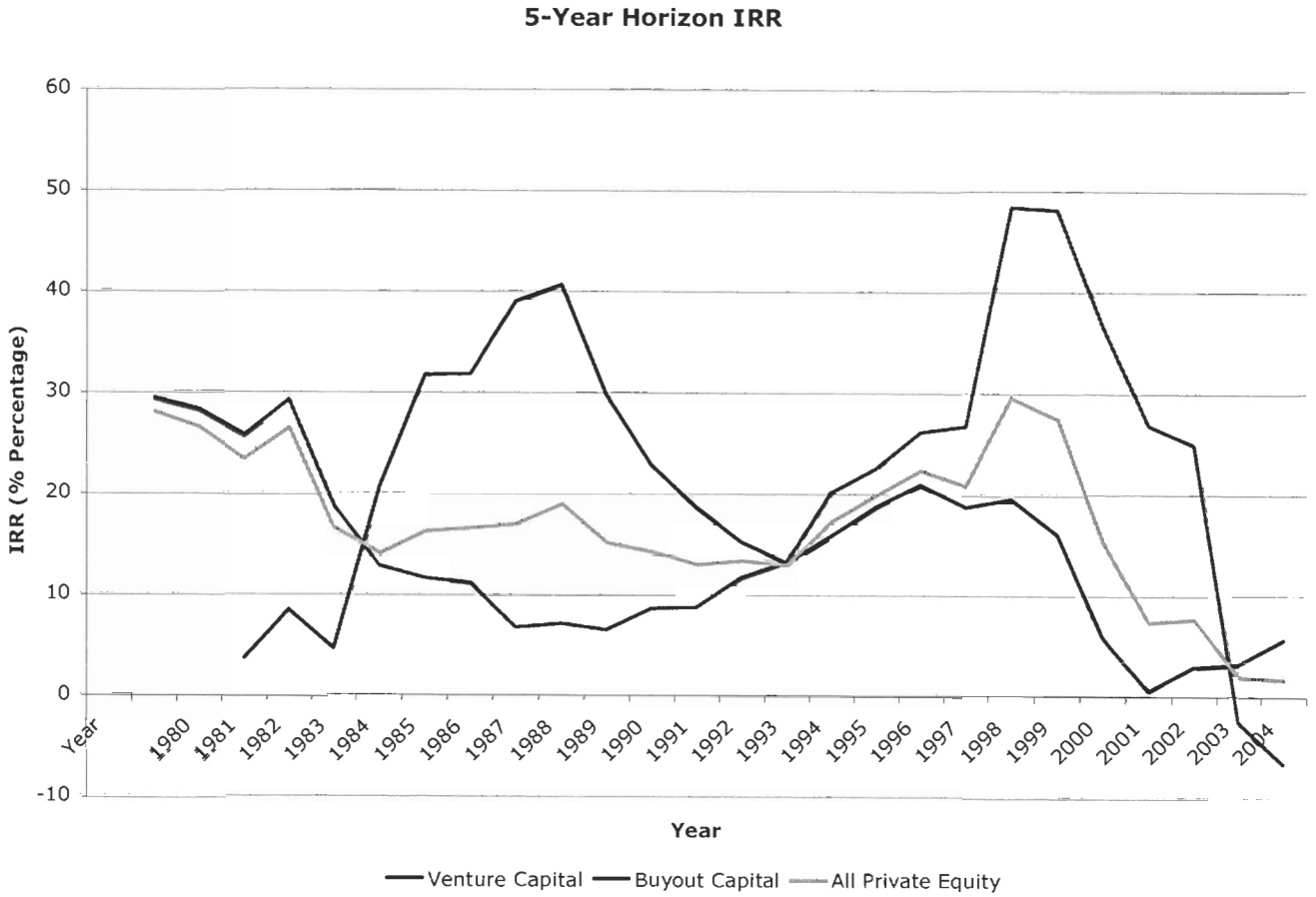


Figure 2: 5-Year horizon internal rates of return (IRR) for Venture Capital, Buyout Capital, and All Private Equity. The sample is obtained from Thomson Financials' VentureXpert database. The sample spans over the period 1980-2005 for Venture Capital and All Private Equity, and for the period 1982-2005 for Buyout Capital.

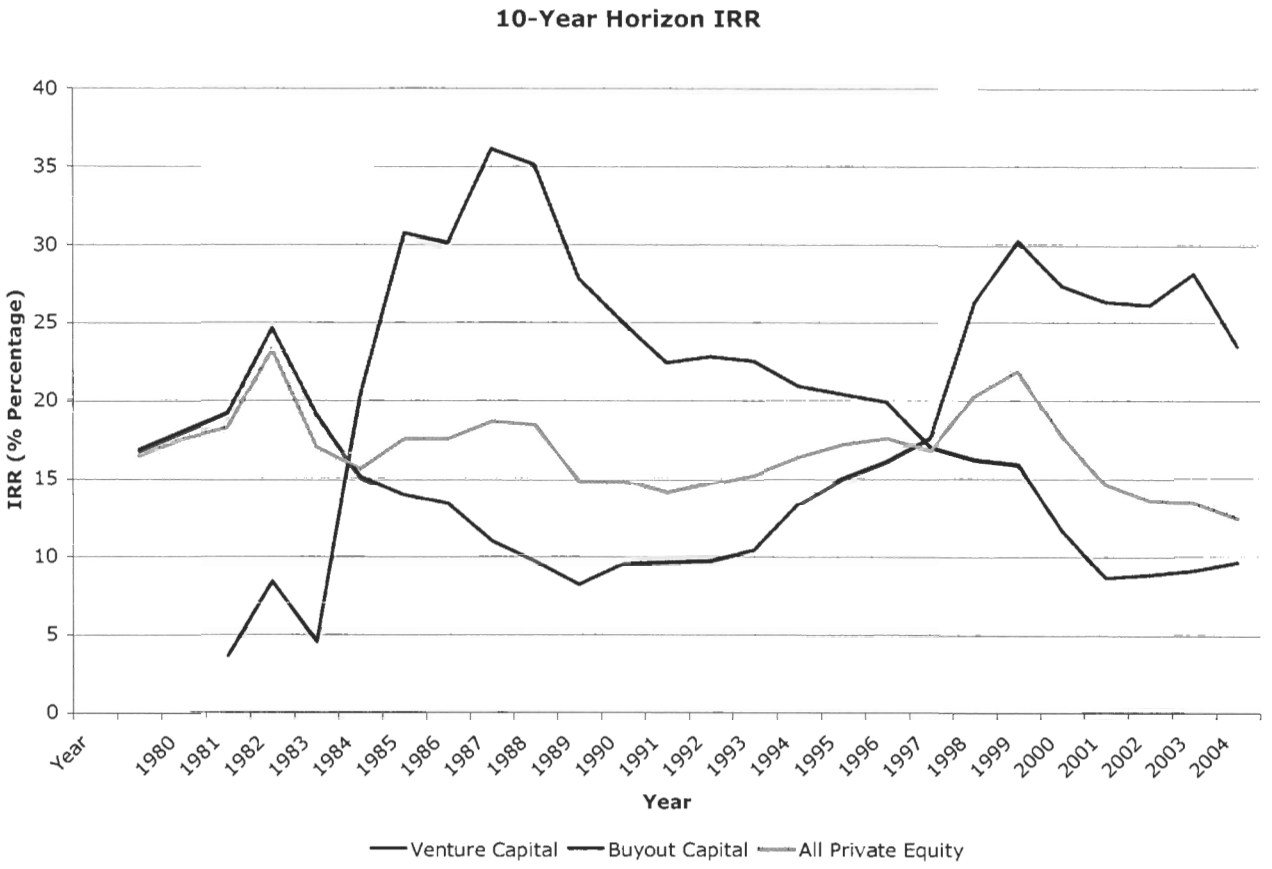


Figure 3: 10-Year horizon internal rates of return (IRR) for Venture Capital, Buyout Capital, and All Private Equity. The sample is obtained from Thomson Financials' VentureXpert database. The sample spans over the period 1980-2005 for Venture Capital and All Private Equity, and for the period 1982-2005 for Buyout Capital.

Year	1 Year Horizon			5 Year Horizon			10 Year Horizon		
	Venture Capital	Buyout Capital	All Private Equity	Venture Capital	Buyout Capital	All Private Equity	Venture Capital	Buyout Capital	All Private Equity
1980	35.80	-	36.60	29.30	-	28.10	16.80	-	16.50
1981	20.10	-	19.00	28.20	-	26.60	18.00	-	17.60
1982	30.50	-	30.00	25.70	3.60	23.50	19.20	3.60	18.30
1983	54.90	40.70	52.50	29.20	8.40	26.60	24.60	8.40	23.30
1984	(5.80)	(3.90)	(4.40)	18.80	4.60	16.60	19.10	4.50	17.10
1985	(0.90)	54.40	2.90	12.80	20.60	14.10	15.10	20.40	15.70
1986	4.80	24.70	11.90	11.60	31.70	16.30	13.90	30.70	17.60
1987	6.10	17.40	9.80	11.10	31.80	16.60	13.40	30.10	17.60
1988	2.60	48.20	17.70	6.70	39.00	17.00	11.00	36.10	18.70
1989	5.20	27.20	13.70	7.10	40.60	19.00	9.70	35.10	18.50
1990	3.10	(11.90)	(4.20)	6.50	29.70	15.20	8.20	27.80	14.90
1991	22.80	23.20	22.20	8.60	22.80	14.30	9.50	25.00	14.90
1992	14.80	8.50	11.50	8.70	18.60	13.00	9.60	22.40	14.20
1993	19.30	16.90	18.60	11.70	15.20	13.40	9.70	22.80	14.70
1994	15.90	26.30	20.60	13.20	13.10	12.90	10.40	22.50	15.30
1995	49.30	22.60	32.20	20.10	15.80	17.30	13.40	20.90	16.40
1996	42.70	32.20	34.90	22.50	18.70	19.90	15.00	20.40	17.20
1997	33.00	24.60	26.80	26.10	20.90	22.40	16.10	19.90	17.60
1998	18.80	15.20	15.60	26.70	18.70	20.90	17.60	17.00	16.80
1999	184.80	27.30	71.30	48.40	19.50	29.60	26.30	16.20	20.30
2000	23.90	1.70	10.50	48.10	16.00	27.50	30.20	15.90	21.90
2001	(34.30)	(15.00)	(20.60)	36.60	5.80	15.40	27.30	11.60	17.70
2002	(29.50)	(5.70)	(13.10)	26.80	0.50	7.40	26.30	8.60	14.60
2003	6.40	25.20	18.10	24.90	2.90	7.70	26.10	8.80	13.60
2004	15.50	18.50	17.10	(2.50)	3.20	1.90	28.10	9.10	13.50
2005	13.00	27.00	19.90	(6.70)	5.60	1.70	23.50	9.60	12.50

Figure 4: 1-Year, 5-Year, and 10-Year Horizon internal rates of return (IRR) for Venture Capital, Buyout Capital, and All Private Equity. The sample is obtained from Thomson Financials' VentureXpert® database, which obtains information on private equity investments. The sample spans over the period 1980-2005 for Venture Capital, 1983 – 2005 for Buyout Capital, and 1980 – 2005 for All Private Equity.

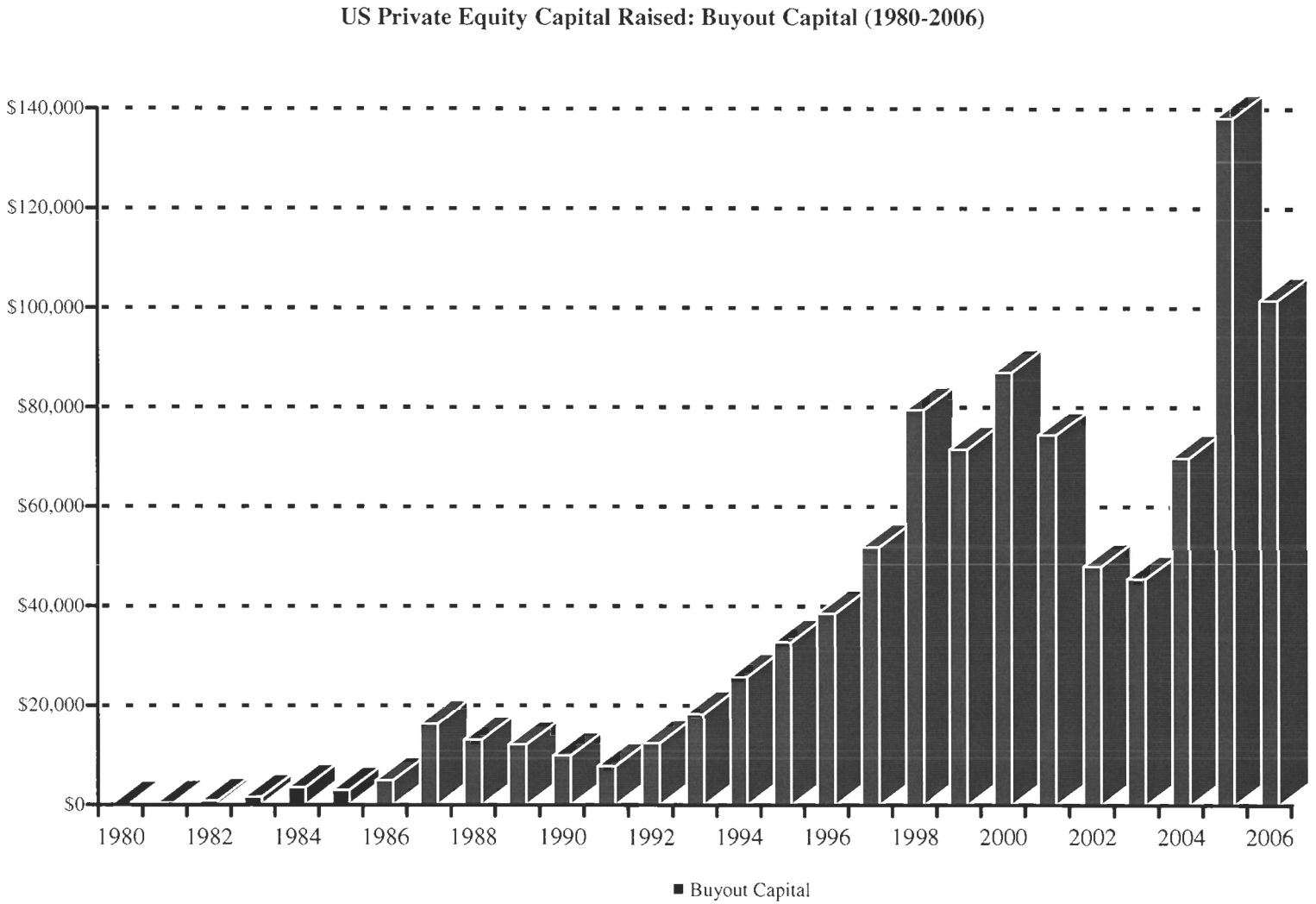


Figure 5: Annual capital raised for Buyout Capital. The dataset is obtained from Thomson Financial and covers the period 1980-2005.

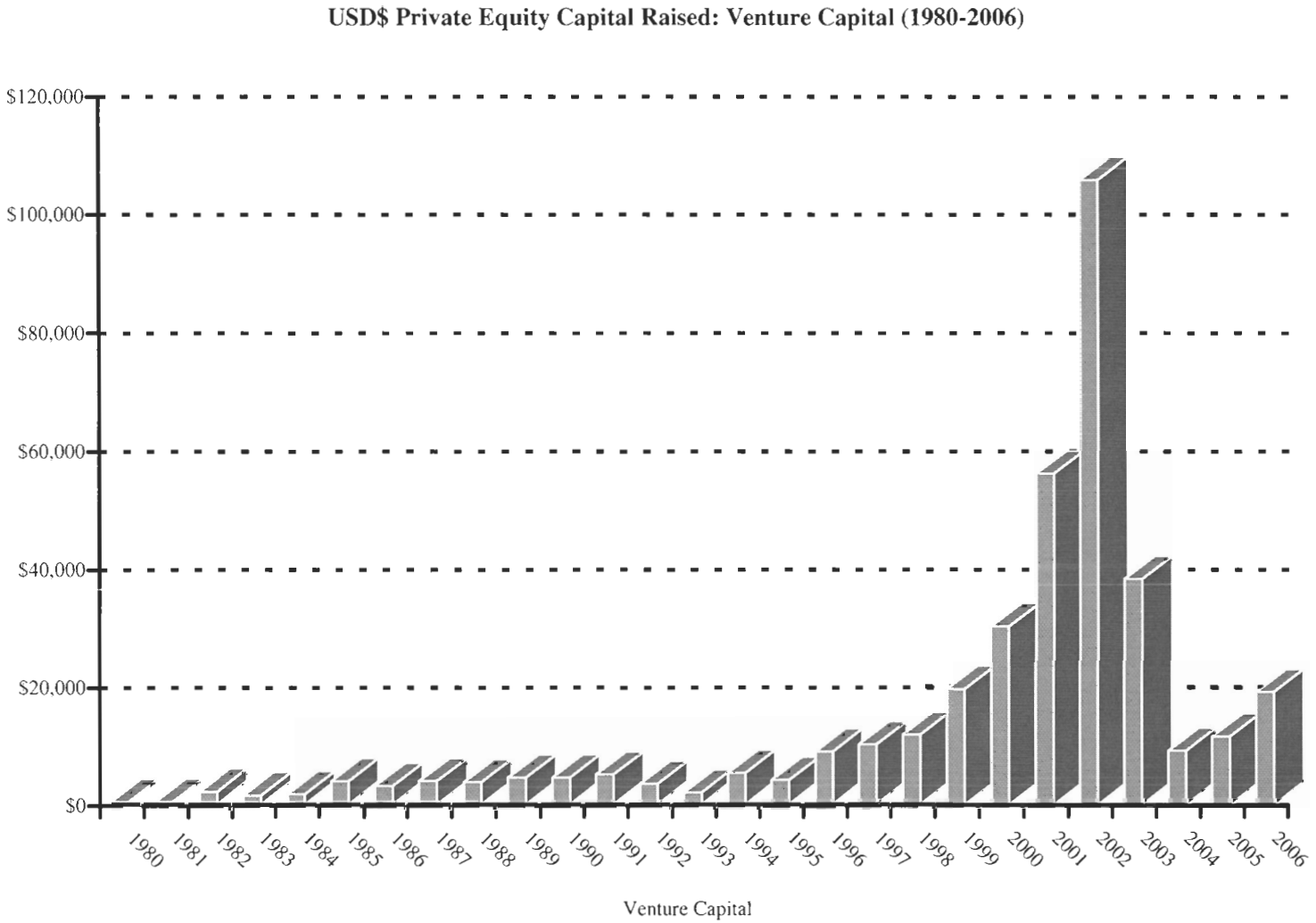


Figure 6: Annual capital raised for Venture Capital. The dataset is obtained from Thomson Financial and covers the period 1980-2005.

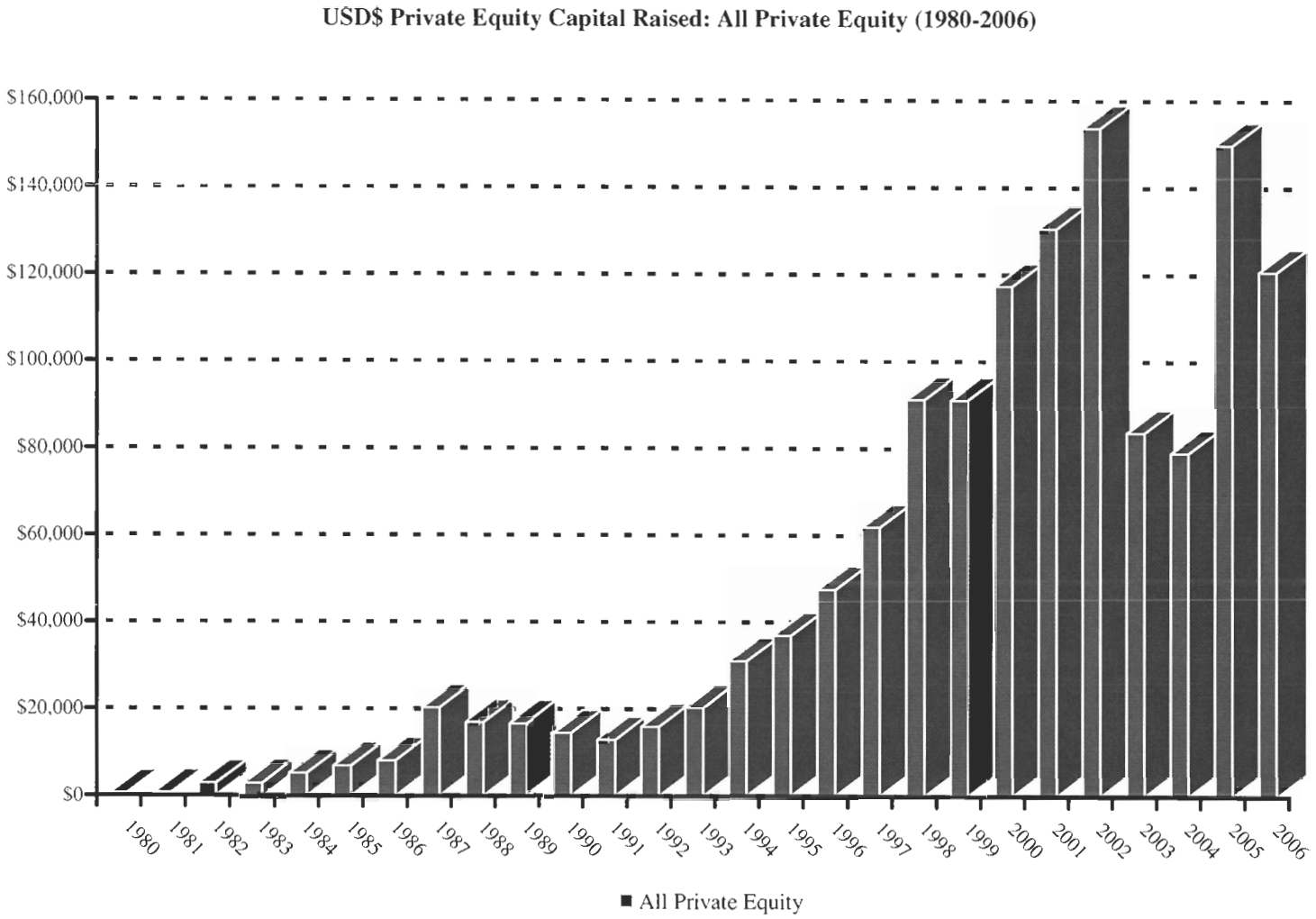
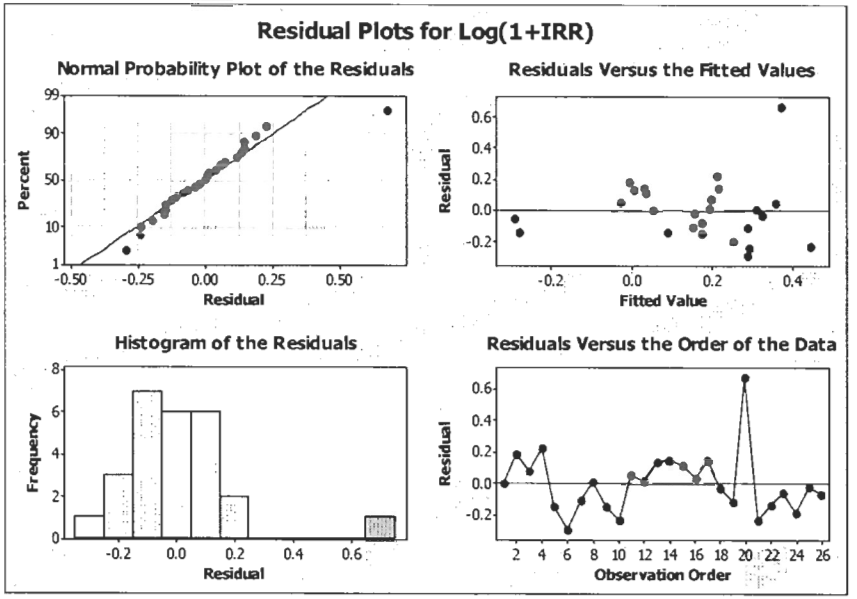


Figure 7: Annual capital raised for All Private Equity. The dataset is obtained from Thomson Financial and covers the period 1980-2005.

APPENDIX 2: OLS & WLS

Figure 1: Results of the Regression Analysis for 1 -Year IRR Horizon Return - Venture Capital[a]

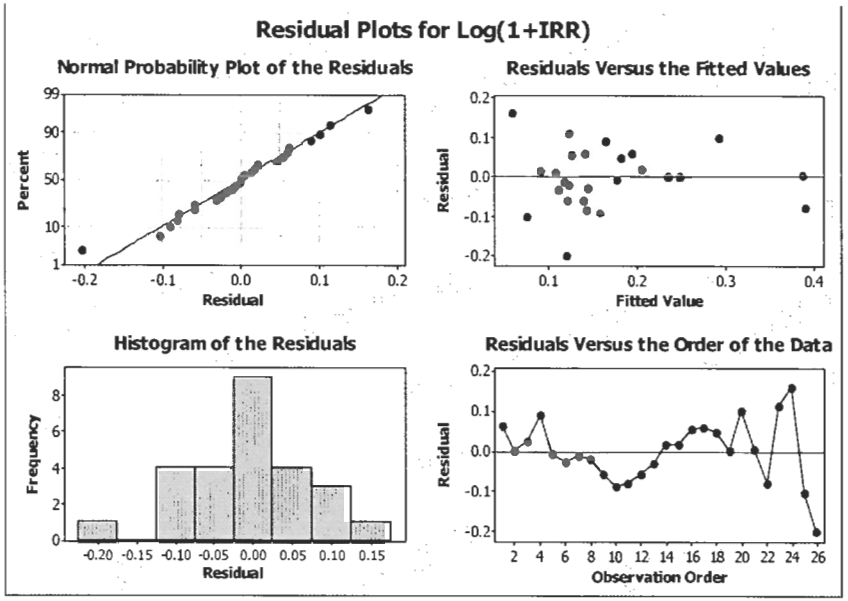
Dependent Variable: $Log(1+IRR)_{VC1}$ (One-Year Rolling IRR)		
	OLS	WLS
Constant	0.1424	0.1465
	(0.184)	*(0.000)*
1) S&P500 1-Yr Rolling	0.9052	0.8784
	(0.004)	*(0.000)*
2) S&P500 5-Yr Rolling	-	
3) S&P500 10-Yr Rolling	-	
4) S&P500 PE	-0.0086	-0.0077
	(0.070)	*(0.000)*
5) Interest Rate	-	
6) GDPCH	-	
7) CPICH	-	
8) $ Invested	0.0121	0.0074
	(0.012)	*(0.000)*
N	26	26
Adjusted R^2	38.30%	-



[a] The dependent variable is the logarithm of realized IRR. The dataset is for the period 1980 to 2005. In columns (1) we use the OLS to estimate the parameters of each explanatory variable and model loading. In columns (2) we use the weighted least squire (WLS). S&P 500 Return is the annual return on the S&P500 Composite Index. S&P 500 P/E Ratio is the annual Price-to-Earning ratio on the S&P500 Composite Interest Rate is the one-year US government T-bill rate. US GDP and US CPI are the annual changes in US GDP and US CPI index, respectively. $ Invested is the new capital invested in the venture capital during one-year horizon. P values are in parenthesis. The residual plots are generated to examine the underlying assumptions of linear regression models and test for serial correlation and heteroskedasticity.

Figure 2: Results of the Regression Analysis for 5 -Year IRR Horizon Return - Venture Capital[a]

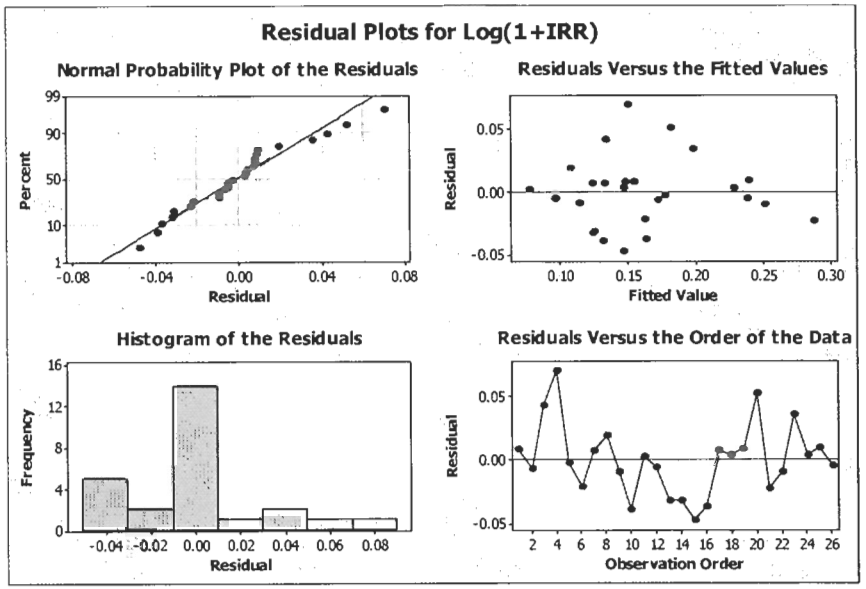
Dependent Variable: $Log(1+IRR)_{VC5}$ (Five-Year Rolling IRR)	OLS	WLS
Constant	-0.1274	-0.1418
	(0.109)	*(0.000)*
1) S&P500 1-Yr Rolling	-	
2) S&P500 5-Yr Rolling	-	
3) S&P500 10-Yr Rolling	-	
4) S&P500 PE	0.0059	0.0063
	(0.013)	*(0.000)*
5) Interest Rate	2.1988	2.2737
	(0.002)	*(0.000)*
6) GDPCH	-	
7) CPICH	-	
8) $ Invested	0.0045	0.0046
	(0.018)	*(0.000)*
N	26	26
Adjusted R^2	46.80%	-



[a] The dependent variable is the logarithm of realized IRR. The dataset is for the period 1980 to 2005. In columns (1) we use the OLS to estimate the parameters of each explanatory variable and model loading. In columns (2) we use the weighted least squire (WLS). S&P 500 Return is the annual return on the S&P500 Composite Index. S&P 500 P/E Ratio is the annual Price-to-Earning ratio on the S&P500 Composite Interest Rate is the one-year US government T-bill rate. US GDP and US CPI are the annual changes in US GDP and US CPI index, respectively. $ Invested is the new capital invested in the venture capital during one-year horizon. P values are in parenthesis. The residual plots are generated to examine the underlying assumptions of linear regression models and test for serial correlation and heteroskedasticity.

Figure 3: Results of the Regression Analysis for 10 -Year IRR Horizon Return - Venture Capital[a]

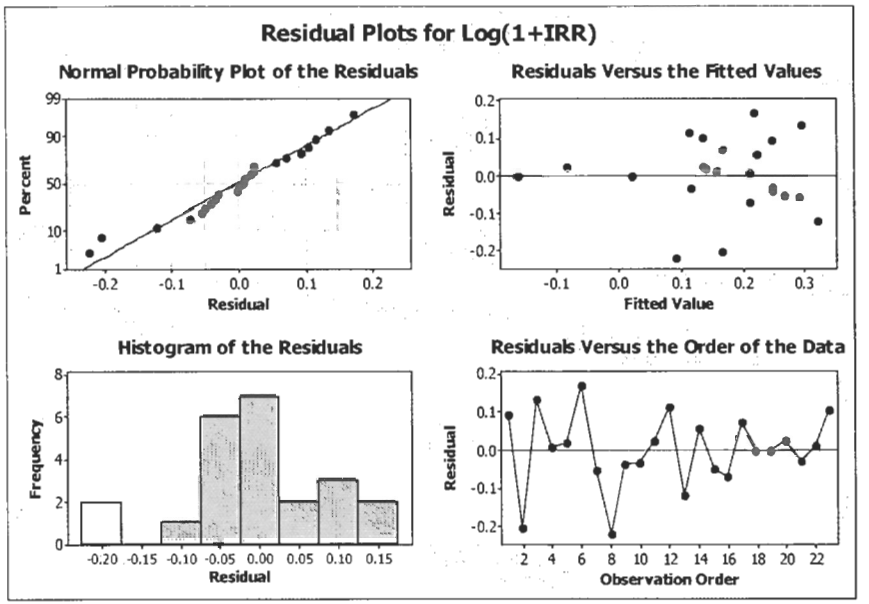
Dependent Variable: $Log(1+IRR)_{VC10}$ (Ten-Year Rolling IRR)	OLS	WLS
Constant	0.1720	0.1646
	(0.005)	*(0.000)*
1) S&P500 1-Yr Rolling	*0.140*	0.1490
	(0.024)	*(0.000)*
2) S&P500 5-Yr Rolling	-0.3739	-0.3985
	(0.031)	*(0.000)*
3) S&P500 10-Yr Rolling	-1.0240	-0.9127
	(0.023)	*(0.000)*
4) S&P 500 PE	0.0021	0.0020
	(0.042)	*(0.000)*
5) Interest Rate	-	
6) GDPCH	0.8197	0.8061
	(0.079)	*(0.000)*
7) CPICH	-0.8088	-0.7494
	(0.054)	*(0.000)*
8) $ Invested	0.0044	0.0044
	(0.000)	*(0.000)*
N	26	26
Adjusted R^2	67.90%	-



[a] The dependent variable is the logarithm of realized IRR. The dataset is for the period 1980 to 2005. In columns (1) we use the OLS to estimate the parameters of each explanatory variable and model loading. In columns (2) we use the weighted least squire (WLS). S&P 500 Return is the annual return on the S&P500 Composite Index. S&P 500 P/E Ratio is the annual Price-to-Earning ratio on the S&P500 Composite Interest Rate is the one-year US government T-bill rate. US GDP and US CPI are the annual changes in US GDP and US CPI index, respectively. $ Invested is the new capital invested in the venture capital during one-year horizon. P values are in parenthesis. The residual plots are generated to examine the underlying assumptions of linear regression models and test for serial correlation and heteroskedasticity.

Figure 4: Results of the Regression Analysis for 1 -Year IRR Horizon Return - Buyout[a]

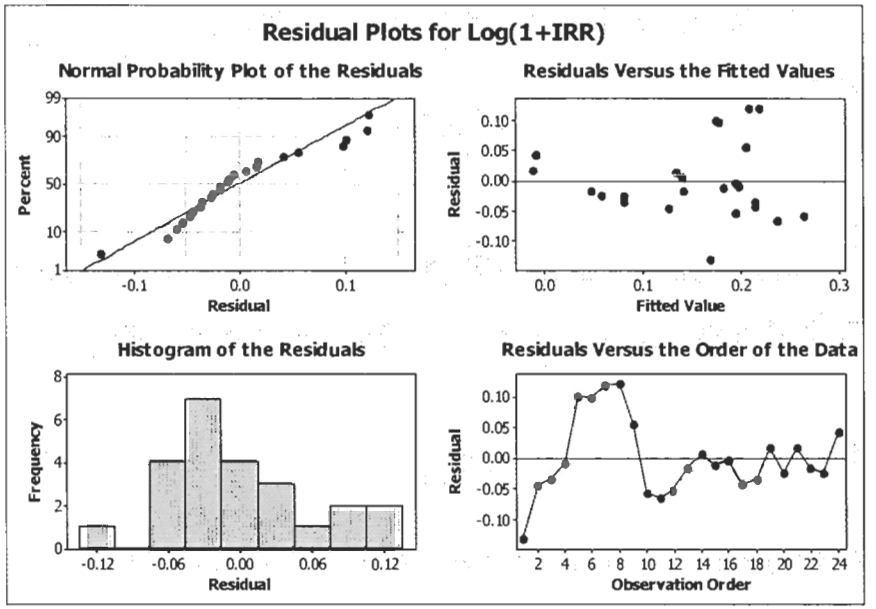
Dependent Variable: $Log(1+IRR)_{BOI}$ (One-Year Rolling IRR)		
	OLS	WLS
Constant	0.2041	0.2033
	(0.003)	*(0.000)*
1) S&P500 1-Yr Rolling	*0.5855*	0.6047
	(0.001)	*(0.000)*
2) S&P500 5-Yr Rolling	-	
3) S&P500 10-Yr Rolling	-	
4) S&P 500 PE	-0.0047	-0.0047
	(0.042)	*(0.000)*
5) Interest Rate	-	
6) GDPCH	-	
7) CPICH	-	
8) $ Invested	-	
N	23	23
Adjusted R^2	54.60%	-



[a]The dependent variable is the logarithm of realized IRR. The dataset is for the period 1983 to 2005. In columns (1) we use the OLS to estimate the parameters of each explanatory variable and model loading. In columns (2) we use the weighted least squire (WLS). S&P 500 Return is the annual return on the S&P500 Composite Index. S&P 500 P/E Ratio is the annual Price-to-Earning ratio on the S&P500 Composite Interest Rate is the one-year US government T-bill rate. US GDP and US CPI are the annual changes in US GDP and US CPI index, respectively. $ Invested is the new capital invested in the venture capital during one-year horizon. P values are in parenthesis. The residual plots are generated to examine the underlying assumptions of linear regression models and test for serial correlation and heteroskedasticity.

Figure 5: Results of the Regression Analysis for 5 -Year IRR Horizon Return - Buyout[a]

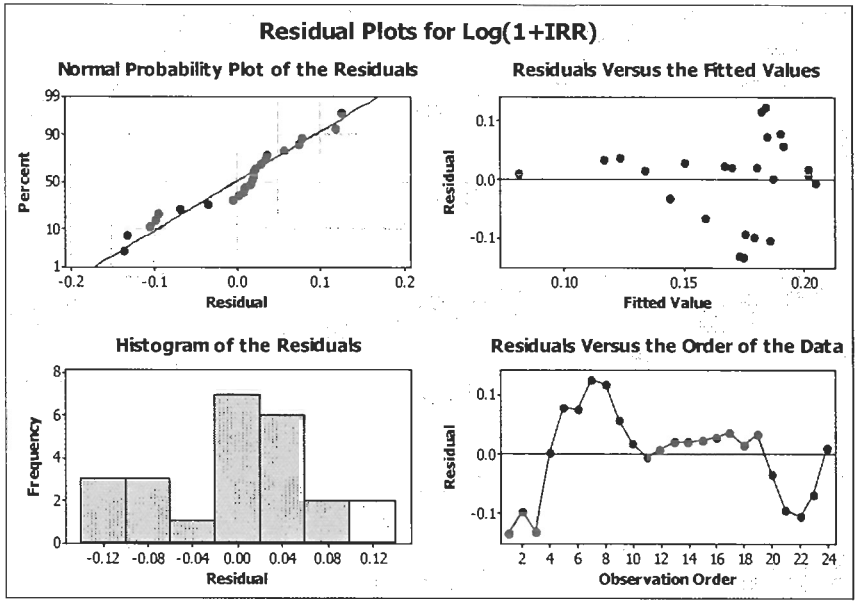
Dependent Variable: $Log(1+IRR)_{BO5}$ (Five-Year Rolling IRR)	OLS	WLS
Constant	0.1165	0.0928
	(0.070)	*(0.000)*
1) S&P500 1-Yr Rolling	-	
2) S&P500 5-Yr Rolling	1.2001	-1.3781
	(0.000)	*(0.000)*
3) S&P500 10-Yr Rolling	-	
4) S&P500 PE	-	
5) Interest Rate	-2.2230	
	(0.041)	
6) GDPCH	-	
7) CPICH	3.7160	2.6910
	(0.078)	*(0.000)*
8) $ Invested	-0.0003	-0.0002
	(0.014)	*(0.000)*
N	24	24
Adjusted R^2	50.20%	-



[a] The dependent variable is the logarithm of realized IRR. The dataset is for the period 1982 to 2005. In columns (1) we use the OLS to estimate the parameters of each explanatory variable and model loading. In columns (2) we use the weighted least squire (WLS). S&P 500 Return is the annual return on the S&P500 Composite Index. S&P 500 P/E Ratio is the annual Price-to-Earning ratio on the S&P500 Composite Interest Rate is the one-year US government T-bill rate. US GDP and US CPI are the annual changes in US GDP and US CPI index, respectively. $ Invested is the new capital invested in the venture capital during one-year horizon. P values are in parenthesis. The residual plots are generated to examine the underlying assumptions of linear regression models and test for serial correlation and heteroskedasticity.

Figure 6: Results of the Regression Analysis for 10 -Year IRR Horizon Return - Buyout[a]

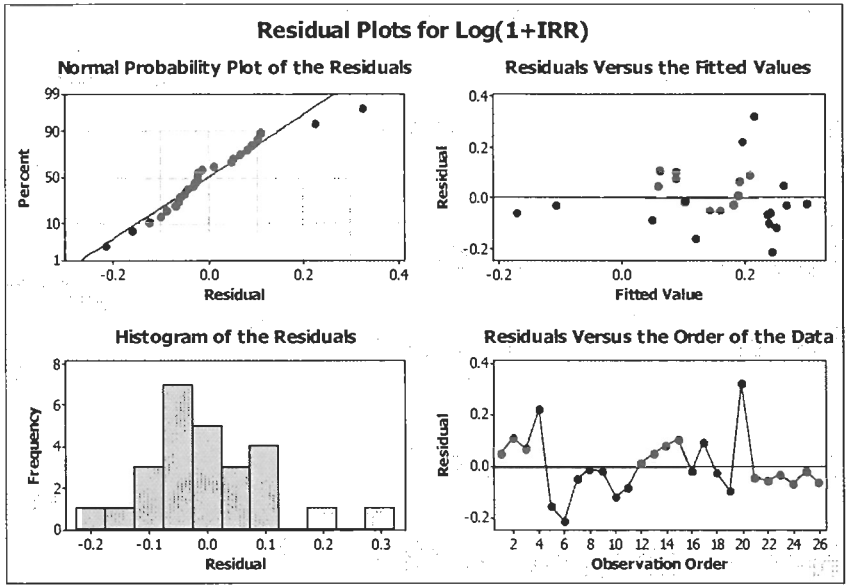
Dependent Variable: $Log(1+IRR)_{BO10}$ (Ten-Year Rolling IRR)		
	OLS	WLS
Constant	0.1939	0.17782
	(0.001)	*(0.000)*
1) S&P500 1-Yr Rolling	-	
2) S&P500 5-Yr Rolling	0.9027	0.79887
	(0.001)	*(0.000)*
3) S&P500 10-Yr Rolling	-	
4) S&P 500 PE	-	
5) Interest Rate	-2.6491	-2.2807
	(0.007)	*(0.000)*
6) GDPCH	-	
7) CPICH	3.3580	3.2197
	(0.066)	*(0.003)*
8) $ Invested	-0.0003	-0.0002
	(0.006)	*(0.000)*
N	24	24
Adjusted R^2	42.60%	-



[a] The dependent variable is the logarithm of realized IRR. The dataset is for the period 1982 to 2005. In columns (1) we use the OLS to estimate the parameters of each explanatory variable and model loading. In columns (2) we use the weighted least squire (WLS). S&P 500 Return is the annual return on the S&P500 Composite Index. S&P 500 P/E Ratio is the annual Price-to-Earning ratio on the S&P500 Composite Interest Rate is the one-year US government T-bill rate. US GDP and US CPI are the annual changes in US GDP and US CPI index, respectively. $ Invested is the new capital invested in the venture capital during one-year horizon. P values are in parenthesis. The residual plots are generated to examine the underlying assumptions of linear regression models and test for serial correlation and heteroskedasticity.

Figure 7: Results of the Regression Analysis for 1 -Year IRR Horizon Return - All Private Equity[a]

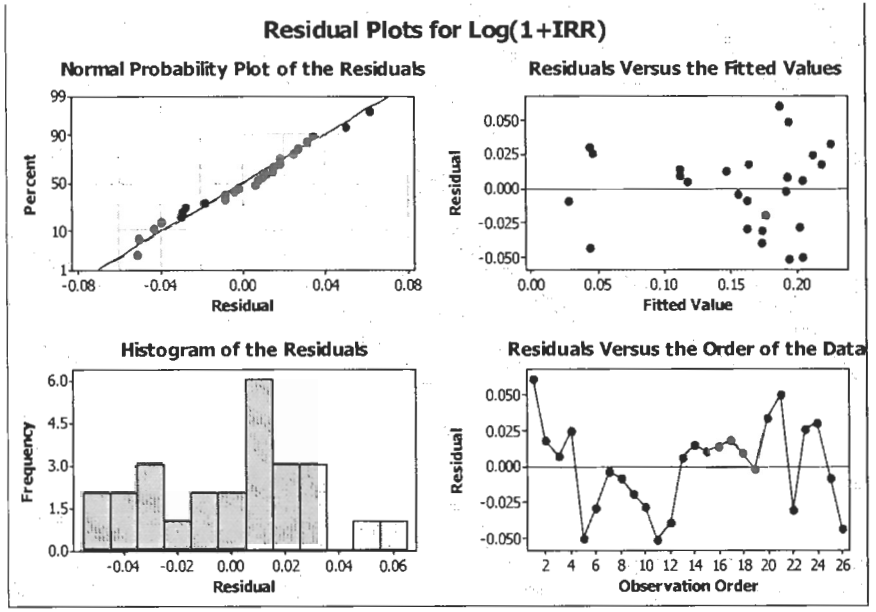
Dependent Variable: $Log(1+IRR)_{APE1}$ (One-Year Rolling IRR)	OLS	WLS
Constant	0.1667	0.1612
	(0.011)	*(0.000)*
1) S&P500 1-Yr Rolling	0.5839	0.6066
	(0.002)	*(0.000)*
2) S&P500 5-Yr Rolling	-	
3) S&P500 10-Yr Rolling	-	
4) S&P 500 PE	-0.0062	-0.0059
	(0.038)	*(0.000)*
5) Interest Rate	-	
6) GDPCH	-	
7) CPICH	-	
8) $ Invested	0.0023	0.0015
	(0.078)	*(0.001)*
N	26	26
Adjusted R^2	42.20%	-



[a] The dependent variable is the logarithm of realized IRR. The dataset is for the period 1980 to 2005. In columns (1) we use the OLS to estimate the parameters of each explanatory variable and model loading. In columns (2) we use the weighted least squire (WLS). S&P 500 Return is the annual return on the S&P500 Composite Index. S&P 500 P/E Ratio is the annual Price-to-Earning ratio on the S&P500 Composite Interest Rate is the one-year US government T-bill rate. US GDP and US CPI are the annual changes in US GDP and US CPI index, respectively. $ Invested is the new capital invested in the venture capital during one-year horizon. P values are in parenthesis. The residual plots are generated to examine the underlying assumptions of linear regression models and test for serial correlation and heteroskedasticity.

Figure 8: Results of the Regression Analysis for 5 -Year IRR Horizon Return - All Private Equity[a]

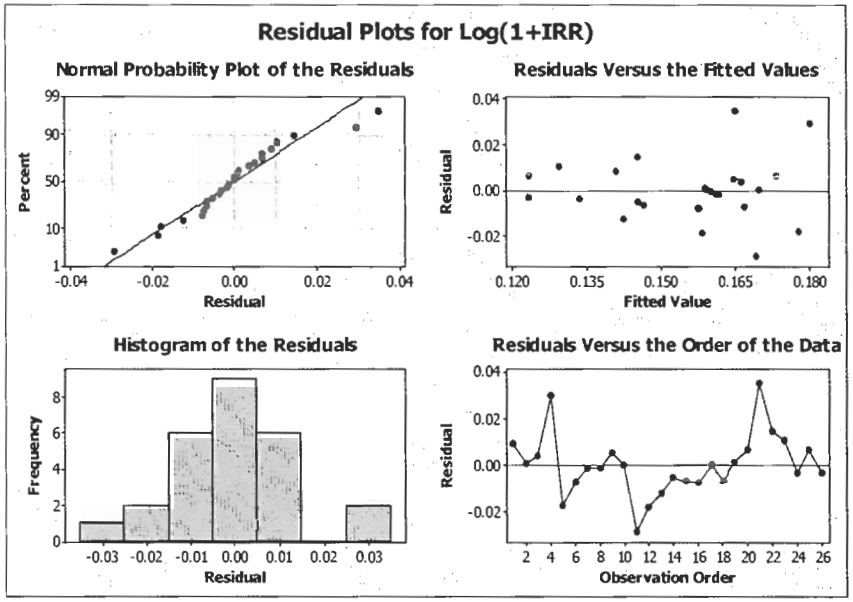
Dependent Variable: $Log(1+IRR)_{APE5}$ (Five-Year Rolling IRR)	OLS	WLS
Constant	-0.1334	-0.1285
	(0.001)	*(0.000)*
1) S&P500 1-Yr Rolling	-	
2) S&P500 5-Yr Rolling	-	
3) S&P500 10-Yr Rolling	1.1669	1.0964
	(0.000)	*(0.000)*
4) S&P500 PE	0.0018	0.0019
	(0.032)	*(0.000)*
5) Interest Rate	2.2496	2.2635
	(0.000)	*(0.000)*
6) GDPCH	-	
7) CPICH	-	
8) $ Invested	-	
N	26	26
Adjusted R^2	76.20%	-



[a] The dependent variable is the logarithm of realized IRR. The dataset is for the period 1980 to 2005. In columns (1) we use the OLS to estimate the parameters of each explanatory variable and model loading. In columns (2) we use the weighted least squire (WLS). S&P 500 Return is the annual return on the S&P500 Composite Index. S&P 500 P/E Ratio is the annual Price-to-Earning ratio on the S&P500 Composite Interest Rate is the one-year US government T-bill rate. US GDP and US CPI are the annual changes in US GDP and US CPI index, respectively. $ Invested is the new capital invested in the venture capital during one-year horizon. P values are in parenthesis. The residual plots are generated to examine the underlying assumptions of linear regression models and test for serial correlation and heteroskedasticity.

Figure 9: Results of the Regression Analysis for 10 -Year IRR Horizon Return - All Private Equity[a]

Dependent Variable: $Log(1+IRR)_{APE10}$ (Ten-Year Rolling IRR)	OLS	WLS
Constant	0.0610	0.055788
	(0.007)	*(0.000)*
1) S&P500 1-Yr Rolling	-	
2) S&P500 5-Yr Rolling	-0.1508	-0.1682
	(0.075)	*(0.000)*
3) S&P500 10-Yr Rolling	0.5358	0.58242
	(0.005)	*(0.000)*
4) S&P500 PE	-	-
5) Interest Rate	0.9777	1.02818
	(0.000)	*(0.000)*
6) GDPCH	-	
7) CPICH	-0.3559	-0.3695
	(0.005)	*(0.001)*
8) $ Invested	0.0004	0.0004
	(0.010)	*(0.000)*
N	26	26
Adjusted R^2	62.40%	-



[a] The dependent variable is the logarithm of realized IRR. The dataset is for the period 1980 to 2005. In columns (1) we use the OLS to estimate the parameters of each explanatory variable and model loading. In columns (2) we use the weighted least squire (WLS). S&P 500 Return is the annual return on the S&P500 Composite Index. S&P 500 P/E Ratio is the annual Price-to-Earning ratio on the S&P500 Composite Interest Rate is the one-year US government T-bill rate. US GDP and US CPI are the annual changes in US GDP and US CPI index, respectively. $ Invested is the new capital invested in the venture capital during one-year horizon. P values are in parenthesis. The residual plots are generated to examine the underlying assumptions of linear regression models and test for serial correlation and heteroskedasticity.

APPENDIX 3: TERMINOLOGY

Venture Capital: Thomson Financial uses the term to describe the universe of venture investing. It does not include buyout investing, mezzanine investing, fund-of-fund investing or secondaries. Angel investors or business angels are also not included in the definition. Venture capital investing is characterized by the large investment risks involved, caused by investing in companies at their earliest stages of development. The risk of commercial failure and the potential loss of a venture capital investors' entire investment is extremely high in venture capital investing. Given the potential for loss of one's complete investment, venture capital investors typically require a substantial equity position in a private company, board representation, and in some cases active participation in the management and development of the investee company. Target returns for venture capital investing range from 25% to 50% annually given the representative risks involved.

Buyout Capital: Thomson Financial uses the term to describe the universe of buyout investing and mezzanine investing. It does not include venture investing, fund-of-fund investing or secondaries. Angel investors or business angels are also not included in the definition. Buyout Capital, as represented by leveraged buyout investing (LBO), and management buyout investing (MBO) is usually deemed to be lower risk than that of venture capital investing. Buyout funds typically invest in mature businesses that have established cash flows, assets, operations, commercialized products, and an operating history. Investments are typically made through convertible debentures or other convertible debt-like securities rather than through plain equity. The combination of investing in more mature

operating businesses and through secured positions serves to lower the potential risk of loss for Buyout Capital investors.

All Private Equity: Thomson Financial uses the term to describe the universe of all venture investing, buyout investing and mezzanine investing. Fund of fund investing and secondaries are also included in this broadest term. VE is not using the term to include angel investors or business angels, real estate investments or other investing scenarios outside of the public market.

Horizon IRR: The Horizon IRR is a dollar-weighted return, and allows for an indication of performance trends in the industry. It uses the fund's net asset value at the beginning of the period as an initial cash outflow and the Residual Value at the end of the period as the terminal cash flow. The dollar-weighted IRR is calculated using those values plus any cash actually received into or paid by the fund from or to investors in the defined time period (i.e. horizon).

One-year horizon looks back over one year from the end of 2003 to the end of 2002 to give you the IRR, three-year horizon looks back from the end of 2003 over three years to the end of 2000 and so on.

The data provided uses 10-year Horizon IRRs and starts in 1980, meaning that it effectively covers a period from 1980 up to 2006, a 25 year period of returns.

IRR Internal Rate of Return: The IRR is the interim net return earned by investors (Limited Partners), from the fund from inception to a stated date. The IRR is calculated as an annualized effective compounded rate of return using monthly cash flows to and from investors, together with the Residual Value as a terminal cash flow to investors. The IRR is therefore net, i.e. after deduction of all fees and carried interest. In cases of captive or semi-

captive investment vehicles without fees or carried interest, the IRR is adjusted to create a synthetic net return using assumed fees and carried interest.

Residual Value: Residual Value is the estimated value of the assets of the fund, net of fees and carried interest.

Pooled IRR: A method of calculating an aggregate IRR by summing cash flows together to create a portfolio cashflow and calculate IRR on portfolio cash flow.

APPENDIX 4: THE LINEAR REGRESSION MODEL

Regression analysis seeks to establish a relationship between two or more variables. The variable to be explained is the dependent variable, denoted as Y. The variables used to explain the dependent variable are called independent variables, denoted as X.

$$y_i = f(X_i) + \varepsilon_i$$

Six assumptions are made in the statistical model:

A1) $y_i = \beta_0 + \beta_1 X_i + \varepsilon_i$

A2) $E(\varepsilon_i) = 0$

A3) Var $(\varepsilon_i) = \sigma_\varepsilon^2$ for all i

A4) Cov $(\varepsilon_i, \varepsilon_j) = 0$ for all $i \neq j$

A5) Cov $(X_i, \varepsilon_i) = \sigma_\varepsilon^2$ for all i

A6) $\varepsilon_i \sqcup N(0, \sigma_\varepsilon^2)$

The first assumption (A1) says that the dependent variable is a linear function of explanatory variable plus an error term that is a random variable. The second assumption asserts that the expected value of the error is zero. The third assumption says that variances for each observation should be equal. The error for one observation is unrelated to the error for

another observation and there is no correlation between each error and the explanatory variable, under assumption 4 and 5. The last assumption asserts that the error term has a normal distribution with mean of 0 and equal variance of σ_ε^2.

1. Ordinary Least Squares (OLS)

The OLS approach is to choose $\hat{\beta}_0$ and $\hat{\beta}_1$ to minimize the sum of the squared errors.

$$\begin{aligned} S &= \sum_{i=1}^{n} e^2{}_i \\ &= \sum_{i}^{n} (Y_i - \hat{Y}_i)^2 \\ &= \sum_{i=1}^{n} (Y_i - \hat{\beta}_0 - \hat{\beta}_1 X_i)^2 \end{aligned}$$

Take the first partial derivatives and set them to zero:

$$\begin{aligned} \frac{\partial S}{\partial \hat{\beta}_0} &= \frac{\partial \sum_{i=1}^{n} (Y_i - \hat{\beta}_0 - \hat{\beta}_1 X_i)^2}{\partial \hat{\beta}_0} \\ &= 2\sum_{i=1}^{n} (Y_i - \hat{\beta}_0 - \hat{\beta}_1 X_i)(-1) = 0 \\ &\Rightarrow \sum_{i=1}^{n} (Y_i - \hat{\beta}_0 - \hat{\beta}_1 X_i) = 0 \end{aligned}$$

Then:

$$\begin{aligned} &\sum_{i=1}^{n} Y_i = n\hat{\beta}_0 + \hat{\beta}_1 \sum_{i=1}^{n} X_i \\ &\Rightarrow \bar{Y} = {}_0 + \hat{\beta}_1 \bar{X} \end{aligned} \qquad (0.1)$$

and

$$\frac{\partial S}{\partial \hat{\beta}_1} = \frac{\partial \sum_{i=1}^{n} (Y_i - \hat{\beta}_0 - \hat{\beta}_1 X_i)^2}{\partial \hat{\beta}_1}$$

$$= 2\sum_{i=1}^{n} (Y_i - \hat{\beta}_0 - \hat{\beta}_1 X_i)(-X_i) = 0$$

$$\Rightarrow \sum_{i=1}^{n} (Y_i - \hat{\beta}_0 - \hat{\beta}_1 X_i)(X_i) = 0$$

Then:

$$\sum_{i=1}^{n} Y_i X_i = \hat{\beta}_0 \sum_{i=1}^{n} X_i + \hat{\beta}_1 \sum_{i=1}^{n} X^2_i \qquad (0.2)$$

Equation (1.1) and (1.2) are known as normal equations. We now have two functions and two unknowns. Therefore $\hat{\beta}_0$ and $\hat{\beta}_1$ can be solved:

$$\hat{\beta}_0 = \bar{Y} - \hat{\beta}_1 \bar{X} \qquad (0.3)$$

$$\hat{\beta}_1 = \frac{n\sum_{i=1}^{n} Y_i X_i - \sum_{i=1}^{n} Y_i \sum_{i=1}^{n} X_i}{\sum_{i=1}^{n} (X_i - \bar{X})^2} \qquad (0.4)$$

2. Weighted Least Squares (WLS)

If residual plots detect the presence of heteroskedasticity, the ordinary least square estimators are not the best (BLUE) estimators and thus a more efficient estimator is obtained by Weighted Least Squares (WLS) estimation which adjusts the weight of squared residuals for unusual observations in proportion to those variances.

We transform the model by assigning each observation by the associated reciprocal of the standard deviation of the error. That is,

$$W_i = \frac{1}{\sigma^2{}_i}$$

Expressed in matrix form:

$$W = \begin{bmatrix} \frac{1}{\sigma_1^2} & 0 & \dots & \dots & 0 \\ 0 & \frac{1}{\sigma_2^2} & \dots & \dots & 0 \\ \dots & \dots & \frac{1}{\sigma_3^2} & \dots & 0 \\ \dots & \dots & \dots & \dots & \dots \\ 0 & 0 & \dots & \dots & \frac{1}{\sigma^2{}_n} \end{bmatrix}$$

The squares of errors:

$$Q_w = (Y - X\beta)^{'} W (Y - X\beta)$$

Minimize:

$$Q_w = \sum_{i=1}^{n} \frac{1}{\sigma_i^{2}} (Y_i - X_i^{'}\beta)^2$$

After transformation, similar to (1.1) and (1.2) the normal equation in matrix form is:

$$(X^{'}WX)\beta_w = X^{'}WY$$
$$\Rightarrow \beta_w = (X^{'}WX)^{-1} X^{'}WY$$

The errors can be shown that:

$$E(\varepsilon_w) = 0$$
$$\sigma^2(\varepsilon_w) = I$$

APPENDIX 5: REGRESSION RESULTS

Exhibit 1: **Ordinary Least Squares (OLS) Regression Results**

Exhibit 2: **Backward Elimination Regression Results**

Exhibit 1: Ordinary Least Squares (OLS) Results

Venture Capital:

1. 1-year regression equation is:

$$\text{Log}(1+\text{IRR}) = -0.123 + 0.549\ \text{SP500 1-Yr Rolling} + 0.70\ \text{SP500 5-Yr Rolling} + 2.52\ \text{SP500 10-Yr Rolling} - 0.00996\ \text{SP500 PE} - 0.91\ \text{Interest Rate} + 0.45\ \text{GDPCH} + 2.79\ \text{CPICH} + 0.00826\ \$\ \text{Invested} + \varepsilon_t$$

2. 5-year regression equation is:

$$\text{Log}(1+\text{IRR}) = -0.306 + 0.191\ \text{SP500 1-Yr Rolling} - 0.974\ \text{SP500 5-Yr Rolling} + 1.51\ \text{SP500 10-Yr Rolling} + 0.00643\ \text{SP500 PE} + 3.96\ \text{Interest Rate} - 0.29\ \text{GDPCH} - 0.44\ \text{CPICH} + 0.00540\ \$\ \text{Invested} + \varepsilon_t$$

3. 10-year regression equation is:

$$\text{Log}(1+\text{IRR}) = 0.132 + 0.164\ \text{SP500 1-Yr Rolling} - 0.589\ \text{SP500 5-Yr Rolling} - 0.769\ \text{SP500 10 Yr Rolling} + 0.00250\ \text{SP500 PE} + 0.707\ \text{Interest Rate} + 0.658\ \text{GDPCH} - 1.16\ \text{CPICH} + 0.00461\ \$\ \text{Invested} + \varepsilon_t$$

Buyout Capital:

4. 1-year regression equation is:

$$\text{Log}(1+\text{IRR}) = 0.496 + 0.516\ \text{SP500 1-Yr Rolling} + 1.03\ \text{SP500 5-Yr Rolling} - 2.14\ \text{SP500 10-Yr Rolling} - 0.00557\ \text{SP500 PE} - 2.14\ \text{Interest Rate} + 0.66\ \text{GDPCH} - 1.58\ \text{CPICH} - 0.000028\ \$\ \text{Invested} + \varepsilon_t$$

5. 5-year regression equation is:

$$\text{Log}(1+\text{IRR}) = 0.073 - 0.106\ \text{SP500 1-Yr Rolling} + 1.02\ \text{SP500 5-Yr Rolling} + 1.05\ \text{SP500 10-Yr Rolling} - 0.00276\ \text{SP500 PE} - 2.31\ \text{Interest Rate} + 0.44\ \text{GDPCH} + 3.71\ \text{CPICH} - 0.000220\ \$\ \text{Invested} + \varepsilon_t$$

6. 10-year regression equation is:

$$\text{Log}(1+\text{IRR}) = 0.239 - 0.125\ \text{SP500 1-Yr Rolling} + 0.988\ \text{SP500 5-Yr Rolling} + 0.365\ \text{S500P 10-Yr Rolling} - 0.00266\ \text{SP500 PE} - 3.04\ \text{Interest Rate} + 0.11\ \text{GDPCH} + 3.25\ \text{CPICH} - 0.000235\ \$\ \text{Invested} + \varepsilon_t$$

All Private Equity:

7. 1-year regression equation is:

$$\text{Log}(1+\text{IRR}) = 0.036 + 0.461\ \text{SP500 1-Yr Rolling} + 0.184\ \text{SP500 5-Yr Rolling} + 1.18\ \text{SP500 10 Yr Rolling} - 0.00698\ \text{SP500 PE} - 0.20\ \text{Interest Rate} - 0.04\ \text{GDPCH} + 1.51\ \text{CPICH} + 0.00217\ \$\ \text{Invested} + \varepsilon_t$$

8. 5-year regression equation is:

$$\text{Log}(1+\text{IRR}) = -0.157 + 0.0154\ \text{SP500 1-Yr Rolling} - 0.036\ \text{SP500 5-Yr Rolling} + 1.36\ \text{SP500 10-Yr Rolling} + 0.00143\ \text{SP500 PE} + 2.09\ \text{Interest Rate} - 0.104\ \text{GDPCH} + 0.618\ \text{CPICH} + 0.000319\ \$\ \text{Invested} + \varepsilon_t$$

9. 10-year regression equation is:

$$\text{Log}(1+\text{IRR}) = 0.0544 + 0.0069\ \text{SP500 1-Yr Rolling} - 0.156\ \text{SP500 5-Yr Rolling} + 0.508\ \text{SP500 10-Yr Rolling} + 0.000305\ \text{SP500 PE Ratio} + 1.02\ \text{Interest Rate} + 0.021\ \text{US GDP} - 0.381\ \text{CPI} + 0.000345\ \$\ \text{Invested Ratio} + \varepsilon_t$$

Exhibit 2: Backwards Elimination (OLS) Regression Results

Venture Capital

10. 1-year regression equation is:

$$\text{Log(1+IRR)} = 0.142 + 0.905\ \text{SP500 1-Yr Rolling} - 0.00862\ \text{SP500 PE} + 0.0121\ \$\ \text{Invested} + \varepsilon_t$$

11. 5-year regression equation is:

$$\text{Log(1+IRR)} = -0.127 + 0.00590\ \text{SP500 PE} + 2.20\ \text{Interest Rate} + 0.00448\ \$\ \text{Invested} + \varepsilon_t$$

12. 10-year regression equation is:

$$\text{Log(1+IRR)} = 0.172 + 0.140\ \text{SP500 1-Yr Rolling} - 0.374\ \text{SP500 5-Yr Rolling} - 1.02\ \text{SP500 10-Yr Rolling} + 0.00213\ \text{SP500 PE} + 0.820\ \text{GDPCH} - 0.809\ \text{CPICH} + 0.00440\ \$\ \text{Invested} + \varepsilon_t$$

Buyout Capital

13. 1-year regression equation is:

$$\text{Log(1+IRR)} = 0.204 + 0.585\ \text{SP500 1-Yr Rolling} - 0.00474\ \text{SP500 PE} + \varepsilon_t$$

14. 5-year regression equation is:

$$\text{Log(1+IRR)} = 0.116 + 1.20\ \text{SP500 5-Yr Rolling} - 2.22\ \text{Interest Rate} + 3.72\ \text{CPICH} - 0.000255\ \$\ \text{Invested} + \varepsilon_t$$

15. 10-year regression equation is:

$$\text{Log(1+IRR)} = 0.194 + 0.903\ \text{SP500 5-Yr Rolling} - 2.65\ \text{Interest Rate} + 3.36\ \text{CPICH} - 0.000253\ \$\ \text{Invested} + \varepsilon_t$$

All Private Equity

16. 1-year regression equation is:

$$\text{Log(1+IRR)} = 0.167 + 0.584\ \text{SP500 1-Yr Rolling} - 0.00620\ \text{SP500 PE} + 0.00232\ \$\ \text{Invested} + \varepsilon_t$$

17. 5-year regression equation is:

$$\text{Log(1+IRR)} = -0.133 + 1.17\ \text{S\&P 10-Yr Rolling} + 0.00180\ \text{SP500 PE} + 2.25\ \text{Interest Rate} + \varepsilon_t$$

18. 10-year regression equation is:

$$\text{Log(1+IRR)} = 0.0610 - 0.151\ \text{SP500 5-Yr Rolling} + 0.536\ \text{SP500 10-Yr Rolling} + 0.978\ \text{Interest Rate} - 0.356\ \text{CPI} + 0.000374\ \$\ \text{Invested} + \varepsilon_t$$

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