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## Industry effect on Venture capital and Private Equity backed transactions

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**INDUSTRY EFFECT ON VENTURE CAPITAL AND PRIVATE  
EQUITY BACKED TRANSACTIONS**

by

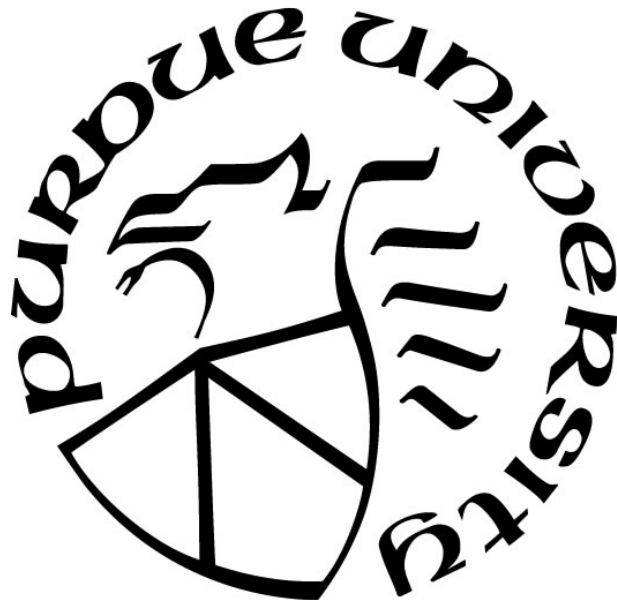
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**A Thesis**

*Submitted to the Faculty of Purdue University*

*In Partial Fulfillment of the Requirements for the degree of*

**Master of Science**



Department of Technology Leadership and Innovation

West Lafayette, Indiana

December 2017

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## LIST OF ABBREVIATIONS

AUM – Asset under Management

BO – Buy out

FF –Fama and French

GICS –Global Industry Classification Standard

M&A – Merger and Acquisition

NVCA – National Venture Capital Association

NAICS – North American Industry Classification System

PE – Private Equity

ROI – Return on Investment

SIC – Standard Industry Classification

S&P–Standard and Poor

VC – Venture Capital



## ABSTRACT

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Title: Industry effect on Venture Capital and Private Equity backed transactions  
Major Professor: Chad Laux.

**Purpose:** The aim of this research is to contrast transaction multiples of mergers and acquisitions backed by private equity and venture capital investors against all other types of transactions

**Design:** The researcher conducted an independent samples t-test on 20-year historical data of mergers and acquisitions gathered through Capital IQ database.

**Findings:** The researcher found that there is a statistically significant difference in transaction multiples of mergers and acquisitions backed by private equity and venture capital firms as compared to those mergers and acquisitions that were not backed by a private equity or venture capital firm.

**Originality and Value:** The findings of this study will provide evidence to suggest that industry group may play an important role in the transaction multiples of deals backed by venture capital and private equity investors.

**Keywords:** Merger and acquisition, private equity, venture capital, valuation

## CHAPTER 1. INTRODUCTION

This chapter provides an overview of the research. The chapter lays down the background and significance of this research. The chapter also provides purpose, research question, assumptions, limitations and delimitations of the research. Finally, the chapter concludes with a brief overview of the research.

### 1.1 Background

Venture capital and private equity firms generally look to invest in private companies with a potential to become large enough to attract public investment at a later stage. Merely inventing a technology or filing a patent may not be enough to get venture capital or private equity firms interested. Most venture capital and private equity firms have a small office with minimal staff. To be efficient, venture capital and private equity firms need to be aware of which factors to look for in an innovative start-up before making an investment decision.

There have been numerous studies that have tried to understand the various factors that affect the decision-making process of a venture capital or private equity firm. While some of these studies use a behavioral approach by interviewing fund managers at venture capital or private equity firms, others depend on data extracted from databases to provide an empirical analysis of the various factors that help in evaluating an investment proposal.

The most recent studies under the behavioral approach include Gompers et. al. (2015) and Gompers et. al. (2016). On the other hand, empirical approach seems to be more widely used with the key ingredients for data collection coming from financial

databases. Some of these include Lerner (2002), Ljungqvist and Richardson (2003), Kaplan and Schoar (2005), Phalippout and Gottschlag (2009).

## 1.2 Significance

This research is intended to be useful for both industry and academia. This research intends to provide an insight into the differences in transaction multiples of deals backed by private equity and venture capital firms. It is expected that a fund manager at a venture capital or private equity firm would be interested in the outcome of this study.

This research intends to provide a cross-sectional analysis across various sectors. For this purpose, the researcher has used “industry” as a filter to classify the data points. The classification by industry is important to this study to provide an industry-by-industry analysis on whether the transaction multiples of the two groups have a statistically significant difference or not.

## 1.3 Statement of Purpose

The purpose of this research is to test the hypothesis that there exists statistically significant difference in transaction multiples of merger and acquisition transactions where the buyer or seller is a private equity or venture capital firm. The data collected during this study will help to predict within a confidence interval whether there is a statistically significant difference in transaction multiples of venture capital and private equity backed deals as compared to rest of the industry.

## 1.4 Research Question

The questions central to this research are:

Is there a statistically significant difference in transaction multiples of deals backed by private equity and venture capital firms as compared to all other firms?

Is there an effect of industry groups on the overall transaction multiples of deals backed by venture capital and private equity firms?

### 1.5 Assumptions

The following assumptions were inherent to the pursuit of this study:

1. Capital IQ database has been used for data extraction for this study. It is a popular database among academicians and industry. The results of this study are limited by the data availability in Capital IQ database.
2. The researcher has identified whether a firm is venture capital or private equity using the “Fund types Managed” column of Capital IQ database. The researcher assumed that firms have reported accurately and honestly the types of funds managed by them.
3. The researcher has acknowledged all other firms as “Non-VCPE” and used a control variable “IsVCPE” to identify whether a firm is venture capital or private equity. The researcher has assumed that the decision making of all other firms is homogenous.
4. The research question is based on the findings of a survey that venture capital and private equity firms do not follow traditional methods of valuation. The researcher has assumed that the above survey is representative of the overall industry perspective.
5. The researcher has analyzed transaction multiples to find differences in valuation of private equity and venture capital buyers as compared to all other

buyers. While there exist various other metrics to measure valuation, the researcher has assumed that transaction multiples are representative of deal valuation.

6. The researcher has calculated p-values using an independent samples t-test. While there exist other methods of calculation of p-values, the researcher has assumed that an independent samples t-test is the best way to determine statistically significant differences between two samples.
7. The researcher will reject the null hypothesis if there are no statistically significant differences between the two samples.

#### 1.6 Limitations

The following limitations are inherent to the pursuit of this study:

1. The study is limited in data collection by availability of database access. The researcher has extracted data from Capital IQ database only. While there exist other databases, the research is limited by the availability of data resources.
2. The researcher has filtered data using geographical location of buyer. The research outcomes are limited to US and Canada only.
3. The researcher has filtered data from 1996 to 2016. The research outcomes are limited to the 20-year period only.
4. The research is limited by the availability of metrics for valuation. While there may be other factors that lead to changes in valuation, the data may not be reported since most of the transactions may not include public firms.

5. The research is limited by the accuracy of independent two-sample t-test performed by SPSS. Though SPSS is a widely used statistical package, the study is limited by the calculation method in the algorithm used by SPSS.
6. The researcher has cut the data into two parts using a control variable “IsVCPE”. This control variable is based on reporting of “Fund Types Managed” by the buyers in transactions. The study is limited to the accurate and honest reporting of fund types by the buyers in transactions sample collected from Capital IQ.
7. The researcher has rejected the null hypothesis for all industry groups where there is no statistically significant difference based on p-values. However, this does not imply that the research can accept the null hypothesis for all other outcomes.
8. The researcher was limited by the constraint of a maximum of 39 non-financial attributes that can be extracted from Capital IQ database.

### 1.7 Delimitations

The following delimitations are inherent to the pursuit of this study:

1. The researcher has used a control variable to identify whether a transaction is backed by a venture capital or private equity firm or not. A further analysis could be performed on non-venture capital and non-private equity dataset to identify investors as hedge funds, investment banks, etc. Due to the limitations of time and resources available, the researcher chose not to do a further analysis.
2. The researcher did not collect data on the methods of valuation to justify that discounted cash flow or any other valuation approach is a “better” or “worse”

estimate of deal valuation. The study is limited to the effectiveness of transaction-multiples approach of valuation to predict the outcome of deals for venture capital and private equity firms.

3. The researcher restricted literature review within the period of data collection.

While studies may have been conducted on similar topic before, the researcher reviewed only those behavioral studies that were conducted in recent times to reflect the data collection period.

4. The researcher restricted the data collection exercise to United States and Canada only.

### 1.8 Definition of Key Terms

transaction multiples - transaction multiples refer to a multiple of one of the financial metrics of a firm namely revenue, profit, invested capital and others. This multiple is an estimated guess that investment managers at venture capital and private equity firms use to for valuation. (Audretsch & Link, 2012)

entrepreneurial firms - entrepreneurial firms refers to companies that provide novice products and services. Since most of these firms start as a small organization, they require capital to grow. Venture capital and private equity investors provide a source of capital to these firms in exchange for ownership stake in form of equity. (Audretsch & Link, 2012)

private equity - private equity refers to capital that is not listed on public markets or exchange. This may include all the funds and investors who directly invest in private firms without any involvement of a formal public market or exchange. (Gompers et al., 2015)

traditional valuation methods - the methods of valuation based on cost, market and income approach. These methods are taught at business schools for determining the value of a firm. It is recommended that an analyst uses either or a combination of the methods to determine the value of a firm in context of private equity or venture capital investing (Audretsch & Link, 2012)

venture capital - venture capital refers to capital that is invested in firms that are believed to have high growth potential or have demonstrated high growth in the past. These firms are also referred to as early-stage companies. Venture capital may be classified as a special form of private equity focused towards investing in early-stage companies in exchange for an ownership stake. (Gompers et. al. 2016)

valuation - valuation refers to the process of determining the value or current worth of the asset. In the world of private equity and venture capital, valuation may refer to the perceived investor value of a company based on a variety of factors including revenue, growth, employees, management, etc. (Audretsch & Link, 2012)

## 1.9 Overview of Study

To gain insight into the transaction multiples of mergers and acquisitions backed by private equity and venture capital firms, this research intends to perform a statistical analysis of venture capital and private equity backed deals against all other deals without the involvement of private equity and venture capital investors.

## 1.10 Organization

This research provides five major chapters and several appendices. Chapter 2 provides an overview of venture capital and private equity. This research begins with a



brief overview and a major section on factors that have influenced decision making of fund managers at private equity and venture capital firms.

Chapter 3 provides an overview to the methodology and framework used in this study. The chapter is devoted to detailed discussion of the methods and data sources used for this research.

Chapter 4 provides a detailed explanation of the analysis of data. The following information is described in detail: transaction multiples, independent samples test for statistical significance of variance of means, splitting of data by industry groups and hypothesis testing for each industry group.

Chapter 5 provides a summary of the document, the conclusions of the study, and discussion of the results and recommendations for further research.

### 1.11 Summary

This chapter has provided an overview of the research including background, significance, purpose, research questions and scope. The chapter concluded with an overview of the research. The next chapter outlines a literature review of the various studies exploring interdisciplinary areas of innovation, entrepreneurship, venture capital, private equity and decision making for investment managers.

## CHAPTER 2. REVIEW OF RELEVANT LITERATURE

The area of venture capital and private equity has long been examined for its importance in affecting investment in firms which have not yet gone public.

Traditionally, private equity has been defined as equity investment in any firm which is not public. However, over the years, with the advent of multiple investment strategies for decision making the area of private equity has been further classified into venture capital, buyouts, restructuring, real estate and mezzanine. The opening section provides an overview of the latest surveys in private equity decision making which forms the backbone of the hypothesis tested in this research. The subsequent sections discuss how academic literature has approached industry classification codes. To identify the investment selection criteria, the author has divided academic literature into two main categories- literature focused on evaluating investments based on financial factors and literature that explores extra-financial factors in investment selection. Finally, the author has identified literature that attempts to establish a correlation between private equity investment decisions, investor sentiment, investor affiliation and innovation.

### 2.1 Approach to this review

The goal of this review is to provide an insight into literature that describes how private equity and venture capital firms are different from other investment firms. The researcher started by analyzing the findings of latest surveys on decision making at private equity and venture capital firms. The aim of this literature review is to establish an overview of academic work discussing the key features of venture capital and private equity firms.

## 2.2 Differences in Private Equity and Venture Capital

Gompers, Kaplan, and Mukharlyamov (2015) surveyed 64 private equity firms about the internal functioning of a private equity office and found that investors rely on internal rates of return and multiples of invested capital. The authors also found that private equity professionals place a heavy emphasis on adding value to their portfolio companies, both before and after they invest.

Gompers, Gornall, Kaplan, and Strebulaev (2016) conducted a similar survey with a larger audience and surveyed 885 institutional venture capitalists at 681 firms to learn how they make decisions across eight areas: deal sourcing, investment selection, valuation, deal structure, post-investment value-added, exits, internal firm organization, and relationships with limited partners. Because this survey was conducted with the assistance of National Venture Capital Association, the survey parameters have been extended to venture capital firms. The authors found that venture capital puts more emphasis on the management team rather than the investment itself. This justifies the “*jockey is more important than the horse*” [Kaplan, Sensoy, Stromberg (2009)] anecdote when it comes to evaluating investment decisions. However, the results of the survey also indicate that venture capital firms are not very different from their private equity counterparts in many areas. The current research aims to identify the differences in transaction multiples due to the presence of a venture capital and private equity buyer. Therefore, this research does not make the distinction between a private equity and venture capital investor.

### 2.3 Choice of industry classification codes

The data requirements for the methodology in this research suggests there may arise a need to group datasets based on industry classification. Bhojraj, Lee, and Oler (2003) compared the four widely available industry classification schemes- SIC codes, NAICS codes, GICS codes and FF (Fama and French) codes. Lee and Oler (2003) collected eight years of sample data using Standard & Poor's database from 1994 to 2001. While there was a high correspondence between SIC and FF (84%) and SIC and NAICS (80%), there was little correspondence between GICS and SIC (56%). GICS outperformed all other classifications based on economic relatedness. This was based on R-square measured in cross-sectional industry returns. On an average GICS outperformed SIC, NAICS and FF by 3.4%, 2.1% and 3.1% respectively.

Boni and Womack (2006) recognized the above research to make a case for GICS code based classification is a better classification method. Boni and Womack (2006) relied on GICS code based classification for their recommendations of analyst returns on industry vs non-industry classification. Boni and Womack (2006) collected data on changes in 169,127 sell-side recommendations in 1996-2002 timeframe using IBES database. The recommendations were then divided into 59 industries as per GICS classification to calculate the signal to noise ratio or Sharpe ratio. Boni and Womack (2006) noted a doubling of the Sharpe ratio in industry classification approach as compared to the non-industry classification approach. The authors concluded that analyst recommendations, based upon GICS, were useful in identifying short term intra-industry mispricing.

## 2.4 Financial factors

It seems obvious to assume that the most important factor for decision making for any investor should be financial returns. While extensive literature has proved a correlation between public equity investments and excess financial returns offered by movement of stock prices, academic literature seems to be divided with no consensus on superior returns for private equity and venture capital firms.

Ljungqvist and Richardson (2003) gathered data from an undisclosed limited partner from 1981 to 2000 whom invested in 3800 companies through 73 funds. A quarter of the funds were venture capital funds and the limited partner was focused on buyouts. Ljungqvist and Richardson (2003) tested the hypothesis that an increase in demand for funds may be met by an increase in money supply. They showed that the limited partner had outperformed S&P 500 return. Ljungqvist and Richardson (2003) concluded when the climate is favorable, the fund managers tend to exit and enter investments quickly but hold on to investments when the market is not favorable.

Within a couple of years, Kaplan and Schoar (2005) studied IRR net of management fees of 746 funds from 1985 to 2001 using Venture Economics database and found that median fund generated only 80% of S&P 500 return. However, those funds which are represented by fund managers from larger and mature private equity houses generated a median 150% of S&P 500 return. Kaplan and Schoar (2005) concluded that "skill" of a fund manager is may be linked with performance of the fund.

Phalippout and Gottschlag (2009) tried to dissect the above two studies - Ljungqvist and Richardson (2003) and Kaplan and Schoar (2005). Both the studies had reported that returns offered by private equity funds outperform S&P 500 returns. However, Phalippout and Gottschlag (2009) found that the above two studies suffered

from a data limitation. While the first study by Ljunqvist and Richardson (2003) collected data on 73 funds through an undisclosed source, the second study by Kaplan and Schoar (2005) only discussed the information on funds available in one database. Phalippout and Gottschlag (2009) expanded the scope and collected an exhaustive list of 1579 funds from the same period (1980-1993) as used in the above studies. A statistical analysis by Phalippout and Gottschlag (2009) showed that instead of over performing the S&P 500, the funds had underperformed by -3.8%. This demonstrates a basic flaw in attributing private equity investor decision making to financial returns. There must be extra-financial factors in play that affect decision making of private equity and venture capital investors.

To identify how venture capital and private equity firms make decisions, it is imperative to understand the emphasis on financial services offered by such investors. Hsu (2004) hypothesized the likelihood that an offer from a venture capital firm is accepted by an entrepreneur is a function of venture capitalist's reputation, valuation and controls. Hsu (2004) conducted a survey on 149 startups which received 246 funding offers as a part of Massachusetts Institute of Technology E-Lab program from 1998 to 2000. Hsu (2004) found that 43% of the startups had only accepted an offer with considerable amount in valuation being "*left-on-the-table*". Hsu (2004) concluded that the most important factor for entrepreneur's selection of venture capital funding must include extra-financial services. This provides a key insight into why financial terms of deals may not be the only factor in selecting investments.

## 2.5 Extra-financial factors

It seems obvious that there are extra-financial factors when it comes to decision making about investment opportunities at private equity and venture capital funds. Because the current research explores differences in transaction multiples of deals backed by private equity and venture capital firms as compared to all other deals, it is useful to understand what non-financial factors may affect actions of private equity and venture capital firms.

Ozmel, Robinson, and Stuart (2013) collected data on 1899 privately held biotech startups that received venture capital funding and participated in strategic alliances. Ozmel, Robinson, and Stuart (2013) hypothesized that the probability a firm gets acquired or goes public is a function of time since its last funding. The findings revealed an asymmetry between the variables. Ozmel, Robinson, and Stuart (2013) concluded that more funding through strategic alliances reduces the probability for venture capital funding but increases probability for further strategic funding.

Ughetto (2010) collected data using Venture Expert and VentureOne databases on European firms undergoing a buyout between 1998 and 2004. Ughetto (2010) hypothesized that the characteristics of a deal and the private equity firm involved can affect subsequent innovation of the acquired companies. Ughetto (2010) observed that the private equity investors may not be regarded as a homogeneous group rather, their individual characteristics, such as financial institution backing, independence, etc. should be regarded as the key criteria for determining influence of private equity on innovation.

Lerner (2002) captured returns to venture capital investments from 1974 to 2001 using Venture Economics database. Lerner (2002) intended to analyze the demand and supply of funds available to venture capital industry. Lerner (2002) argued that due to

lack of flexibility in accepting funds and liquidating funds, the cycle of fund raising does not necessarily follow the logical demand supply curve of economics. Lerner (2002) observed that venture funding and innovation are positively related to a third unobserved factor, namely, technological opportunities.

Chen, Gompers, Kovner, and Lerner (2009) noted that more than half of the venture capital and private equity offices were concentrated in three metropolitan areas- San Francisco, Boston and New York. Chen, Gompers, Kovner, and Lerner (2009) also observed that more than half of the venture capital backed firms are in the same three cities and established a relationship between location and funding. Chen, Gompers, Kovner, and Lerner (2009) gathered data on 2039 venture capital firms collated from VentureXpert and Pratt's database. Subsequently data on employment and innovation was gathered from Department of Commerce of each state and TAXSIM database. The data included each state's gross product, marginal income tax rate, long term capital gains tax and innovation. Chen, Gompers, Kovner, and Lerner (2009) relied on patent filings to measure innovation and concluded that multiple factors come into play in deciding venture capital investments including location of firm, income tax rates, innovation of firm and employment opportunities.

Fang, Ivashina, and Lerner (2010) evaluated the link between banks and private equity market. A sample of 2105 deals from 1998 to 2008 was collected by matching private equity deal information from Capital IQ database with corresponding lending information from DealScan database. This was done to evaluate the righteousness of the proposed 'Volcker Rule' which was going to limit bank ability to engage in investing and trading activities. Fang, Ivashina, and Lerner (2010) showed that almost a quarter of all



private equity investments involved bank-affiliated private equity groups and these private equity groups had better financing options as compared to independent private equity firms. Fang, Ivashina, and Lerner (2010) argued that it also provided a “quid-pro-quo” competitive advantage to the banks when it comes to underwriting loans to the investee firms. However, there was not sufficient evidence to suggest that the exit multiples for bank-affiliated private equity groups were better than other private equity groups.

Acharya, Gottschalg, Hahn, and Kehoe (2009) evaluated 66 deals of more than 100 million euros in terms of enterprise value from twelve private equity firms initiated between 1996 and 2004. Acharya, Gottschalg, Hahn, and Kehoe (2009) intended to answer three questions- are returns to private equity-backed firms larger than comparable firms, what is the effect of private equity ownership on operating performance of portfolio companies and what are distinguishing characteristics of performance. Acharya, Gottschalg, Hahn, and Kehoe (2009) suggested that 20-25% of deal IRR came from alpha due to private equity involvement and the private equity ownership lead to a 3-4% increase in deal margin. For the third question, Acharya, Gottschalg, Hahn, and Kehoe (2009) conducted an interview of 48 general partners and found that private equity firms generated higher alphas for those deals where they frequently interacted with the management and leveraged external support.

## 2.6 Summary

The current research aims to identify differences in transaction multiples for venture capital and private equity investors and effect of industry group on overall transaction multiples. The latest studies have indicated that the multiples of transactions

backed by private equity and venture capital firms may be dependent not only on financial returns but also some non-financial factors. Because private equity and venture capital investors tend to have a long-term horizon, they may play an active role in advising and influencing firm operations.

## **CHAPTER 3.     FRAMEWORK AND METHODOLOGY**

The research is focused on understanding the differences in transaction multiples of deals backed by private equity and venture capital firms as compared to all other deals. The literature review has provided evidence to suspect that there are extra-financial factors which contribute to the decision-making process of venture capital and private equity firms. This section outlines the research framework, population and sampling approach, sample size, unit of measurement, variables, data collection methods and analysis.

### **3.1    Theoretical Framework**

The research attempts to establish that there may be statistically significant differences in deals backed by private equity and venture capital firms as compared to all other deals. Also, there may be non-financial factors into play – one important factor is industry. Industry group may be used to improve the prediction power of a regression model that intends to explain variance in a transaction multiple.

### **3.2    Population and Sampling**

The industry classification section of the literature review discussed how GICS codes may be the most effective classification scheme. To reap the benefits of GICS classification, the researcher aims to extract the data from a database that used GICS classification. Capital IQ database is a well-known database that uses GICS classification for industry sectors. The researcher accessed Capital IQ transaction screening report with a filter on geographical locations: United States and Canada. The central theme of this

study revolves around the surveys conducted in 2015 and 2016 on the decision-making process at venture capital and private equity firms. Because these surveys have been limited to the Americas geography, it is imperative that the current research is limited to the same geography only. The total population size is 674,474 merger and acquisition transactions in United States and Canada.

The researcher extracted a total of 113 columns from Capital IQ database for each row of transaction. Based on the data availability, the researcher decided to include the following variables as independent variables to predict the deviation of transaction value from enterprise value: EV/REV, EV/EBITDA, EV/EBIT, industry, geographical location and transaction date. The researcher aims to predict the variance in transaction values as compared to enterprise values for all deals based on a control variable. The control variable helps to determine whether a Venture Capital or Private Equity was involved as a buyer in the transaction.

### 3.3 Data cleaning

Out of the 674,474 rows of data that was extracted, the researcher aimed to cut the data into two categories. First, transactions where a private equity or venture capital was the buyer and second, all other transactions where private equity or venture capital was not the buyer. Most financial database companies started during the dot-com bubble of 1995 and it is expected that any data prior to that point has been backfilled. The data needed to be cleaned for blanks in industry classification. The following six steps summarize the data cleaning process:

1. All transaction announced date: [1/1/1996-1/1/2016]
2. Transaction status: closed

3. Primary industry: removed blanks
4. Target revenue: is greater than zero
5. Primary country target: United States and Canada
6. Primary country buyer: United States and Canada

Based on the above parameters, the data was cleaned and a filter was set on the column “fund-types managed”. The researcher searched for all fields which contained the terms “Venture Capital” or “Private Equity”. This allowed the researcher to cut the data into two datasets:

1. All deals where private equity or venture capital buyer was involved with 6589 rows. For all future purposes, this is referred to “VCPE” dataset.
2. All deals where private equity or venture capital buyer was not involved with 24486 rows. For all future purposes, this is referred to as “Non-VCPE” dataset.

A control variable IsVCPE is introduced into the combined dataset to differentiate between the two datasets. This control variable helps analyze the differences in variances of transaction value with enterprise value in the context of type of fund managed by the buyer. If the buyer manages Venture Capital or Private Equity funds, the control variable IsVCPE is set to 1. If the buyer does not manage Venture Capital or Private Equity funds, the control variable IsVCPE is set to 0.

### 3.4 Data Analysis

To understand the influence of presence of a Venture Capital or Private Equity buyer on transaction multiple of a merger or acquisition deal, the researcher followed a

methodology like that discussed in Stromberg (2008). Stromberg (2008) analyzed global leveraged buyout activity, exit behavior and holding period using 21,397 transactions from 1970-2007 based on Capital IQ database from Jan 1, 1970 to June 30, 2007. The purpose of the study by Stromberg (2008) was to build the most comprehensive database on leveraged buyout deals and to show that leveraged buyout transactions have grown both economically as well as geographically. Stromberg (2008) has further broken down the data into two datasets based on the filter whether the leveraged buyout transaction was supported by a financial buyer or a non-financial buyer. Although the purpose of Stromberg (2008) is different from current research, Stromberg (2008) provides a methodology performing dissection of data based on involvement of a financial sponsor against non-financial sponsor.

The researcher started by creating pivot tables for each dataset. This helped to identify by industry and year the average transaction value as compared to the average enterprise value. For the VCPE dataset, the researcher could create a pivot with 149 industry classifications. However, many of the transactions involved firms with negative EBITDA leading to a division by zero error for EV/EBITDA multiples. The researcher proceeded by filtering out these firms leaving the pivot with a total of 119 industry classifications. The same process was repeated for Non-VCPE dataset. The researcher started with a pivot of 157 industry classifications which was reduced to 141 industry classifications after filtering out negative EBITDA transactions.

### 3.5 Classification of industry groups

The researcher downloaded GICS classification table from Capital IQ website. This table classifies companies based on business description into sectors, industry group,

industry and sub-industries. Each sector, industry group, industry and sub-industry is allocated a unique code. The researcher used “vlookup” function of excel to assign sub-industry code to the data. This is the finest granular level to which classification is possible. The 342 sub-industry codes roll into 70 industries and these 70 industries roll into 24 industry groups.

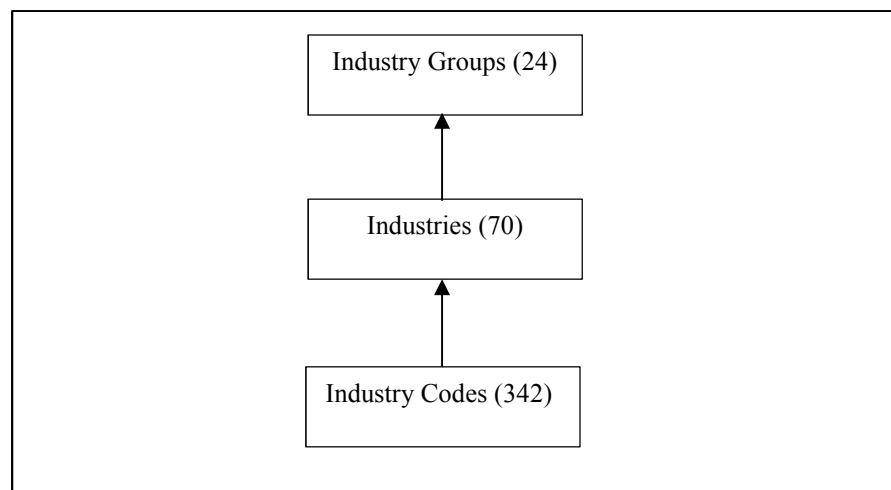


Figure 1. Flowchart to show GICS classification roll-up

The researcher used the assigned sub-industry codes to sort the data. This allowed a proper roll-up into 24 industry groups. In the VCPE dataset, the industry group “Banks” did not have enough data to make into the final cut. To perform a perfect comparison, it became imperative to take this industry group out from Non-VCPE dataset as well. The researcher then rolled up the data using pivot tables and assigned a control variable to monitor data in the clustering sheet. The control variable “IsVCPE” was set to 0 for the data from Non-VCPE data set and set to 1 for the data from VCPE data set.

## CHAPTER 4. RESULTS AND ANALYSIS

The researcher intends to compare the transaction multiples of VCPE dataset against Non-VCPE dataset using transaction multiples for transactions. The most commonly used multiples include EV/Revenue, EV/EBITDA and EV/EBIT. Because the number of observations for the industry group “Banks” was too small, the researcher discarded this industry group when analyzing data for testing of hypothesis.

### 4.1 Hypothesis testing

Based on the control variable, the researcher dissected the data into two groups:

1. Group 1 (IsVCPE = 0) does not have a Venture Capital or Private Equity buyer
2. Group 2 (IsVCPE = 1) has a Venture Capital or Private Equity buyer

The null hypothesis is defined as: Mean variance in valuation for Group 1 equals mean variance in valuation for Group 2

The alternate hypothesis may be defined as: Mean variance in valuation for Group 1 does not equal mean variance in valuation for Group 2

The researcher ran a descriptive statistics analysis on the two groups individually. The VCPE dataset contained 1160 observations for EV/REV multiple and the Non-VCPE dataset contained 12694 observations for the EV/REV multiple. However, because some companies may have zero or negative EBIT and EBITDA values, the final dataset only contained 706 and 4666 valid observations for VCPE and Non-VCPE dataset respectively. The researcher conducted an independent samples t-test to determine



whether there exists statistically significant difference in the transaction multiples of deals involving private equity and venture capital buyer as compared to those deals where there was no involvement of a private equity or venture capital buyer. With p-value less than 0.05 for the independent samples t-test, the researcher concluded that the null hypothesis may be rejected. There is no statistical evidence to suggest that there is a similarity in the overall means of the two groups.

Table 1 Independent samples t-test for equality of means

<b>Hypothesis</b>	<b>p-value</b>	<b>t-test</b>	<b>df</b>
Equal variances assumed	<0.001	5.241	13852
Equal variances not assumed	<0.001	8.630	1995

#### 4.2 Industry group

The researcher aimed to test using independent samples t-test the hypothesis that the presence of a private equity and venture capital buyer leads to statistically significant differences in transaction multiples. The researcher aimed to further investigate the effect of industry group on the transaction multiple of a deal involving venture capital and private equity buyer.

The researcher used GICS classification to divide the dataset into 23 industry groups. For each industry group, an independent sample t-test was conducted using EV/Revenue variable as shown in Table 1. The researcher found that for five out of the 23 industry groups, p-values are less than 0.05 thus indicating a coherence with the results obtained from overall dataset. It can be summarized that in general VCPE buyers tend to pay lower EV/REV multiples as compared to Non-VCPE buyers except for one industry group Telecommunication services.

Table 2 Industry group mean for EV/Revenue variable

<b>Industry Group</b>	<b>VCPE</b>	<b>No. of obs.</b>	<b>Non-VCPE</b>	<b>No. of obs.</b>
Healthcare Equipment and Services	1.8	109	4.1	1265
Pharmaceuticals, Biotechnology and Life Sciences	1.4	24	15.8	453
Software and Services	5.0	133	9.5	2094
Technology Hardware and Equipment	1.4	58	5.5	970
Telecommunication services	14.9	16	6.2	326

The researcher further investigated the results obtained for the five industry groups using other variables namely EV/EBITDA in Table 2 and EV/EBIT in Table 3. The researcher found that except for “Telecommunication Services” the four industry groups resulted in p-values less than 0.05 using both EV/EBITDA and EV/EBIT variables. It may be summarized that VCPE buyers tend to pay lower EV/EBITDA multiples as compared to Non-VCPE buyers.

Table 3 Industry group mean for EV/EBITDA variable

<b>Industry Group</b>	<b>VCPE</b>	<b>No. of obs.</b>	<b>Non-VCPE</b>	<b>No. of obs.</b>
Healthcare Equipment and Services	10.1	74	20.6	532
Pharmaceuticals, Biotechnology and Life Sciences	9.2	17	31.3	152
Software and Services	16.6	80	30.6	782
Technology Hardware and Equipment	14.0	31	23.8	389

A similar result was obtained using EV/EBIT variable. This was expected due to high correlation of 0.73 between EV/EBITDA and EV/EBIT variables. The difference in mean values is confirmed by low p-values. This allowed the researcher to confirm the

results received for the overall dataset, for EV/Revenue variable and for EV/EBITDA variable. It may be summarized that VCPE buyers tend to pay lower EV/EBIT multiples as compared to Non-VCPE buyers.

Table 4 Industry group mean for EV/EBIT variable

<b>Industry Group</b>	<b>VCPE</b>	<b>No. of obs.</b>	<b>Non-VCPE</b>	<b>No. of obs.</b>
Healthcare Equipment and Services	15.7	71	28.3	478
Pharmaceuticals, Biotechnology and Life Sciences	14.5	16	34.4	138
Software and Services	25.1	69	36.5	661
Technology Hardware and Equipment	19.9	27	31.1	351

### 4.3 Regression

A further breakdown of the two datasets – VCPE and Non-VCPE based on industry groups revealed that there exist differences in the sample mean variances of the groups. To investigate by how much industry groups effect overall transaction multiples, the researcher created a linear regression with EV/REV as dependent variable industry group as independent variable. Because the variable “Industry Group” did not contain numeric data, a coding scheme was implemented to create indicator variables for each industry group. In total, 46 indicator variables were created using a binary coding mechanism -23 binary variables (IsVCPEAutomobile, IsVCPEBanks, and so on) for the IsVCPE group and another 23 binary variables (IsNonVCPEAutomobile, IsNonVCPEBanks, and so on) for the Non-VCPE group.

When the researcher created a linear regression to predict EV/REV, an overall prediction power (R-Square adjusted) of .26 was observed. The prediction power did not

improve significantly by just adding IsVCPE as an indicator variable. However, the model prediction power increased when the researcher included the 46 indicator variables into the regression model. A multiple linear regression was calculated to predict EV/REV based on financial factors (EV/EBITDA and EV/EBIT) and extra-financial factors (VCPE and industry group). The R-Square adjusted for the model including 46 indicator variables went up to .39. The 14% increase in model prediction power may be attributed to the combined effect of IsVCPE control variable and the 23 industry groups represented by each indicator variable. Both financial factors (EV/EBITDA and EV/EBIT) and extra-financial factors (VCPE and Industry) were significant predictors of EV/REV.

A significant regression equation was found ( $F(48, 5323) = 72.581, p < .000$ ), with an R-Square adjusted of .396. EV/REV is equal to  $.6 + .148 (\text{EV/EBITDA}) - 0.564 (\text{IsAutomobileVCPE}) - 0.39 (\text{IsCapitalGoodsVCPE}) - 0.154 (\text{IsCommercialVCPE}) - 0.621 (\text{IsConsumerDurablesVCPE}) - 0.105 (\text{IsConsumerServicesVCPE}) + 1.917 (\text{IsDiversifiedfinancialsVCPE}) + 2.977 (\text{IsEnergyVCPE}) - 0.978 (\text{IsFoodStaplesVCPE}) - 1.194 (\text{IsFoodBevVCPE}) + 0.004 (\text{IsHealthcare EquipVCPE}) - 0.517 (\text{IsHouseholdVCPE}) - 0.122 (\text{IsInsuranceVCPE}) - 0.19 (\text{IsMaterialsVCPE}) - 0.015 (\text{IsMediaVCPE}) - 0.339 (\text{IsPharmaVCPE}) + 4.546 (\text{IsRealEstateVCPE}) - 0.803 (\text{IsRetailingVCPE}) + 0.19 (\text{IsSemiconductorVCPE}) + 0.36 (\text{IsSoftwareVCPE}) - 0.617 (\text{IsTechVCPE}) + 1.803 (\text{IsTelecommunicationVCPE}) - 0.575 (\text{IsTransportationVCPE}) + 0.77 (\text{IsUtilitiesVCPE}) - 0.343 (\text{IsAutomobileNonVCPE}) - 0.937 (\text{IsbanksNonVCPE}) - 0.524 (\text{IsCapitalGoodsNonVCPE}) - 0.245 (\text{IsCommercialNonVCPE}) - 0.888 (\text{IsConsumerDurabNonVCPE}) + 0.554 (\text{IsConsumerServicesNonVCPE}) + 2.756 (\text{IsDiversifiedfinancialsNonVCPE}) + 2.027 (\text{IsEnergyNonVCPE}) - 1.145$

$(\text{IsFoodStaplesNonVCPE}) - 0.581 (\text{IsFoodBevNonVCPE}) - 0.023$   
 $(\text{IsHealthcareEquipmentNonVCPE}) - 0.905 (\text{IsHouseholdNonVCPE}) - 0.123$   
 $(\text{IsInsuranceNonVCPE}) - 0.256 (\text{IsMaterialsNonVCPE}) + 0.937 (\text{IsMediaNonVCPE}) +$   
 $1.098 (\text{IsPharmaNonVCPE}) + 6.235 (\text{IsRealEstateNonVCPE}) - 1.421$   
 $(\text{IsRetailingNonVCPE}) + 0.746 (\text{IsSemiconductorNonVCPE}) - 0.152 (\text{IsTechNonVCPE})$   
 $+ 0.755 (\text{IsTelecommunicationNonVCPE}) + 0.597 (\text{IsTransportationNonVCPE}) + 0.822$   
 $(\text{IsUtilitiesNonVCPE}) - 0.017 (\text{Implied Value/EBIT})$ , where each indicator variable is  
 coded as 1 = True, 0 = False.

The researcher tested the regression model against the assumptions of homoscedasticity by creating a p-p plot of standardized residuals against the dependent variable – EV/REV. The researcher did not observe any time-series patterns to suggest autocorrelation and a scatterplot confirmed the linearity of relationship between dependent and independent variable. The normality of independent variable was established using a histogram, although right skewed with sharper peaks suggesting high kurtosis.

## CHAPTER 5. CONCLUSIONS

This chapter presents the conclusions of the analysis performed on both the sets of data – VCPE set and the Non-VCPE set with a perspective on industry groups and possibilities for future research.

### 5.1 Study Conclusion

Based on a statistical analysis of the two datasets, the researcher concluded that the presence of a venture capital or private equity buyer leads to statistically significant differences in transaction multiples of deals. The researcher performed an independent two samples t-test to validate the results with a statistically significant confidence interval of 95%. A further drill down revealed that the differences are statistically significant for five industry groups only. The five industry groups show statistically significant differences in deal multiples in VCPE dataset as compared to non-VCPE dataset. A regression analysis suggested a link between industry groups and transaction multiples based on the presence of a venture capital or private equity buyer.

### 5.2 Discussion

An independent sample t-test revealed statistically significant differences in transaction multiples of the deals involving a private equity or venture capital buyer as compared to all other deals which did not involve a private equity or venture capital buyer. A private equity survey by Gompers et. al. (2015) observed that there may be differences in transaction multiples of deals valued by private equity investors due to considerable asymmetry of information between general and limited partners. This

follows the observations made by Phalippout and Gottschlag (2009) regarding the lack of availability of reliable financial data as a source for calculating private equity returns in previous studies leading to inaccurate results. The results of this study provide evidence to believe that there must be extra-financial reasons for differences in transaction multiples of deals involving a private equity buyer.

A venture capital survey by Gompers et. al. (2016) observed that the valuation techniques of venture capital investors are more similar with private equity investors. Hence, it may be possible to combine both private equity and venture capital investors together in one group. The dataset revealed in general, venture capital and private equity firms offered lower transaction multiples. As hypothesized by Hsu (2004), venture capital investors must provide various extra-financial services that are valued by investee firms to compensate for lower multiples. Various extra-financial factors have been explored in the literature review – technological opportunities (Lerner, 2002), management interaction (Acharya, 2009), location of firm (Chen et. al., 2009), bank affiliation (Fang et. al., 2010), financial institution backing (Ughetto, 2010) and strategic alliances (Ozmel et. al., 2013).

The researcher assigned 342 industry codes to each data point and rolled it up to 24 industry groups using GICS classification as suggested by Boni and Womack (2006). While the overall dataset revealed differences in deal multiples for VCPE dataset as compared to non-VCPE dataset, a deeper analysis by industry groups revealed that the results may be driven by five industry groups - Healthcare Equipment and Services, Pharmaceuticals, Biotechnology and Life Sciences, Software and Services, Technology Hardware and Equipment and Telecommunication services. One may hypothesize that

overwhelming influence of strategic mergers may be driving higher multiples for Non-VCPE dataset thus leaving VCPE with only “left-out” deals.

A linear regression model confirmed some effect of industry groups on transaction multiples. The effect is more pronounced when each industry group is combined with the binary variable – IsVCPE that helps to decide whether the transaction involves a venture capital or private equity buyer. It is observed that the prediction power of linear regression improves when 46 indicator variables (that combine the control variable IsVCPE with each of the 23 industry groups) are introduced. Although not all industry groups may be a significant predictor of transaction multiple, the overall model has been able to explain variance in the dependent variable with higher prediction power than previous models. A researcher attempting to build a regression model to explain the variance in transaction multiples may utilize this method of creating indicator variables to improve the prediction power of their model.

### 5.3 Future work

Future research may be required to know what factors are responsible for the differences in valuation of the two groups. The researcher created a linear regression model to identify the relationships between industry group as an independent variable and EV/REV as a dependent variable. The researcher created 46 binary variables, also known as indicator variables, 23 each for VCPE and Non-VCPE groups. While the power of the regression may not be sufficient to explain all the variance in the dependent variable, future research may include more independent variables to improve the predictability of the model.



Another area of research may explain why the five industry groups have statistically significant differences than the rest of the industry groups. It may be observed that overall the two datasets VCPE and Non-VCPE show statistically significant differences. However, a deeper analysis based on industry groups revealed that the differences may be statistically significant only for five industry groups. This may require further investigation on why the five industry groups - Healthcare Equipment and Services, Pharmaceuticals, Biotechnology and Life Sciences, Software and Services, Technology Hardware and Equipment and Telecommunication services have statistically significant differences in transaction multiples of deals backed by venture capital and private equity firms.

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