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MASTER'S THESIS

Venture capital and agency theory

An empirical and contemporary study identifying the difference in agency costs of founder-CEOs and professional CEOs in technology startups.

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The paper constitutes the final thesis of the authors' M.Sc. in Finance & Investments (cand.merc. FIN) and M.Sc. International Business (cand.merc.IBS) at Copenhagen Business School. It includes 113 standard pages including figures, table of contents and appendices.

Preface

This master's thesis was written in Copenhagen, Denmark between late June and early September 2016. It constitutes the finalizing project on the M.Sc. Finance & Investments (cand.merc.FIN) and M.Sc. International Business (cand.merc.IBS) program at Copenhagen Business School. The paper is crafted from a collaborative work between Daniel J. Bertelsen and Alexander Pazdecki Clarke.

The motivational drivers behind this paper are manifold. The choice of topic reflects our joint curiosity in venture capital and technology startups. From several years of employment within the field of technology venture capital, mergers and acquisitions and investment banking the topic has been chosen as it bridges academic theories and industry practice within a relatively unique area of research.

The primary target audience of this paper is venture capital professionals focusing on the US or European technology sector. The secondary target audience is professionals within academia since the paper offers valuable contributions through empirical findings from which further research can be conducted.

It is assumed that there is a basic understanding of venture capital, regression modelling, econometrics and statistics among the entire target group.

We wish to thank everyone who has assisted us throughout the process – especially to our advisor, Palle Nierhoff, who we wish to show the upmost gratitude for his insightful assistance and patience in advising us through this project, which we know has not been easy at times.

Lastly, we are thankful to all the teachers, lecturers and professors at Copenhagen Business School whom we have had the privilege to meet and work with throughout the years. Finally, we would like to thank our close friends, families and loved ones for showing support and faith in us throughout our personal endeavor to become the first individual, from our respective families, to graduate from university.

Daniel J. Bertelsen

Copenhagen, Sept. 10 - 2016

Alexander P. Clarke

Copenhagen, Sept. 10 - 2016

"Man is an animal that makes bargains: no other animal does this - no dog exchanges bones with another."

- Adam Smith

Abstract:
In the recent decade, technology startups have been at the center of everyone's attention. However, little academic attention has been paid towards research of how these firms react to financial theory.

In this paper, the authors aim to shed light upon a relatively untouched subject in modern academics. Their endeavor is to investigate whether or not potential differences in agency costs between professional CEOs and founder CEOs within technology startups, exists – and if so, how do they differ?

Not only is the paper of a highly unique nature since very little, contemporary research has been carried out on the subject; the paper also manages to uncover numerous noteworthy findings which lays the foundation from where additional research can be conducted. The research carried out shows consistent and sound indication which culminates in the following findings: 1) Consistent difference in agency costs between professional CEOs and founder CEOs. 2) Consistent differences in agency costs between US and European technology startups and 3) Tobin's Q a more sound measurement than exit valuation.

The paper manage to demonstrates substantial evidence suggesting that professional CEOs yield a higher level of agency costs when compared to founder CEOs. The research takes multiple views and approaches where it first crafts a multiple regression model to test whether or not some chosen variables have a significant effect on exit valuation. Secondly, the model then tests for potential differences between professional CEOs and founder CEOs by incorporating the dummy variable methodology. Lastly, the authors suggest a new model which replaces the static size of "exit valuation" as the dependent variable, with the more dynamic and representative "Tobin's Q" as the dependent variable. Although the research carries some shortcomings, it offers valuable insight from which further research can be conducted.

Additionally, the paper aims to contribute not only to the world of academia, but likewise to the world of practitioners within venture capital. From the research and findings, the paper offers valuable insight to venture capital investors on what potential factors to consider when investing in a US-based or European-based technology startup.

Finally, from the research the authors can observe a consistent pattern, which make up strong evidence that professional CEOs do yield a higher level of agency costs within technology startups.

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Introduction

Venture capital and entrepreneurship have caught the attention of society, politicians and businesses worldwide, increasingly attracting the best and brightest talents from global elite business schools and long-honored industries like investment banking and management consulting. The phrase *"unicorn"*, slang for a start-up with a billion-dollar valuation, is now a common household term. All over the world, consumers are starting to be technology-enabled in their everyday lives. They use Airbnb to rent an apartment from another private person on their vacations, they put second-hand clothes up for sale on online marketplaces like Ebay, they use Uber to order transportation when they are in a hurry, and they outsource their social lives to Facebook.

Since the 1990's, the world has witnessed a rapid increase in technological developments across almost every sector in the developed world. From observing the history of the Western World since the 1950's, it is evident that technology has proven to have an increasingly significant impact on our society, always playing a key role in the industrial – and infrastructural – well-being of society and life quality overall. By the time of writing this paper, the world has seemingly changed radically within the past two decades, due to vast technological advancements. Enhancements that keep pushing the very boundary of what would otherwise have been perceived as impossible the year before – enabling new infrastructural developments to take place and impact our society on levels of both a micro and macro nature. These developments not only drive innovation and overall developments in society, they also have proven to spawn new breeds of opportunities with a high level of commercial interaction. Consequently, innovative business models and a richer level of data insight across consumers, as well as across the industries of retail, finance, and real estate, have given rise to an overall disruption of many industries and business segments. It is evident that more industries are being threatened by their own lack of innovation, and it is thus important to question how this disruption will affect academia as well.

Additionally, not only have technological advancements enabled new business models to arise, but capitalism has played a crucial role in the development of these models throughout the past decades. Venture capitalists have proved to rapidly embrace the commercial potential and impact of technological advancements during the past decades. In 2015 alone, the software industry made up a whopping 40% of all venture capital investments made in the

United States (Statista, 2015). The recent rise in venture capital within the technology sector implies the enormous potential technology brings with it. The rapid increase in technological advancements has allowed young companies to establish themselves as significant market competitors within a minimal timeframe, showing growth cycles that seemed impossible merely two decades ago. Venture capitalists have arguably noticed the overwhelming potential that comes with technology-specific business models, which are capable of rapid growth cycles and high exit valuations within a very short time span.

As curious and reflective academic practitioners, it is hard to neglect the fact that conventional academia within the economic and social sciences is facing the threat of being rendered moot when compared to today's changing, economic landscape. Old, conventional economic theories, developed in an age of industrialism and conventional capitalism, which have been taught for decades, may soon be endangered due to a possible paradigm shift of immense proportions. In this paper, we aim to shed light on this very topic and to answer some fundamental questions of whether or not recent developments in technology have affected central economic theories. Our thesis focuses on studying technology entrepreneurs. Hardly any unicorns become unicorns without investments and guidance from venture capitalists. Venture capitalists try to add value through funding, networks, experience and in-house analytical capabilities. In exchange for this, entrepreneurs sell a minor stake of their firm. By entering into this agreement, the entrepreneur automatically puts up a "for sale" sign on his firm. The firm might be sold shortly after either via an initial public offering (IPO) or an acquisition. It might also be up for sale for a long time - the venture capitalist might see the benefit of growing the firm before selling off his stake. The contract governing the relationship between the venture capitalist and the founder is pivotal in determining when to exit the firm and how much value can be created long term in the firm.

The goal of eventually exiting the firm is rarely the only deal term in the contract between a venture capitalist and a founder. However, in classic agency theory (Jensen and Meckling, 1976) it is postulated that as the founder loses control, the value of the firm is harmed. This happens because the agents (founder) managing the firm acts in their own best interests rather than maximizing the shareholder value. In other terms, when the founder gives up equity, agency costs should be reducing the value of the startup.

For the unicorns, this is clearly not the case. Some of the world's largest and most profitable companies have a wide selection of venture capitalists as minority shareholders and board positions. Many unicorns even replaced their founder CEO with a professional executive as CEO.

Problem statement

This situation poses an interesting dilemma. Theory suggests a value decrease when the founder gives up equity. So why would a founder give up equity for cash injections? Where is the gap between theory and practice? Therefore, the problem that will be investigated in this paper is:

"What are the potential differences in agency costs for investors when choosing between a founder-CEO and a professional CEO to run the technology startup in which they invested in?"

In recognition of the limits of quality data on the problem statement, we have chosen a methodological approach that can aid in the analysis of such companies and venture capitalists.

Motivation

The motivational drivers behind this paper are multifarious. As scholars, the authors of this paper have been faced with the theoretical groundwork behind agency cost and its myriad of applications in both theoretical and real world purposes. From several years of employment within the fields of venture capital technology, mergers and acquisitions, and investment banking, our motivation is partly manifested in our own interest on the subject, which has been developed from working closely with founders and investors within the technology sector.

Furthermore, during the past decade, the world surrounding technology startups and venture capital has arguably caught increased attention from the public. It is well known that many young academics today choose to abandon a conventional career within finance, investment banking or consulting in order to pursue their ambition and interest in working with fast-growing technology startups. Their motivations can be highly diverse – some prefer hip and

well-balanced work, with a focus on work-life balance that usually comes with working in technology startups; others might pursue their own agenda in which employment in a technology startup is merely access to 'learning the ropes' of business, which should ultimately prepare them for venturing out and starting their own companies. Not only is this evident by the outcry from several major Wall Street banks that are experiencing an increased challenge when it comes to young talent acquisition and retention (Kopecki, 2016), but also by the sheer amount of technology companies being founded by young professionals who appreciate the opportunity of a lucrative work-life balance combined with significant financial upsides. In today's world, it is not hard to come by a young individual who claims to be an entrepreneur or founder of a technology startup – it is even more likely to meet young professionals who admit to having a personal dream and ambition of one day breaking out of the corporate chains of employment and following their passion and ambition of running a successful (technology) startup. All these trends and tendencies are hard to ignore, and as scholars we are intrigued by the flamboyant and lucrative world of technology startups – but even more so, of how this trend might alter the current paradigm of agency costs when analyzed in relation to venture capital and value growth. Either way, the evidence is clear – more and more fresh graduates prefer to begin their career in startup companies rather than a conventional corporate, entry-level job.

The subject and problem statement presented in this paper are deeply rooted in our own interest and fascination with these recent developments. As scholars, we have been educated and trained to understand and apply theories dating back to the early days of conventional capitalism and industrialism. A majority of the most widespread academic theories being taught are rooted in findings from studying large, listed corporations and industrial behemoths. However, with recent developments, and our potential hypothesis that the paradigm has shifted during the past decades, we are curious to know whether or not these conventional theories are useful in this brave new world where small technology companies succeed in disrupting entire conventional industries at an alarming rate while managing to distort and challenge conventional theories.

Last, but most importantly, there is a new kind of entrepreneur on the rise (Diezma, 2016) - an entrepreneur who is faced with different opportunities and challenges than ever before. Today's high tech entrepreneurs are born with ICT (Internet, Communication and Technology), and it is second nature to most of them.

Networking technology has changed the barriers of entry. Companies such as Mozilla or Upworthy allow their employees to work from anywhere around the world, as long as they are connected to the internet (McKendrick, 2014). Programmers with master's degrees can be hired from Eastern Europe and Asia for as little as $5.00 an hour. Some papers refer to them as innovation-driven enterprises or IDEs (Aulet & Murray, 2013), and they stand opposed to the typical small and medium enterprise, the SME. The IDE wants rapid growth, brand awareness and credibility, fast. The SME is much more focused on survival. Liao and Welsch (2008) found that while tech-driven and non-tech-driven companies have their differences, the core activity-sequencing of the firms are rather similar, whereas what differentiates the firms is their non-core actions. However, they do call for more research on that specific topic. The above is why we chose to focus on ventures created since 2005 – they are a new breed of entrepreneurs, and by limiting our subject to that of value creation with a special focus on agency costs, this paper will be on the forefront of contemporary research, adding unique information to the field.

Contribution

The contribution of this paper will be of both academic and practical use. It is unconventional in the sense that we are trying to (dis)prove the bridge between classical theory and best practice in the venture capital industry. Our aim is to augment existing theory and to support our hypothesis about venture capital investments.

Academic contribution

For academia, the interesting question lies in whether classical agency theory applies to the vibrant world of technology venture capital from the early stages of growth throughout their development into multi-million dollar companies. This paper suggests that there is still some truth to the Jensen-Meckling proposition from 1976, but that the theory needs to be augmented to take into consideration the structure of the firm and the terms under which the founder gives up control. Additionally, this paper will aim to uncover new findings and shed light upon potential differences in agency costs between professional CEOs and founder CEOs. This paper therefore offers a theoretical microeconomic explanation to why Jensen and Meckling should expand their theory.

Practical contribution

Venture capitalists' theoretical framework for analyzing potential investments is very limited. This paper will provide venture capitalists with a powerful tool of structuring a deal to maximize potential value that can easily be applied in any venture capitalist funding scenario. It will give venture capitalists insights into the mechanisms governing value creation on a deeper level than has been possible so far.

In a more practical sense, we will investigate much of the environment surrounding the firms of interest. This means that venture capitalists will gain understanding of the best time to onboard a professional CEO, and whether they even should bother getting a professional CEO on board in the first place.

Structure

The paper will commence with a methodology section where the choice of strategy in terms of analyzing the problem formulation will be presented.

Secondly, we will discuss the limitations of our study. This section includes an explanation of the focal points of this thesis and how "deep" the analysis will go in terms of defining what type of agency costs have been discovered. We will introduce why we limited the survey to American and European tech firms and why we do not distinguish between states in the analysis. We will also discuss our experience and how that may bias this thesis towards a more practical than academic orientation. Additionally, we also discuss our limits in terms of deal terms and why it is important to make a disclaimer in the name of these.

Thirdly, we will present the relevant theoretical framework, which will cover the core theoretical works we applied. In this section, we will introduce three key theoretical areas:

1. **Agency theory and its implications for the firm**
2. **Deal terms – what they are and why they are important**
3. **Tobin's Q**

The purpose of this section is to provide the reader with the required framework to understand the approach, analysis, reasoning and magnitude of our results.

Fourthly, to better gain an understanding of the investment process in order to analyze the deal terms resulting from the aforementioned process, we have conducted a literature review of agency theory. In this literature review, we introduce the two schools of agency theory and a short discussion of the decadal development.

Fifthly, we will offer our analysis of the value creation related to founder CEOs. We have devised a statistical regression model with the purpose of testing if a professional CEO adds more value than a founder CEO in order to test agency theory. Since agency theory is hardly the only relevant contributor to exit value, we also conducted tests for other variables. We conducted this test in two ways: one where we looked purely at the exit value as the dependent variable and the other where we looked at Tobin's Q. Our argument for testing exit value only is that ultimately, the exit value is the goal for any investor. We do, however, also acknowledge that purely looking at the exit value may be flawed; for instance, there might be an exit value dependent on amount of capital raised. This is why we also turned to Tobin’s Q as a way of measuring value creation.

Sixthly, we will present our findings and the implications of this paper. We will discuss our findings, what they mean, and how they might be of importance to academia and practitioners. We will consider how our findings correspond with the limited previous research on the subject, and where we believe further research is required to shed more light on the subject.

Finally, we will offer a conclusion to the matter, which will be a summarization of the results and conclusions we will offer throughout the paper, presented and communicated in as seamless a way possible in order to paint a clear image of our findings and provide key takeaways from our research.

Methodology

In this section, we will explain how data was obtained. We will furthermore elucidate how we made adjustments to data and did calculations. A clearly outlined clarification of our research methodology has an imperative role in our effort to develop a paper of high

scientific integrity and academic merit. In order to reach a sensible conclusion to our outlined problem, we will adopt and sustain a clearly outlined explanation of methodology.

Firstly, we will touch upon the scientific methodology of the paper. Secondly, we will explain the core data set used in the analysis. Thirdly, we will explain how we determined which factors to include in our models in our explanation of agency costs. Fourthly, we will elaborate on the paper's statistical methods and their statistical merits through comprehensive tests of verification.

Scientific methodology

Research Methodology

In this paper, we will adopt a neo-positivistic approach characterized by an epistemological paradigm (Guba, 1990). Our choice of methodology is intentional. It is our goal to remain as objective as possible in relation to our observations and analysis, but to refrain from adopting a purely positivistic research methodology as we deem it unfit for the case in question for several reasons.

The positivistic epistemological paradigm has long dominated the natural and social sciences, typified by purely quantifiable data. However, it is our belief that an objective observer role is necessary in order to reach sensible conclusions and deductions from our data in an attempt to quantify and draw strong inferences regarding the truth we are trying to uncover. However, despite our attempt to maintain the role of objective observers, we cannot deny the fact that the analysis of our observations is not completely unbiased, which is why we applied the neo-positivist epistemological paradigm in our research methodology. As reflective practitioners of academia, we are aware that at our own bias towards the truth is a consequence of how we interpret and decipher the observed reality of our research, which may or may not alter the final outcome of our analysis.

Research approach

Our paper required a substantial amount of data collection, to which we will apply theory in order to deduce possible answers our stated problem. In order to retrieve relevant empirical data, we aimed to collect information via several approaches.

Data

We collected a significant amount of relevant data from various data providers.

- Primary data**:** Our paper relies solely on secondary data obtained from tertiary, professional and reliable data providers. While we have tried to find some firms' annual accounts from governmental organizations such as the SEC, it is a tedious process and not all firms are obliged to publish financials. The accounts that we found via the SEC were also available on Pitchbook.com. Thus, our research does not contain primary data.

- Secondary data: Our main provider was Pitchbook.com - a worldwide, renowned and broadly-used database containing a significant amount of information on relevant transactions within mergers and acquisitions, venture capital and private equity. The data retrieved from Pitchbook.com made a foundation from where we will make empirical conclusions and inferences in alignment with our stated problem.

Defining our dataset

United States of America

We wanted to research the anatomy of agency costs in technology startups, which has made an exit in recent history. Therefore, it is only natural for us to make a selection of firms who were founded relatively recently. Our dataset consisted of data from the widely-recognized database Pitchbook, where we set criteria to limit our dataset to the relevant firms: we wanted our study to be contemporary, so one of the parameters was that the firm must have been founded in the year 2005 or later; the exit must have taken place in the year 2005 or later and be of the type "full exit", "IPO" or "LBO"[1]; and a firm must have been a US firm with a minimum exit valuation of $10 million in the Information Technology sector in the United States.

[1] "Full exit" is synonym to a full acquisition. "IPO" is synonym for Initial Public Offering, which occurs when a private company goes public by being listed on a relevant stock exchange. "LBO" refers to Leveraged Buy-Out, which is frequently observed in full-acquisition transactions or takeovers.

Rationale for the $10 million minimum criteria

First, if the exit has this size there may be a higher chance of the company having a professional CEO.

Second, finding data on companies smaller than $10 million proved cumbersome and inadequate. We furthermore removed firms where data is inconsistent or insufficient. This could be, for example, if we could not find out whether the firm had a professional CEO or founder CEO. We found out whether the firm had a professional CEO or founder CEO by searching other various information sources (i.e. Google, CrunchBase and LinkedIn). If there was no overlap between the founders and the CEO at the time of the transaction, we assumed the CEO to be professional (thus, a non-founder CEO).

The US dataset consisted of 794 deals (including capital raises) on 463 firms after we removed the incomplete entries. Of these firms, 138 had a professional CEO, while the rest of the firms had a founder CEO. By far, the biggest industry group was software with 288 of the firms classifying themselves as software companies, 51 as a commercial service firm, and 29 as communications and networking companies. The 96 companies that classify their industry as other than these categories include but are not limited to media, IT services and computer hardware.

We believe these assumptions to be fair and in line with the purpose of our thesis, namely to assess the unicorns of the Western World. Thus, we need a sample of firms with relatively steep growth in the tech sector.

Europe

We have copied the search approach from US firms by replacing geographical location with Europe, excluding Turkey and Russia.

Although we believe our sample data to have a fair framework, there are some drawbacks to our method. First of all, the Pitchbook database is, in some cases, incomplete or incorrect. Although Pitchbook has a very high standard of information, the information we draw may not be entirely correct.

Measuring agency costs

Admittedly, the process of measuring agency costs can be challenging. By studying the work of others, we have found two approaches, which we will classify as the Income Statement Approach ("ISA") and the Market Value Approach ("MVA"):

1. **ISA: Compare non-pecuniary benefits of founder CEOs vs. professional CEOs**
2. **MVA: Compare value creation of founder CEOs vs professional CEOs**

Both approaches have weaknesses and strengths. They hold one fundamental difference, which is that the ISA deals with accounting data, while the MVA deals with market data. The ISA uses accounting figures such as revenue, costs and balance sheet figures to assess agency costs. The MVA uses market data such as transactions and capital raises to calculate the value of the agency costs.

One study (Ang, Cole, & Lin, 2000) took the ISA approach. They quantified agency costs by looking at the expense ratio, operating expense-to-annual sales, and the asset utilization ratio (annual sales-to-total assets). They argued that the first ratio measures how effectively the firm's management controls operating costs including "perquisite consumption"[2], and that agency costs can be measured by the difference of the ratios. They also argued that the asset utilization ratio measures how effectively the firm deploys its assets. A low asset utilization ratio will therefore imply that the manager is making poor choices regarding the use or acquisition of assets, resulting in lower turnover and non-efficient assets such as a fancy office space.

We applaud this methodology as an efficient way of calculating agency costs. However, by using only accounting data, one forgoes the important link between shareholder value and agency costs: the market value.

In contrast to the above ISA study, two other studies are important. In the first one, "Rich Versus King", Wasserman (2006) introduces the hypothesis that founders want to keep

[2] "Perquisite consumption" can best be translated into i.e. gratuities, bonuses, privileges and so-called "freebies".

control and have their equity be of high value. He summed this up in a model, which can be seen below in Table 1(with a few modifications).

	Value of stake		
Control kept		**Substantially lower than potential value**	**Close to potential value**
	Low	Flop Example: Webvan	Rich Example: Cisco
	High	King Example: Family firms	Rich & Regal Example: Facebook

Table 1 - "Rich vs. King", Wasserman (2006)

As he mentioned, the ideal situation for the entrepreneur is in the lower right quadrant where the founder both grows a successful firm while retaining control. However, this is a rare case, as his paper then proceeded to show. The case where the founder is neither chairman nor CEO actually yields the highest value creation in dollars to the investors according to Wasserman's studies.

Similar to Wasserman (2006), our study and analysis will initially measure the dollar value creation. Other than testing CEO founders versus professional CEOs, he also tested for board of directors control and previous management experience. We believe that ultimately investors are interested in the amount of return they get from their investments, and therefore we acknowledge Wasserman's method.

However, we also recognize that Wasserman's methodology is flawed. The usual investment has some kind of risk-return expectation - an expectation that is not addressed in Wasserman's methodology. Since we have a hard time assessing the actual risk or variance of the venture capital investments, we will use another methodology to incorporate this aspect of an investment. In their article concerning agency costs of controlling minority shareholders, Cronqvist & Nilsson (2003) used Tobin's Q as a proxy for firm value in their regression between controlling minority shareholders voting rights and firm value. They argue this is reasonable because Tobin's Q, in a way, measures the added value of human capital to the firm. Because the controlling minority shareholders can affect the firm's decisions through their share of votes, they can also affect the Q-value.

To conclude, it is deduced that both methods are valid methods of measuring agency costs. Especially in the case where one mixes the ISA and the MVA by substituting balance sheet accounting figures with market values in the ISA method, one has a method that incorporates the key components of agency costs. However, seeing that tech start-up companies do not often publicize their financial accounts and accounting may be flawed or even incomplete, information regarding non-pecuniary benefits or even operating costs is scarce. Therefore, to ensure validity and precision of our study, we have chosen the Market Value methodology going forward. We will firstly apply the approach suggested by Wasserman (2006) and then test the same results with Tobin's Q afterwards, similar to Cronqvist and Nilsson (2003).

Limitations

In this section, we shall define the limitations of our data and analysis. The subject of agency costs assumes many facets, and therefore it is only natural to discuss some of the limitations we will inevitably face in the process of writing this thesis. This section will also contribute to the explicit scoping of our focus going forward and elaborate on where we take other papers' results for granted in order to ensure academic progress.

Depth of analysis

We have clearly stated that our goal is to investigate agency costs. Therefore, we will not consider quantifying them, and as a result, we will not point to the specifics of the agency costs, meaning that we will not be looking into the accounting treatment of items. We will, for example, not determine whether a CEO has used an excessive amount on hotels, fine dining and wine (which would, of course, be the way of the authors of this paper). This limitation serves several purposes.

First of all, it is an inexhaustible task to gather financial statements from technology start-ups. They guard their financial records, and financials are likely not complete nor correct.

Second of all, the accounting treatment of small business can vary greatly. Hence, it is difficult to compare financial accounts across small- and medium-sized firms.

Thirdly, our paper aims not to determine the magnitude of agency costs, but to assess whether the theory proposed by several scholars popularly referred to as agency theory is still relevant in our high-tech 21st century, and if so, to what extent this can be attributed to founder CEOs versus professional CEOs.

Sector and industry

Firstly, in order to develop a paper of high scientific standards, academic integrity and empirical focus, our research will surround VC-backed[3] companies within the technology sector only. This choice of industry is grounded in our own interest on the subject matter, combined with the belief that the technology sector makes an optimal choice of focus due to its widespread impact and importance to other industries. This, combined with its recent dominance in the VC[4] world during the past decades, making data and information more accessible, made the technology sector our preferred choice for investigation.

Geographical limitation

Secondly, our study will carry a geographical limitation. We strive to keep a main focus on the United States of America ("USA" or "US"), with a comparison to the European ("EU") market, too. Thus, we will omit smaller emerging markets, as we believe these are mainly characterized by a high degree of factions and polarization, each with their own unique market and investment characteristics, which do not provide an aligned nor uniform holistic picture of the recent evolution of VC-backed technology companies.

We have decided to also not distinguish between different states in the USA. It is common knowledge that most of the technology-focused venture capital industry is centered around Silicon Valley in California. There might be differences between the afore-mentioned and the rest of the United States, but we shall not address this in our paper. The reason for this is partly that our sample is not big enough for us to generate knowledge about state-specific agency problems. Also, in order for us to contribute with something meaningful, we must simplify our analysis to focus on our core-areas.

[3] "VC-backed" is an abbreviation for companies backed by venture capital (VC) investments.

[4] VC is an abbreviation of "venture capital", and these terms will be used interchangeably throughout this paper.

Experience Bias

The authors have both worked within the venture capital industry. One of the authors carries two years of experience from working in Denmark's largest venture capital fund, with focus on the technology sector. Additionally, both authors have enrolled as venture capital interns in Zambia to gain a non-Western perspective of how a venture capital fund operates in Sub-Saharan markets. From these experiences, portfolio companies have provided insight into how professional and founder CEOs would use their power respectively.

Finally, both authors have undertaken employment within one of the leading technology-focused investment banks in the Nordics, focusing solely on M&A, private equity and venture capital transactions within the technology sector. Consequently, the authors might have obtained a biased perspective from personal experience and deep industry understanding.

The objective is to exclude these experiences from our analytical work. Hence, one might argue that there are two agendas: one academic and one practical. While we consider both to be important, the authors do have practical experience in the field, and we intend the paper to be of practical use as well as academic use.

Time constraint

Finally, our paper will hold a limitation of time. In order to create an accurate conclusion to our paper, we will only look at VC instances within the past ten years as we deem such instances to reflect findings and conclusions that will fit our current reality in the most optimal manner.

Deal terms

While we have included a section on deal terms in our theory section, there will be little discussion and analysis of how they affect the firms chosen for analysis. We recognize that they have a large influence on the organization and especially the exit value:

> Consider the case of a firm at a $50 million valuation with a $25 million capital injection with 2x liquidation preference at a sale of $50 million – the only owners who will get anything from the sale are the investors.

It is for this reason that we have included deal terms as a section. We wish to acknowledge the massive influence deal terms can have on the incentives of the owner-manager or CEO. However, a quantitative analysis cannot be conducted. This is because deal terms are usually confidential, and gaining access would be next to impossible.

Survivorship bias

While we consider our data to be complete, we must also acknowledge survivorship bias. The bankruptcy rate for smaller firms is larger than it is for established firms, and, therefore, our data might be incomplete by not including firms that went bankrupt.

Time period

Seeing that our agenda is the research of agency theory in 21st century tech firms, we believe that our sample should be relatively new. Therefore, we have chosen firms founded after January 1st 2005 and that exited before June 1st 2016.

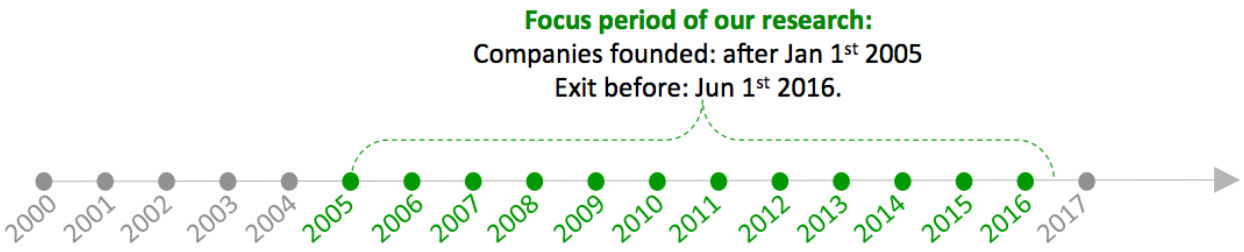


Figure 1 - Focus period of our research (fabricated by author)

This timeframe poses some obstacles. We cannot control against earlier periods and the timeframe is too short to say anything about trends within the time period.

Theory

This section will be split into two main parts. The first part will recap the theoretical background for agency costs. Specifically, focus will be on the 1976 Jensen & Meckling article, which is one of the theoretical foundations for agency theory. Agency theory has, since its inception, been a pivotal theory in the governing of organizations. It is for this

reason that we will also have a look at the evolution of the theory in the literature review. Additionally, we will include a section on the history and theory of entrepreneurship to give the reader some theoretical background as to what an entrepreneur is and how the view on this has evolved over the century.

The second part will consist of the deal terms that venture capitalists typically use. It is important to highlight these because a detailed analysis of the agency theory and its weaknesses also require a strong understanding of the implications of capital injections. While this paper cannot empirically research which impact deal terms have on the firms, we will try to offer an explanation of why outcomes have turned out as they have. One of the key assumptions of agency theory is to see the firm as a "black box" containing legal obligations from supplier to buyer. To disregard the contracts that govern the management of the firm would be to neglect a large sum of what influences the firm, its founder, its owners and its management. It is for this reason that we have devoted a large section to explaining these terms, while not going into depth with them in the analysis. Our hope is that the reader will comprehend the uncertainty that deal terms yield in terms of our analysis.

Finally, there will be a section outlining how to assess the value created in companies. In the analysis, we will use two overall approaches. The first will be our own analysis of the dataset we obtained from the database Pitchbook. This section does not require particular theoretical knowledge but we expect the reader to have fundamental experience with the mechanics and anatomy behind multiple regression analysis and rudimentary statistics as we will develop a hypothesis for each. The second part of the analysis will be done using Tobin's Q in the same manner that Cronqvist and Nilsson (2003) did. Finally, we will be comparing European technology firms with American firms to see if there is a difference between the two. One could suspect so, considering the historical differences in board structures in the US and Europe (Krivogorsky, 2006) (Jungmann, 2006).

Part 1: Agency theory

Originally proposed based on prior work ((Spence & Zeckhauser, 1971), (Ross, 1973)) in 1976 by Jensen and Meckling, the agency theory has gained pivotal influence in modern corporate governance. The Jensen & Meckling paper viewed the firm as a set of contracts

between the owners and the production factor providers, and it is the behavior of this relationship their paper investigated. In other words, they viewed the firm as a legal fiction.

Key Idea	• Principal-agent relationships should reflect efficient organization of information and risk-bearing costs
Unit of analysis	• Contract between principal and agent
Human assumptions	• Self-interest • Bounded rationality • Risk aversion
Organizational assumptions	• Partial goal conflict among participants • Efficiency as the effectiveness criterion • Information asymmetry between principal and agent
Information assumption	• Information as a purchasable commodity
Contracting problems	• Agency (moral hazard and adverse selection)
Problem domain	• Relationships in which the principal and agent have partly differing goals and risk preferences (i.e. compensation, regulation, leadership, impression management, whistle-blowing, vertical integration, transfer pricing).

Table 2 - Agency Theory (Eisenhart, 1989)

The agency relationship is defined as *"a contract under which one or more persons (the principal(s)) engage another person (the agent) to perform some service on their behalf which involves delegating some decision making authority to the agent".* Jensen & Meckling then argued that if both parties are utility maximizing, then there is reason to assume that the relationship will not always be in the best interest of both parties. In the table above (Table 2, (Eisenhart, 1989)), there is a short summary of the theory.

The monitoring expenditures by the principal

It will be possible for the principals to mitigate the unwanted behavior of their agents through various covenants. These covenants may come in the form of provisions regarding

"dividends, future debt issues and maintenance of working capital" (Jensen & Meckling, 1976).

However, implementing these covenants comes at a cost since you would have to monitor the agent. This is what monitoring costs means – the cost of monitoring the agent. Like the Jensen & Meckling paper argues, bondholders and shareholders should only engage in monitoring costs when the marginal benefit of doing so is greater than the cost associated.

The bonding expenditures by the agent

Bonding costs could, for instance, issue a guarantee - in that way the agent promises something and will incur a penalty if he does not deliver on said promise.

The residual loss

Jensen & Meckling (1976) argues that the divergence between the optimal decision making and the actual decision making as a result of the contract between principal/agent is the residual loss. The dollar-equivalent of the loss of "poor" decision making is what will constitute the residual loss.

Going deeper into the effect of outside equity on firm value

If a manager owns 100% of the claims that can be made on a firm, then he will make operating decisions that maximize his own utility. These decisions will be of monetary character as well as non-pecuniary benefits.

According to Jensen & Meckling, the optimal mix of pecuniary and non-pecuniary benefits is when the marginal utility of expenditure is equal to the marginal utility from an additional dollar of purchasing power. In other words, the owner-manager will spend money in the firm on his non-pecuniary benefits until the benefit of doing so is the same as gaining the same amount of utility from increased wealth.

If the owner-manager decides to sell an equity stake, say 10%, then he will bear 10% less of the costs of his non-pecuniary expenditure. In other words, he will spend until the marginal amount of purchasing power is 90 cents, as compared to $1 in the above example.

In the graph below, it is shown how agency problems occur. The maximum value of the firm is found in F = 0. In the initial state, with the owner-manager having 100% of the equity, he will choose a combination of firm value and non-pecuniary benefits that optimizes his utility (F_1, V_1). If the owner-manager chooses to sell a share of the firm, α, then the investor would be willing to pay $(1-\alpha) * V_1$ because he is anticipating agency costs. This is the blue scenario depicted in the graph below.

Since an investor assumes the owner-manager will continue at his current level of welfare, the new slope, the dotted line, must cross the blue point. But since the owner-manager now pays less (he will pay $(1-\alpha)$ for non-pecuniary benefits), he is not maximizing his welfare. This can also be seen in the graph: The blue utility line now crosses the line with the slope of -α in two places. Therefore, the owner-manager will move his line outwards to increase the welfare arising from the firm. The new combination of firm value and non-pecuniary benefits will therefore be (F_2, V_2) with $V_1 > V_2$.

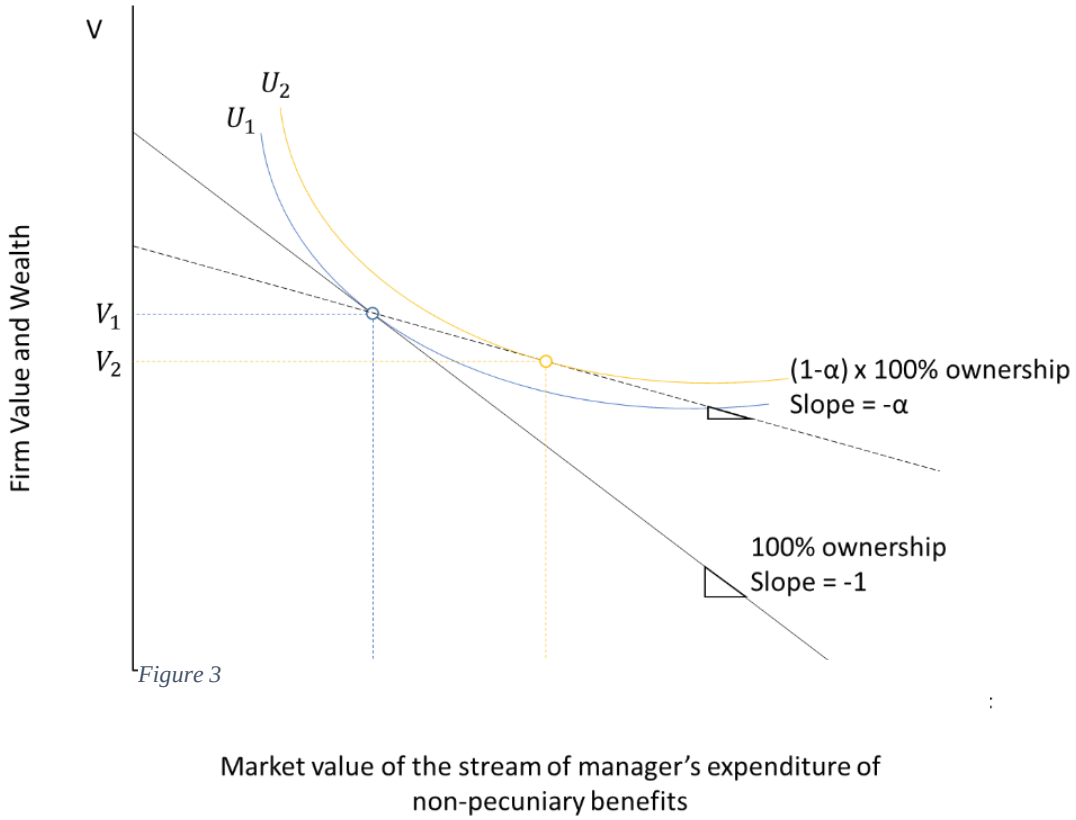


Figure 3

Figure 2 - Illustration of Agency Costs (fabricated by author)

This effect can be mitigated, but at the cost of monitoring or bonding[5]. However, if the market anticipates the agency costs, Jensen & Meckling argued that the owner will bear the costs himself. If the potential investors anticipate agency costs of 5%, they will pay (1-5%) for the equity share. As one can see from the graph above, this is an important factor because it tells us that with the owner-manager still in possession of voting power, he will have an incentive to decrease value for the investor. Jensen & Meckling also argued that this is not the biggest challenge to firm value. They argue that the most important obstacle to increased firm value is the fact that the founder's incentive to search out new profitable work streams decreases, and the creativity of the owner will fall. He may avoid these because the stress and anxiety of searching out these opportunities, and the trouble and risk of implementing new technology, may be too high compared to the potential returns.

Reducing agency costs through monitoring and bonding

It will be possible for the principals to mitigate the unwanted behavior of their agents through various covenants. These covenants may come in the form of provisions regarding "dividends, future debt issues and maintenance of working capital" (Jensen & Meckling, 1976).

However, implementing these covenants comes at a cost since you would have to monitor the agent. This is what monitoring costs means – the cost of monitoring the agent. Like the Jensen & Meckling paper argues, bondholders and shareholders should only engage in monitoring costs when the marginal benefit of doing so is greater than the cost associated. Bonding costs could, for instance, issue a guarantee - in that way the agent promises something and will incur a penalty if he does not deliver on said promise.

The agency costs of debt

Consider a 100% debt-free firm, which is solely owned by the owner-manager. Imagine the owner had two similar investments; the expected value of the projects is the same, the CAPM[6] price for the distributions are the same, but the variance of the projects are dissimilar.

[5] Bonding costs – the implied cost of not pursuing value-creating opportunities (opportunity costs). Bonding costs will be explained in further depth in the subsequent section.

[6] CAPM refers to the Capital Asset Pricing Model, which is a renowned theory within finance and economics. The reader is expected to be familiar with the CAPM and its characteristics.

If the owner-manager was to finance the project with equity, and he afterwards decides to sell the claims to his outcome either in the form of debt or equity, he would be indifferent to the two investments. The outcome would not affect him because he would sell it off.

The contrary is the case if the owner can issue debt first and then decide on the investment. In this case, by promising to take on the low-risk investment, but then subsequently choosing the high-risk investment, the owner-manager can transfer wealth from the bondholders to himself as equity holder. Consider the Black-Scholes[7] model. The market values on the claim on the debt will diminish with the variance. However, since the equity can be seen as a European call option, the value of the equity will increase with the variance.

Another agency cost involves the monitoring and bonding expenses. For debt holders to enforce the provisions they impose onto the firm, they need to spend resources on monitoring (i.e. board-meetings, detailed annual accounts) and bonding (i.e. value of opportunities not pursued).

The third agency cost of debt is the bankruptcy and liquidation cost. Bankruptcy and liquidation come in many shapes, but one example is distressed companies having to pay executives higher salaries due to the risk of bankruptcy. Another example is in the computer industry, where a supplier in distress is less likely to obtain new orders. If a firm's hardware supplier goes bankrupt, they will no longer be able to service the products bought by said firm.

In summary, there are three agency costs associated with debt:

1. **Impact on the choice of investments**
2. **Monitoring and bonding costs**
3. **Bankruptcy and liquidation costs**

[7] Black-Scholes model: A Nobel prize-winning model focusing on the valuation of European options contracts.

The history and evolution of entrepreneurship

To gain a fundamental understanding of the entrepreneur and his surrounding society, it is necessary to establish a view on what an entrepreneur is. To aid in this endeavor, we consult Joseph Schumpeter, an Austrian economist, who was imperative in laying the foundation for modern entrepreneurial research. His findings and ideas were instrumental in developing entrepreneurship's role in mainstream research by *"linking entrepreneurship to a theory"* (Jones & Wadhwani, 2006). Schumpeter, who later taught the first mathematical economics course at Harvard, was very much interested in economic history and macroeconomics, and most of his research revolved around this. However, as opposed to the general consensus at the time, he did not believe uncritically that the economy was a product of factors, which had their own impact (he mentions population as an example; the general consensus was that an increase in population would increase economic activity. Schumpeter believed that it is hard to generalize this finding, and there exist several explanations as to why a population increase could in fact both increase and decrease economic activity. He believed that entrepreneurs were fundamental to how a society evolved in a broad sense.

Schumpeter defined the difference between an entrepreneur and an inventor as following:

"… it is particularly important to distinguish the entrepreneur from the 'inventor'. Many inventors have become entrepreneurs and the relative frequency of this case is no doubt an interesting subject to investigate, but there is no necessary connection between the two functions. The inventor produces ideas, the entrepreneur 'gets things done', which may but need not embody anything that is scientifically new … Finally, 'getting new things done' is not only a distinct process but it is a process which produces consequences that are an essential part of capitalist reality. The whole economic history of capitalism would be different from what it is if new ideas had been currently and smoothly adopted, as a matter of course, by all firms to whose business they were relevant. But they were not. It is in most cases only one man or a few men who see the new possibility and are able to cope with the resistances and difficulties which action always meets with outside of the ruts of established practice." (Schumpeter, The creative responses in Economic History, 1947)

"The function of entrepreneurs is to reform or revolutionize the pattern of production by exploiting an invention or, more generally, an untried technological possibility for producing a new commodity or producing an old one in a new way, by opening up a new source of supply of material or a new outlet for products, by reorganizing an industry and so on. This function does not essentially consist in either inventing anything or otherwise creating the condition which the enterprise exploits. It consists in getting things done." (Schumpeter, Capitalism, Socialism & Democracy, 1947)

Schumpeter thus defines an entrepreneur not as someone who has ideas, but someone who sees the connection between readily available technologies and uses them in a new way with a certain emphasis on execution rather than hesitation. It reminds an awful lot of the, in the authors' opinion grossly misused, term "disruption"[8]. It underlays what he calls creative destruction, the process of replacing old technologies with new, tearing down the old technology in the process. Up until his death in 1950, Schumpeter repeatedly called for investigation of entrepreneurs and their firms, but also on changes in the societies, industries, markets and political systems in which they operated.

A range of scholars spread the Schumpeterian view on entrepreneurs, making it a mainstream research topic until the 60's. At this point research started focusing on maximizing efficiency within the modern multi-divisional firm, a stream of research embodied in the framework proposed by Chandler (1962), leaving entrepreneurial research as a fringe research area.

We believe that the original definition of an entrepreneur is ever-relevant. Although much is still the same in terms of the entrepreneurs' place and meaning in society, as Schumpeter argued, the entrepreneur should be subject to discussion in relation to the surrounding society. It is, among other things, this gap in contemporary research we are attempting to bridge.

[8] Disruption: In the world of venture capital and entrepreneurship, the term "disruption" has been broadly adopted by mainstream media over the past decade. Today, the term is a widely used buzzword by the business community when describing entrepreneurial endeavors or vision of creative destruction.

Part 2: Venture capital deal terms

One of the hardest things to investigate is how deal terms affect corporate governance, and thereby impact the outcome of the principal/agent relationship. In itself, it is not hard to investigate, but access to shareholders' agreements and venture capital deal terms are often restricted or outright confidential. There has been some research on the topic, i.e. Bienz & Walz (2010) but substantial research has not, to our knowledge, been made about how deal terms actually influence firms. This section will provide a description of deal terms most commonly used. There will be four sections.

In the first section, the reader will find a description of deal terms related to equity. Then, a description of non-financial deal terms will also be included. Figure 4 below shows that there exists some overlap between all of the types of deal terms, and that they rarely stand alone.

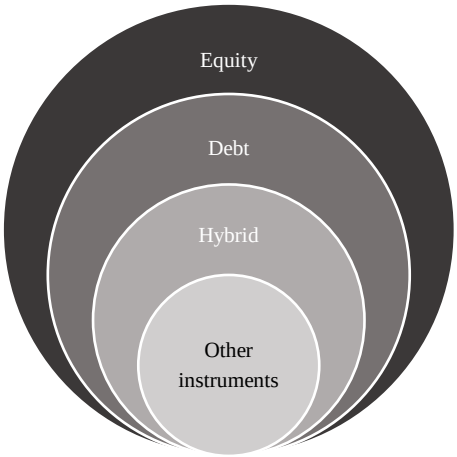


Figure 4 - Illustration of overlaps between deal terms (fabricated by author)

Figure 4 is also a representation of how the next four sections will be structured.

Section 1 – Equity terms

In the following, we will describe which deal terms relating to equity are relevant.

Drag-along rights

If the majority owner sells his or her shares, the minority owners must sell, typically at the same terms and price. Drag-along rights are usually terminated with the IPO.

Registration rights

The right of holders of restricted stocks[9] to have the firm listed in order to sell their shares. Under this umbrella of registration rights are also so-called piggyback registration rights, which allow investors to register their shares if the firm goes through a registration (i.e. IPO).

Redemption rights

Having redemption rights means the investor is able to sell back the shares to the firm after a specified time period. They are rarely used, and only about 10 to 15% of term sheets have them according to Kramer & Patrick (2015). Redemption rights protect the investor against the case where a firm move "sideways", i.e. does not deliver the projected financial performance.

Anti-dilution

An anti-dilution provision protects the investor from being diluted in case of later stock issuances with a lower price. Consider a firm that has 500 shares. Now, an angel investor buys 400 shares at $1 each in the firm. The firm is now valued at $500 pre-money ($900 post-money) and the investor owns 44.4%. Suppose the firm looks to raise $150 to invest in new computers, but the valuation is lower than it previously was due to some obstacles faced by the firm. What will the situation look like for the founder and the angel investor?

There are two types of anti-dilution: **full ratchet** and **weighted average ratchet** (O'donnell, Commissaris, & T.), which are divided into broad-based anti-dilution or narrow-based. The broad-based anti-dilution takes into account all rounds, as opposed to the narrow-based anti-dilution, which only accounts for the previous round. In the full ratchet, the original investor's share price will be adjusted to the new price. With the weighted average, the original investor's share price will be calculated based on a formula. In the section below, we will give an example of no anti-dilution, full ratchet anti-dilution and a broad-based weighted average ratchet. In Table 3 below are our assumptions.

[9] Unregistered shares of ownership in the firm that are nontransferable.

Series A: $400 at $1/share ($500 pre-money, $900 post-money)				
	# Shares	Investment	Conv. Price	Fraction
Common stock	500			55.6%
Series A	400	$400	$1.000	44.4%
Total	900			100.0%

Table 3- Anti-dilution (fabricated by author)

No anti-dilution

If there is no anti-dilution, the capital expansion will be straight forward. The firm will issue new shares, which together with the existing shareholders will constitute the new share base. See the example in Table 4 below.

Series B: $150 for 25% of Company ($450 pre-money, $600 post-money)				
	# Shares	Investment	Conv. Price	Fraction
Scenario 1: No anti-dilution				
Common stock	500			41.7%
Series A	400	$400	$1.000	33.3%
Series B	300	$150	$0.500	25.0%
Total	1,200			100.0%

Table 4 - No anti-dilution (fabricated by author)

As can be seen, the new investor now owns 25% of the company. The angel investor (series A) owns 33.3% versus 44.4% earlier, while the founder has been diluted the most, going from a 55.6% to 41.7%.

Full ratchet

The Angel investor will clearly not be happy being diluted as much as was the case with no anti-dilution. Therefore, he might have included a full-ratchet anti-dilution provision in the term sheet. Basically, with a full ratchet, the conversion price of existing preferred stock is reduced to the price of the new issuance. In this example, the angel investor experiences a 50% drop in the share price.

Scenario 2: Full ratchet				
Common stock	500			28.9%
Series A	800	$400	$0.346	46.2%
Series B	**433**	$150	$0.346	**25.0%**
Total	1,733			100.0%

Table 5 - Full Ratchet (fabricated by author)

As evident from Table 5, if there is a full ratchet anti-dilution, the angel investors' share will "eat" from the founder's share. What happens is that the new conversion will be $\frac{\$1}{\$0.5} = 2$, meaning that for every share the angel investor has, he will now receive 2. We also know that the founder still has 500 shares. Furthermore, the new investor should possess 25% of the company. Hence, the new total share count must be

$$(500 + 800) = (1 - 25\%) * x <=> x = 1733.$$

The new investor requires 25% of these, which are 433 shares. His share price will then be $0.35. More importantly, the founder's ownership of the firm has been reduced dramatically, which surely has an impact on his motivation going forward.

Weighted average

Had the angel investor instead used the weighted average anti-dilution, the situation would be different. The weighted average anti-dilution provision is not as radical as the full ratchet anti-dilution provision. As a result, the weighted-average anti-dilution provision is used more often. The weighted average formula uses the formula:

$$C_2 = C_1 * \frac{A + B}{A + C}$$

Where C_2 is the new conversion price, C_1 is the old conversion price, A is the outstanding shares before new issue, B is the aggregate consideration received by the firm with respect to the new issue, and C is the number of shares issued in the subject transaction.

In this case, the old conversion price is $1. The outstanding shares before the issue totaled 900. The new number of shares being issued is 300, and the number of shares issued in the subject transaction is 150/$1 = 6. Therefore,

$$C_2 = \$1 * \frac{900 + 150}{900 + 300} = 0.875$$

which means that the angel investor should receive $\frac{1}{0.875} = 1.14$ shares per existing share. The angel investor has 400 shares, and with the broad-based weighted-average dilution, he will receive an extra $400 * (1.14 - 1) = 57$ shares. The situation will then look like Table 6 below.

Scenario 3: Broad-Based Weighted-Average Ratchet

Common stock	500			39.8%
Series A	457	$400	$0.875	36.4%
Series B	**300**	$150	$0.500	**23.9%**
Total	1,257			100.0%

Table 6 - Broad-based weighted-average dilution (fabricated by author)

A full ratchet may seem like the best solution for investor protection because it gives the investor the highest anti-dilution. But if an investor is using the full ratchet, and the firm in which he has invested finds itself in distress, other shareholders might not agree to raise another round of financing because they themselves will be diluted heavily.

Pro-rata rights

This is the right to participate in new rounds of financing with one's ownership share. If one owns, for example, 30% of the equity and a new round is being raised, he has the right to purchase 30% of the equity issued. Thereby, the investor will not be diluted.

Right of first refusal

This is the equivalent of a call option. It is a contractual agreement that the shareholder has the right to purchase the asset before any third party.

Co-sale rights or tag-along rights

Allows minority shareholders to sell at the same offer as the majority shareholder. Say i.e. a majority VC firm wants to exit an investment after five years. Tag-along rights will give the minority shareholders the rights to sell at the same price and terms as the VC firm/majority shareholders.

Preferred stock

Preferred stockholders have different rights. They are "more important" than common shareholders in the sense that the preferred stockholders must always be paid before the common shareholders in any event, be it distribution of dividends, liquidation or a sale.

Liquidation preferences

In the event of liquidation or a sale, investors want to make sure they are paid first. Therefore, in some term sheets, investors will introduce a liquidation preference. Take the example where a VC firm invests $50 million in a firm for a 50% ownership share, and thereby a post-money valuation of $100 million. If the firm then sells for $75 million, the VC will get $37.5 million.

However, if they have preferred stock, they would get their $50 million back first – and then split the remaining $25 million. This represents a liquidation preference of 1x. Had they had a liquidation preference of 1.5x, they would be able to keep all $75 million.

Dividends

Some term sheets will include a provision of dividends. There are differences as to how they should be paid. Some have to pay immediately and others will be accrued and only paid in the event of liquidation or – for preferred stock – conversion.

Section 2 – debt covenants

In the following section, we will address which deal terms are used when raising venture debt. We assume the reader's familiarity with interest and repayments.

Collateral

Often, a debt provider will require having some kind of security in the borrower. This could be, for example, Intellectual Property (IP) rights or physical assets.

There can be several tranches of debt, where one type of debt is subordinated to other kinds of debt.

Warrant coverage or equity kicker

Sometimes a debt provider will require having warrants on the equity as a form of "upside" or maybe even risk mitigation (the debt provider can take control with the firm if exercising enough warrants). A percentage of the face value will then be converted at the last financing rounds' equity price.

Rights to invest

The debt provider might also request a right to invest in subsequent equity financing rounds at equal terms and pricing, which the other investors are offered.

Covenants

A covenant can best be translated into an "agreement". A lender might choose to impose some restrictions as to how the money can be spent and/or operational requirements. In private equity, for instance, it is not unusual to see requirements pertaining to the ratio of earnings-to-debt.

Section 3 – Hybrids

This section will provide an overview of how debt and equity can be combined to form hybrid securities.

Convertible bond

A convertible bond is issued as a loan, but can later be converted into equity. Typically, an investor will convert if the value of the equity is larger than the value of the debt.

There are four types of convertible bonds:

1. Vanilla convertible bonds: Grants the holder the option to convert the loan into shares at a predetermined price. There may be coupon payments. Usually they have a fixed maturity.
2. Mandatory convertibles: A variation of the vanilla convertible bond where the bondholder will be forced to conversion.
3. Reverse convertibles: The reverse convertible is best thought of as a knock-in short call option. When the price of the underlying asset (the stock) drops below a threshold, the investor will now have his securities priced at the current price. Because of the significant downside of risk, the coupon on reverse convertibles is higher.
4. Packaged convertibles: Is a bond and a call option or a warrant packed together.

Payment-In-Kind (PIK) loans

A Payment-In-Kind (PIK) loan does not have any cash flow from the borrower to the lender until maturity. Instead, the loan carries warrants. The warrants will then be the "payment" for the loan.

Section 4 – other provisions

This section is aiming at providing the reader with an overview of other deal terms that do not fall within the direct categories of either equity, debt or hybrids.

Investor board seats

By having representatives loyal to the investor on the board of the firm in which they invested, investors have a say in critical matters. An investor can have an observer, who serves mainly to pass on information to the investor, or a full board member with voting rights. In the latter case, the investor will have an actual say in how the firm is run.

Some start-ups are happy at the prospect of including professionals on their boards. Having an investor on the board can mean having a confidante, a technical expert or even an industry network. In mainstream media and within the world of investing, this is usually referred to as "smart money".

Information rights

Often paired with the investor board seats provision is a clause on just how much information the firm has to share with the investor. Often, this could be something like the firm sharing the audited accounts 180 days after year-end. It could also be that the firm has to share unaudited accounts every month, or even that the investor has the right to do unannounced inspections.

Founder restrictions

For a startup, it may be unfavorable if the founder chooses to jump ship. It may result in a loss of know-how, IP knowledge, and, most importantly, may signal a damaged value to employees and the company about the company's overall capability to execute and deliver. Therefore, one provision often seen is that the founder or CEO cannot leave the firm before a certain period. This provision is also often observed in relation to mergers and acquisitions as so-called "earn-out" or "lock-in" agreements where the founder cannot leave the acquired firm until certain agreed-upon KPI's[10] or milestones have been met.

We have now examined and clarified in-depth the world of term sheet provisions. These can be pivotal for the firm because they represent part of the legislative/organizational framework that the firm is facing. Our purpose was to give the reader an understanding of which term sheet provisions are used.

Tranche funding

Most venture capitalists do not deploy their funding immediately in one big batch; rather, they pay out the agreed funding in tranches. The tranches are often linked to the company's performance, financially or organizationally. For instance, for Facebook, an investor might only pay the upcoming tranche if the firm at a given point in time has reached a certain

[10] KPI: an abbreviation of Key Performance Indicator

number of active users. It is believed that by terminating funding when performance is poor, investors are able to mitigate poor managerial incentives (Bolton & Scharfstein, 1990).

Part 3: Tobin's Q

Tobin's Q (Tobin, A general equilibrium approach to monetary theory, 1969) (Tobin & Brainard, Pitfalls in Financial Model Building, 1968), the ratio of market value of total assets and the book value, will be used to assess agency costs.

$$Q = \frac{Market\ value\ of\ Assets}{Replacement\ value\ of\ assets}$$

Some argue that Tobin's Q is the contribution of intangible assets like growth options, human capital, brand value, etc. towards the firm. Because the ownership can affect the firm's intangible assets, Q can be used to measure the expected value of the owner's decisions; in other words, it captures the "hypothesized agency costs" (Cronqvist & Nilsson (2003)). In the Cronqvist and Nilsson study, they considered an owner with >25% of the firm's votes to be a controlling owner. They also divided the controlling owners into five categories to capture different investor types. The five categories are 1) Founder Family, 2) Non-Founder Family, 3) Corporation, 4) Financial Institution and 5) Dispersed Ownership. There is actually difference between the Q-value for these categories.

The model that Cronqvist and Nilsson proposed is a multiple regression model:

$$q_{it} = \beta_0 + O'_{it}\beta_1 + C'_{it} + Y'_t\beta_3 + e_{it}$$

Where

$e_{it} = u_i + v_{it}$
β_0 is the intercept
O'_{it} is a vector of ownership variables
C'_{it} is a vector of observable firm characteristics
Y'_t is a vector of year dummies
e_{it} is the error term.

The paper defines the error term as an unobservable firm-specific effect, u_i, and an ordinary white noise term, v_{it}, meaning the latter is an uncorrelated, zero-mean, constant and finite variance process. In our regression model, we will be doing the same test, but will test for different parameters.

An important distinction between the aforementioned study and our study is that Cronqvist & Nilsson (2003) used publicly traded companies. In our study, this will not be possible all the time, and we therefore have to do the study on a transaction basis, i.e. when the firm either raised money, went public or got acquired/merged.

Summary of venture capital deal terms

Hopefully, the reader should now have an understanding of the prevailing anatomy and relevant deal terms usually found within venture capital term sheets. By all means, the science of equity and debt deal terms are arguably more complex than what we have presented here. However, this section has merely aimed at providing the reader with the necessary insight and knowledge to optimally grasp and participate in the discussion and review of our analysis and findings later on.

This concludes the theory section. By now, the reader should have obtained a basic understanding of concepts that we will use in the coming sections.

Literature review

In their 1976 article, Jensen and Meckling extended the theory on agency costs. The article would later prove to be pivotal in the development of management theories for a good forty years after its initial publication.

This section will provide a literature review of the development of their idea since it was first published, with a timeline of development through the decades. The articles we will review will deal with the organizational/financial literature, thus excluding other applications of

agency theory such as politics, marketing and sociology. The papers we included in the literature review have been found by assessing the amount of quotations and the relevance of the article to our purpose.

Agency Theory - 1970's

Jensen and Meckling published their article in 1976. One of the first to add onto the principal/agent theory was Shavell (1979). Shavell pointed out, that a principal pays a fee to enjoy the outcome of the agent's work. However, Shavell argued that different fee payments and levels of information should yield different outcomes of the project in which there is a principal/agent relationship. Shavell proceeded to introduce two situations: One in which the principal has no information of the agent's effort, so the fee depends on the outcome. Here, if the agent is risk-neutral, his fee will be the outcome less the principal's share.

This allocation provides the right incentive to the risk-neutral agent. However, to a risk-averse agent, this arrangement would associate him with the risk of the outcome, something that he is not interested in. Shavell then goes on to prove that (a) if the agent is risk-averse his fee would still depend somewhat on the outcome, but he will never bear the full risk and (b) that whether the agent's efforts are very small or very large, inappropriate incentives tend to disappear.

The second scenario (b) is when the principal holds information about the agent's effort. In this scenario, the agent will not lose anything if he is risk neutral and the fee depends on the outcome. Therefore, information has no value. If the agent is risk-averse however, it would be advantageous to incentivize him by making his fee depend on effort instead of the outcome alone. Shavell's theory is important, because it pinpoints the determinants of an outcome (agent's effort, randomness) and what impact different incentives will have (fixed fee, variable fee) under different circumstances (information of effort, no information of effort).

The Agency theory did not really catch on until the 1980's, where it became pivotal in organizational research.

Key takeaways from the 1970's

- *The 70's were the birth of agency theory*
- *There were few contributors to theoretical development including, but not limited to, Spence & Zeckhauser (1971), Ross (1973), Jensen & Meckling (1976) and Shavell (1979).*

Agency Theory - 1980's

In the 1980's, agency theory truly took off and became pivotal in studying theories of the firm.

According to Jensen (1983), agency theory literature was split into two schools both addressing the contracting problem between two parties "who both use the same agency costs minimizing tautology": One, the principal-agent literature, has emphasis on mathematical modeling and formalized research within the contractual agreement. The other, which Jensen referred to, is the positive agency literature.

The latter is more focused on empirical results and the environment in which the organization operates and therefore is affected by. The positive agency theory focuses almost exclusively on the CEO/owner relationship, whereas the principal/agent theory tries to widen the scope to include other relationships as well (Eisenhart, 1989) (Perrow, 1986) (Hirsch, Michaels, & Friedman, 1986). According to Jensen, although the two are separate, they also contribute to each other. As can be seen from Figure 5 below, agency theory in itself is a field of research, which is divided into Principal-agent theory and positive agency theory.

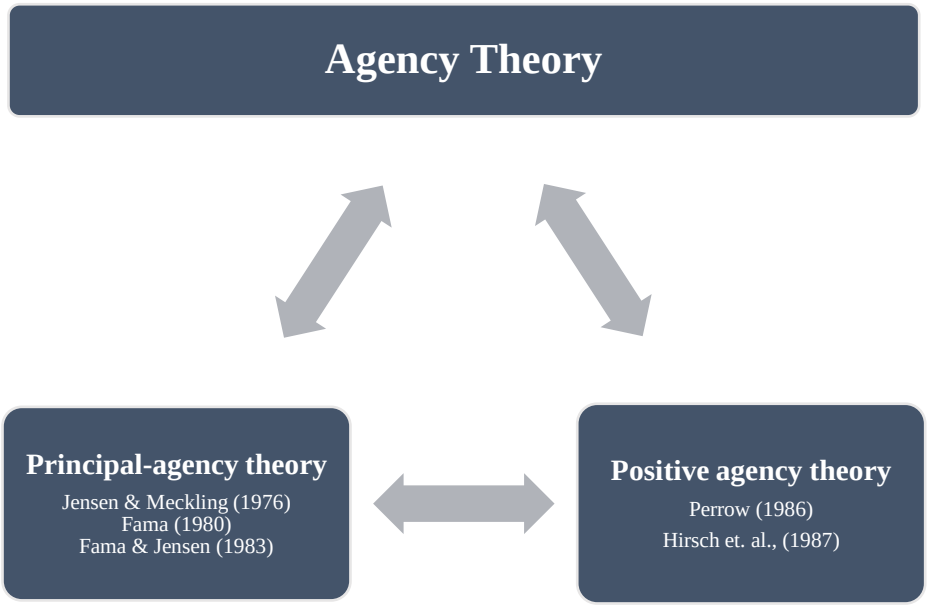


Figure 5- Agency theory split (fabricated by author)

In the below Table 7 (Eisenhart, 1989), some of the most influential articles have been listed. They have also been classified according to their research stream (Positivist vs. Principal-Agent), how large their sample size was and what it consisted of (which variables were measured to support agency theory, which dependent variables were altered and whether or not there has been any support for agency theory or not).

Author(s)	Research Stream	Sample	Agency Variables	Dependent Variables	Results
Amihud & Lev (1981)	Positivist	309 Fortune 500 firms	Manager vs owner controlled	Conglomerate mergers & diversification	Support
Walking & Long (1984)	Positivist	105 US firms	Management's equity and options	Managerial resistance to takeover bid	Support
Anderson (1985)	Principal-Agent	159 sales districts in 13 electronics firms	Importance of non-selling activities, length of selling cycle, & difficulty evaluating sales performance	Representative vs corporate sales force	Mixed
Eisenhardt (1985)	Principal-Agent	54 retail stores	Information systems, cost of outcome measurement, & outcome uncertainty	Salary vs commission	Support
Eccles (1985)	Principal-Agent	150 interviews in 13 chemical,	Decentralization	Type of transfer price	Inductive model

		electronics, heavy machinery & machine component firms			
Wolfson (1985)	Positivist	39 oil & gas limited partnerships	General partner's track record	Share price	Support
Argawal & Mandelker (1987)	Positivist	209 major corporations	Executive stock holdings	Acquisitions, divestitures & debt/equity ratio	Support
Kosnik (1987)	Positivist	110 major corporations targeted for greenmail	Proportion of outside directors, equity held by outside directors, & outside directors with executive experience	Payment of greenmail (Yes/No)	Mixed
Eisenhardt (1988)	Principal-Agent	54 retail stores	Job programmability, span of control, & outcome uncertainty	Salary vs commission	Support
Conlon & Parks (1988)	Principal-Agent	40 dyads	Monitoring	Performance-contingent compensation	Support
Barney (1988)	Positivist	32 Japanese electronics firms	Employee stock ownership	Cost of equity	Support
Singh & Harianto (1989)	Positivist	84 Fortune 500 Firms	Managerial stock	Golden parachute contracts	Support

Table 7 - Agency theory through the 1980's (fabricated by author)

As can be seen from first glance at Table 7, by far, most research has been supportive towards agency theory. Only two articles have mixed conclusions.

In the following section, there will be a short discussion of the collective results of the 1980's agency theory research.

According to (Eisenhart, 1989) the common approach in the **positivistic approach** is to identify an area where shareholder and management interests clash. The researchers of this field then try to show that information or outcome-based incentives can solve the agency problem.

Principal-agent research focuses more directly on the contract between principal and agent. The approach in many of these studies is to try to find the most effective contract in a given

situation. Many of these studies therefore use a set of variables to predict if the contract is behavior or outcome based because doing so will allow the principal and agent to choose the most efficient contract.

Key takeaways from the 1980's

- *Agency theory divided into two schools: Positivistic literature and principal/agent theory*
- *Principal/agent theory was dominant at first, but the positivistic soon took over*
- *Positivistic agent theory allows for agency theory to be applied in other settings and interacts with environment factors to have an influence on the results*

Agency Theory - 1990's

While agency theory in itself was still divided into principal-agent theory and positivist agency literature, agency theory, having dominated organizational research for a good decade, was being challenged by novel lines of thought.

In general, during the 1990's, research moved gradually from discussing and proving principal-agent theory vs. positive agent theory to application in other settings and augmentation with adjacent economic theories. One might argue that due to the nature of the positivists' research, they came out dominant from the 1980's clash with the principal-agent school.

Author(s)	Research Stream	Sample (if applicable)	Agency Variables	Conclusion	Results
Donaldson & Davis (1991)	Positivist	321 US firms	ROE	The paper did not provide any support for agency theory, but it did promote stewardship theory	Abandonment
Hill & Jones (1992)	Positivist	0	N/A	Augmenting agency theory with stakeholder perspectives, which was previously regarded as mutually exclusive	Support
Lafontaine (1992)	Positivist	548 US franchisees	Propensity to have franchisees rather than	There are incentive issues on both sides.	Support

			in-house units	Incidence of franchising is larger when there is an incentive or monitoring problem downstream	
Roth & O'Donnell (1996)	Positivist	100 subsidiaries in 5 countries	Subsidiary compensation	Compensation strategy is influenced by agency problem	Support
Stroh, Brett, Baumann, & Reilly (1996)	Positivist	20 Fortune 500 companies, 670 managers	Compensation versus task programmability	There is support to agency theory in the sense that the level of programmability was negatively correlated to programmability. However, there was no support for the risk premium hypothesis (high variable pay in turbulent periods)	Mixed
Kochnar (1996)	?	Other articles	Capital structure	Viewing capital structure from a transaction cost point of view counters learnings from agency theory. The article supports the former.	Abandonment
Beccerra & Gupta (1999)	Positivist	1 multinational firm	N/A	Transaction cost theory and agency theory are not opposites, but supplement each other	Support
Denis, Denis, & Sarin (1999)	Positivist	Other articles	Equity ownership structure versus diversification strategies	The evidence strongly suggests that ownership structure influences corporate strategy	Support
Lane, Canella, & Lubatkin (1999)	Positivist	Other articles	Strategic behavior of companies' diversification of risk versus ownership structure	Disagrees with (Denis, Denis, & Sarin, 1999). Finds little theoretical or empirical evidence that monitoring affects firms' diversification and acquisition strategies.	Support, but not in this domain

Table 8- Agency theory through the 1990's (fabricated by author)

As can be seen from Table 8 above, there are some studies that tried to deviate from the consensus. This seems to have been the 1990's contribution to agency theory. There is especially one "feud", which is particularly interesting; that of Lane, Canella, & Lubatkin (1999) and Denis, Denis, & Sarin (1999). Where Denis, Denis & Sarin stated that ownership

structure has influence on diversification (acquisition) strategy; this is refuted by Lane, Canella & Lubatkin.

Key takeaways from the 1990's

- *The 1990's saw predominantly positivistic literature*
- *There was some dispute as to the usefulness of agency theory in explaining organizational behavior*

Contemporary research (2000 – present)

As we move closer to the present, we see some interesting developments within agency theory. There has been a vast increase in available data, better supervision, and research methodologies as well as a financial crisis that have arguably all contributed to an increased interest in the subject of agency theory and agency costs.

All contributions and research on the subject carried out from 2000 to 2011 show evidence that supports agency theory on several levels. Outlined in Table 9 below you will find the final conclusions of the most significant findings and research on the subject throughout the period.

Author(s)	Research Stream	Sample (if applicable)	Agency Variables	Conclusion	Results
(Ang, Cole, & Lin, 2000)	Positivist	1,078 small corporations	Operating expense ratio, asset utilization	Agency costs are higher when an outsider manages the firm and are inversely related to managers' ownership share	Support
(Hendry, 2005)	Positivist	Interviews with non-executive directors	CEO incompetence (not measured, only explained)	Agency theory only begins to offer an explanation for poor executive performance, but one needs to look beyond agency theory for the real reason	Support

(McDonald, Khanna, & Westphal, 2008)	Positivist	600 randomly selected firms from Forbes list of largest industrial and service firms	Advice seeking, CEO ownership and performance-contingent CEO compensation, outside directors experience, firm performance	High levels of CEO ownership and performance-contingent compensation will increase cEO's tendency to seek outside advice	Support
(Hillman & Dalziel, 2003)	N/A	Other articles	Primarily financial performance	Integrating agency and resource dependence views allows for a richer understand of firms	Support, with recommendations
(Colombo, Croce, & Murtinu, 2014)	Positivist	225 unlisted Italian high-tech entrepreneurial firms	Total factor productivity	Owner-managers produce better results	Support
(Miller, Le Breton-Miller, & Lester, 2011)	Positivist	Fortune 1000 Companies	A number of different variables, including growth and returns	Compared to lone founders, family owners tend to value conservation of the firm	N/A

Table 9- Contemporary agency theory, 2000-present (fabricated by author)

As can be observed from Table 9, contemporary research carried out since the 2000's overall seems to show support of agency theory. It can be argued that the theory has gained further interest and attention from academia due to the strong empirical evidence, which started to show up throughout the 2000's. Furthermore, the increased attention and interest in agency theory may also be an offspring of the 2007-09 financial crisis. Governments, regulatory entities and the general public have commanded stronger regulations and a higher level of corporate governance within the financial sector in order to avoid similar crises in the future. The general awareness created from the financial crisis has arguably had a direct impact on the increased academic attention and interest in agency theory.

Key takeaways from contemporary research

- *More research recommends augmentations for agency theory*
- *Focus is still on testing whether agency theory holds*

Agency Theory: Conclusion

Our test and research of agency theory is timely and well-founded because the paradigm for companies has shifted – the venture capital industry is as vivid as ever, and no one, except Colombo, Croce, & Murtinu (2014), has really taken the time to research if agency theory

applies to tech startups, and what impact a (de)validation of agency theory in this sector might have. The latter is something that has not necessarily been the focus of research in the past fifteen years.

Analysis

Introduction

In this section, we will dive into an in-depth analysis of our proposed research subject. Our analysis is based on a top-down approach where we begin by taking the reader from a macro perspective and gradually increasing the granularity of our data, until reaching a narrower and micro-specific level. The overall aim of our analysis is two-fold:

1) We aim to investigate the possible relationship between post-2005 technology companies and agency theory. In doing so, our analysis draws upon multiple scientific disciplines within the realm of statistics and multiple regression. Ultimately, we assume that the reader is familiar with the methodology and reasoning behind multiple regression modeling.

2) We strive to draw a coherent and seamless transition between each section of our analysis in an attempt to deliver, as clearly as possible, a thread and communicate our analysis and methodology to the reader. In doing so, we have attempted to make the level of complexity as intuitive as possible without sacrificing either academic merit or integrity. We wish to enable the reader to follow our line of thought as effortlessly as possible.

To begin, we will now set the scene for our top-down analysis approach by clarifying our choice of geographic regions.

We found it to be interesting to test our hypothesis across different regions. Therefore, we have chosen to examine two leading regions within venture capital, seeing as how the amount

of data we could get would be the highest in these two. We have therefore chosen Europe (EU)[11] and The United States (US).

	US	EU
Absolute exit value ("Wasserman" method)	Part 1	Part 3
Tobin's Q ("Cronqvist and Nilson" method)	Part 2	Part 4

Table 10 - Overview of analysis (fabricated by author)

Introductory analysis

Aim of introductory analysis:

We will approach our in-depth analysis in a deductive manner, applying a top-down approach where we will gradually increase the level of data granularity used. In this section, we will start from the top and work our way down through the analysis, clarifying our thoughts and reasoning behind our choice of variables and parameters, which will be tested through numerous hypotheses.

Data summary and overview

Our overall intention of investigating whether or not agency theory still applies in the vibrant, brave new world of technology startups starts from a few overall data tendencies. From doing an overall analysis of our initial data set, we can observe said tendencies, which sparked the groundwork for the overall analytic aim of this paper.

Our raw data from Pitchbook contained 1,097 observations of US technology companies that were founded after the year 2005 and have since done an exit either through IPO, acquisition or any sort of buyout (levered and non-levered). Our 1,097 observations come with a range of 23 filters (i.e. company name, date founded, deal date, etc.) from which we can retrieve our

[11] Europe data: As stated in our data section in the beginning of this paper, the data for Europe is excluding Turkey and Russia.

assumed relevant data to estimate what we consider to be relevant parameters for our model(s) and analysis.

Unfortunately, not all of our 1,097 US observations came with the full level of relevant data points needed throughout all of our analysis. We have thus removed firms where data is inconsistent or inadequate. This could be, for instance, if we could not find out whether the firm had a professional CEO or founder CEO, exit date, founding date, etc.

Consequently, we ended up with a sample size of 188 US observations that contained the relevant data entries needed for our analysis.

Thus, our US analysis will be solely based on these 188 observations as they adequately fit the requirements of our analysis. We aim to maintain a high level of consistency, which is why we from this point on will refer to these 188 observations as 'our data' from here on.

Overall summary of companies

Of these firms, 126 (67.0%) had a professional CEO at the time of exit, while the remaining 62 (33.0%) had a founder CEO at the time of exit.

By far, the biggest industry group was software. Out of the 188 US firms observed, 155 (61.2%) of the firms classified themselves as software companies. Additionally, 23 (12.2%) classified themselves as a commercial service company, and 8 (4.3%) as communications and networking companies. Additionally, 42 (22.3%) companies classified their industry as other than these categories including but not limited to media, IT services and computer hardware. Figure 6 provides a convenient summary.

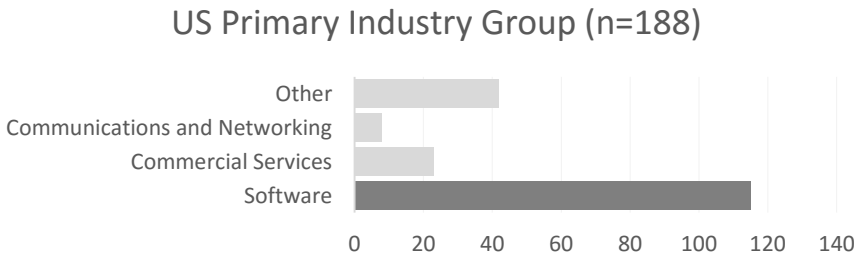


Figure 6 - Descriptive statistics, distribution of industry groups (fabricated by author)

It is our belief that these data adequately fulfill the parameters of our research. We believe our assumptions and hypotheses outlined later on to be fair and fully aligned with the purpose of our thesis when applied to this data.

We will now dive into the analysis. The first overall question that we would like to ask is whether a professional CEO actually adds value. According to Jensen & Meckling (1976), a company owned and managed by the founder will use some of the value that could be created for the founder's own non-pecuniary benefit. This might not yield the highest value, but the owner's utility will be maximized. According to Jensen & Meckling (1976), agency costs arise as a consequence of principals having lower information than the agents. This can be reduced through monitoring (i.e. audit reports or meetings) and bonding (i.e. demanding a certain performance of the firm). Our argument, therefore, is that a professional CEO can more easily be monitored and bonded than an owner-manager, and that the corresponding lower consumption of non-pecuniary benefits should be lower. There can, of course, be other factors interfering with the results, and these factors will be addressed in the analysis.

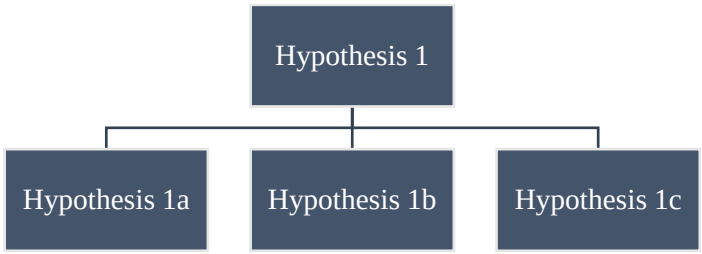


Figure 7- Structure of hypothesis (fabricated by author)

Hypothesis 1: Tech firms with a founder CEO will have more valuable exits than those with a professional CEO

To test this assumption, we have been looking at the average exit valuation of the sample firms. It turns out that on average, firms in our US sample with a founder CEO performed 45.51% better than firms with a professional CEO.

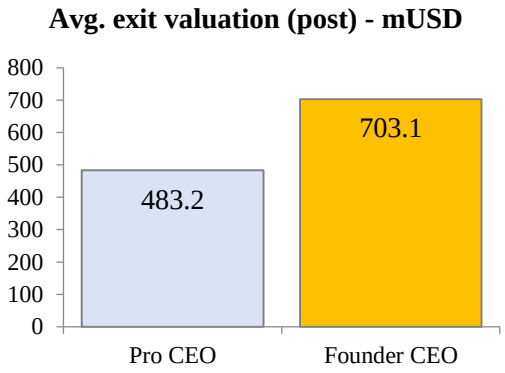


Figure 8- Overview of avg. exit valuation (post) from our sample data, divided into professional CEOs and founder CEOs (fabricated by author)

However, this high level analysis only shows one result with one variable. The real world and the underlying factors are undeniably much more complex. For instance, one might ask: Is the higher value a result of the founding CEOs or is the fact that the founding CEOs are still in power a result of firms having a higher value? It's a question about correlation and causation, which we will also address later on.

Distribution of percentage value creation

As a first step of our analysis, we wanted to gain a visual impression of how value creation is distributed between professional and founder CEOs in our US data.

Consequently, we have taken the valuation at point of exit and compared this to the valuation of the foregoing (penultimate) investment round. We assumed that the difference between exit valuation and the valuation of the foregoing investment round serves as a realistic indicator of the level of value creation up to the final life of the technology company observed.

The difference is converted into percentage change. This gives us a value, which is easy to compare and interpret. The observations are then split between professional CEOs and founder CEOs. The distribution is depicted in the below histogram (Figure 9), which depicts the percentage value creation observed in bins of 50%.

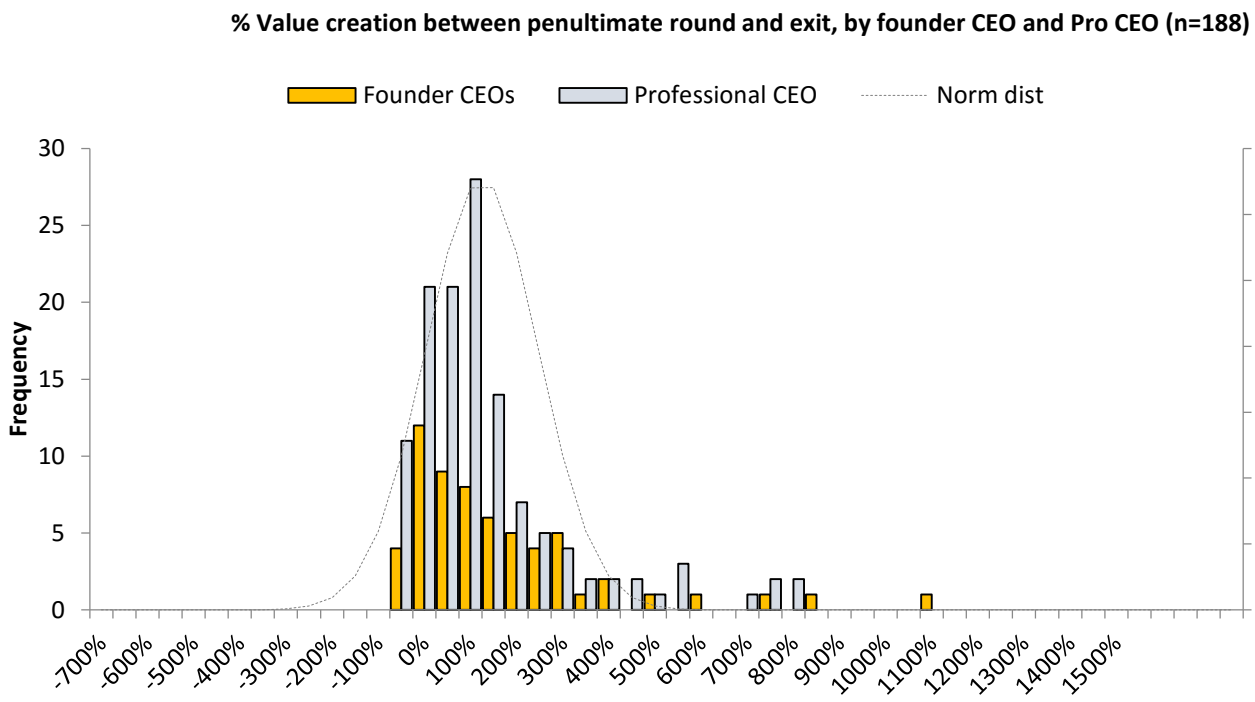


Figure 9- Histogram showing the distribution of percentage value creation in our data, by professional CEO or founder CEO (fabricated by author)

How to read the histogram: Number of occurrences of the percentage value creation between exit and penultimate valuation, divided between founder CEOs and professional CEOs. Each bar is a bin of 50% value creation. Example: The tallest bar in this chart tells us that 28 times professional CEOs managed to create between 100% and 150% value creation between exit and penultimate valuation round.

The histogram in Figure 9 suggests several interesting findings. Firstly, there doesn't seem to be a significant difference, in our US data set in terms of value creation between professional CEOs and founder CEOs. As a matter of fact, the average percentage value creation between the exit valuation and penultimate valuation round was 115% for professional CEOs and 145.5% for founding CEOs.

Secondly, the US observations appear to be somewhat positively skewed due to a long tail of extreme outcomes of value creation. Obviously, it's difficult to argue how the distribution would be skewed the opposite direction since -100% value creation would rarely occur! However, we believe that the distribution is normally distributed, centered around a mean of 1.26 (126%) with a standard deviation of 1.97 (197%).

Estimation and testing of relevant parameters

It is our belief that several factors have an effect on technology startup exit valuation. Thus, in order to test our sub-hypotheses, we have selected six parameters, which we believe to have a significant impact on startup exit valuation. The parameters we have chosen are based on both intuitive economic sense as well as from questioning and discussion with industry experts and an empirical observation from working in the industry for several years.

Thus, we will apply the multiple linear regression approach in order to test whether or not our chosen factors actually do play a significant role in relation to exit valuation of the sample of US technology startups in our data set.

To do so, our regression model will aim to explain the significance of the chosen factors in an attempt to estimate the true population of exit values, resulting in the following model:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \varepsilon$$

$$\hat{Y} = b_0 + b_1 x_1 + b_2 x_2 + b_3 x_3 + b_4 x_4 + b_5 x_5 + b_6 x_6 \, D_1 + e$$

Where D_1 indicates dummy variable (0 or 1)

Our overall model will take the following shape when including our chosen factors:

1. Y-variable: Exit value (measured in million USD).
2. Number of employees the startup employs at date of exit.
3. Years since the company was founded (difference between exit year and founding year).
4. Number of previous investment rounds.
5. Number of total investors involved.
6. The level of the US GDP measured in billion USD.
7. Whether the company is managed by a professional CEO or a founding CEO (dummy variable where *1 = professional CEO* and *0 = founder CEO*).

This results in our overall population model to look like following:

$$\text{Exit value} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \varepsilon$$

$$\text{Exit value} = \beta_0 + \beta_1(\text{Number of employees}) + \beta_2(\text{Years since founded}) + \beta_3(\text{Number of previous investment rounds}) + \beta_4(\text{Number of investors involved}) + \beta_5(\text{US GDP}) + \beta_6(\text{Professional CEO})*D_1 + \varepsilon$$

Where D_1 indicates dummy variable (1 = Professional CEO; 0 = founding CEO).

The estimation model looks as follows:

$$\widehat{\text{Exit value}} = b_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + e$$

$$\widehat{\text{Exit value}} = b_0 + b_1(\text{Number of employees}) + b_2(\text{Years since founded}) + b_3(\text{Number of previous investment rounds}) + b_4(\text{Number of investors involved}) + b_5(\text{US GDP}) + b_6(\text{Professional CEO})*D + \varepsilon$$

P-values and T-statistics explained:

Before we continue onto our analysis and regression modeling, we would like to justify our validation criteria of or methodology. As mentioned previously, we do expect the reader to have a fundamental knowledge of multiple regression analysis and probability statistics. In our analysis we will adopt the p-value approach when evaluating our parameter estimates. It is our belief that the p-value approach is in alignment with customary data analysis. Additionally, throughout our analysis we will remain to a five percent significance level as we evaluate this to also be in uniform with current research methodology. Thus, when evaluating the p-values of our models parameter estimates, given the observed t-statistics we are in fact evaluating what the *smallest* significance level would be, at which the null hypothesis would be rejected. This level is the p-value. In other words, *"the p-value is the probability of observing a t-statistic as extreme as we did if the null hypothesis is true."* (Woolridge, 2009).

Thus, for final clarification an example would probably be in order: if we observe a p-value of i.e. 0.50, then we would observe a value of the t-statistic as extreme as we did for the 50% of all random samples when the null hypothesis is true; this is pretty weak evidence against the null hypothesis.

Hopefully this brief section has equipped the reader with satisfying insight and understanding of our use of p-values in our analysis, given a 5 percentage significance level.

Stepwise regression

In the follow sections, we will regress each factor onto exit valuation. We will gradually add an additional parameter from our above-mentioned chosen factors. As part of the process, we expected to see a slight change in coefficient values as we progressed into the full model, which contains all six chosen factors.

We investigated whether or not each factor was statistically significant at the .05 significance level. Thus, any parameters with a p-value above 0.05 would suggest an insignificant effect on the Y-variable (Exit value). Additionally, we aimed to achieve as high an Adjusted R^2 value as possible, as we attempted to develop a model with a goodness-of-fit measure of high integrity and merit.

Lastly, we expected to observe changes in our parameter coefficients and p-values as we continuously added or removed more factors to the model. At the end of this step-wise regression, we considered the final model from an overall perspective and whether or not it needed further calibration while justifying our decisions and choices.

Hypothesis 1: Number of employees affects tech startup exit valuation

From an intuitive economic standpoint, we would expect the number of employees in the company to be highly correlated to the exit valuation of said company. All else equal, a flourishing, growing and profitable company can only be assumed to employ a higher caliber of people compared to a less successful company. Consequently, the more successful and profitable the company is, the higher the number of employees and the higher the assumed exit valuation.

From regressing number of employees onto the exit value across our US data observations, we observed the following regression results:

SUMMARY OUTPUT - USA

USA - Regression Statistics	
Multiple R	0.76
R Square	0.58
Adjusted R Square	0.58
Standard Error	900
Observations	188

ANOVA

	df	SS	MS	F	Significance F
Regression	1	211500458	211500458	260.9153	2.9894E-37
Residual	186	150773365.4	810609.4914		
Total	187	362273823.4			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	72.1	72.2	1.0	0.319	-70.2	214.5	-70.2	214.5
Employees	1.5	0.1	16.2	0.000	1.3	1.7	1.3	1.7

Table 11- Multiple regression, step 1, US data (fabricated by author)

Our results suggest that one additional employee, on average, adds $1.5 million to the exit valuation of a technology startup. The coefficient comes with a high level of statistical significance (p-value < 0.05). One can argue whether or not the coefficient of $1.5 million makes any economic sense. For example, one could argue that the relationship is purely correlational and not causational as, all else equal, an unsuccessful company would not have its exit valuation increased by just hiring another random employee.

On the contrary, the coefficient could be interpreted as the marginal value added from employing one additional employee, on average. If so, then this measure could potentially mean that, on average, US technology startups manage to create $1.49 million in annual value from hiring an additional employee, which strongly supports one of the strongest attributes about technology companies, namely, high scalability. A high level of scalability, which usually makes up one of the crucial success factors in most international technology startups, would imply that there would be an almost linear relationship between revenue creation and hiring another person (i.e. salesperson), which ultimately leads to an increase in value, all else equal. However, the presumed linear relationship can only be expected to maintain its linearity until some saturation point is reached, as the relationship arguably would be subject to a diminishing rate of return.

Due to these arguments and the high level of statistical significance, we believe this parameter should be included in our model going forward.

However, it's important to consider whether the relationship is purely correlated and not causational. From our calculations, the correlation between exit value and number of employees in our dataset appears to be 0.764 indicating a somewhat strong level of correlation. However, the correlation coefficient does not tell us whether the relationship is purely linear or maybe of some other functional form.

Hypothesis 2: Years since founded affects startup exit valuation

We believe the number of years between the inception of a technology startup and its year of exit plays a role on the effect on the exit valuation.

The logic behind our reasoning is two-fold.

Firstly, the longer a company has been in business for, the more time said business will have had to build up a certain value in relation to either an IPO or acquisition rationale.

Secondly, a longer financial track record would arguably not only underline the growth potential of a company, but also serve as a proof of the business' stability and ability to generate money. We believe that the longer a company can show proof of financial stability and profitability, the more likely the company is to continue in generating profits going forward. Applying this assumption to the Discounted Cash Flow (DCF) model, a higher level of future cash flows and a high level of stable, financial profitability would, all else equal, result in a higher valuation when used in a DCF valuation.

On the contrary, we believe that number of years between company inception and exit has an ambiguous relationship on exit valuation. When it comes to technology startups, it can be argued that a long track record is a good or bad sign in terms of exit timing. For instance, one of the most characteristic attributes of technology startups is their proneness to almost exponential, explosive growth early on. Their growth cycle arguably can have an impact on exit valuation when combined with the timing of the exit. The intuition here being that a technology company may be more valuable for an acquirer at a certain point at which proof of concept and business has reached a certain level of validity, and the company is on the

verge of explosive growth. At this point, the company would arguably be worth more to an acquirer due to factors such as unrealized potential, synergy effects or a non-measurable level of asymmetric information between seller and acquirer. In that case, a savvy acquirer would be able to acquire the company at a lucrative price (i.e. below fair value), which would result in a shorter payback time and eventually a higher level of return on investment (ROI) for the acquirer. This would ultimately be reflected in our model by a positive parameter coefficient for the variable "years since founded".

However, companies that have passed the point of explosive growth and have been in business for longer (i.e. a higher number of years between years founded and year of exit) would arguably pull down the exit valuation of the company since most upsides from future growth and synergies have been materialized for a potential acquirer. In that case, we would expect the coefficient to be negative, thus having a negative impact on exit valuation the longer a tech startup has been in business.

For these reasons, we believe that this parameter serves as a viable parameter in our model. Thus, from adding the parameter to our existing model, we retrieved the following results.

SUMMARY OUTPUT - USA

USA - Regression Statistics	
Multiple R	0.77
R Square	0.59
Adjusted R Square	0.58
Standard Error	898
Observations	188

ANOVA

	df	SS	MS	F	Significance F
Regression	2	213029107.1	106514553.6	132.0328	2.36993E-36
Residual	185	149244716.3	806728.196		
Total	187	362273823.4			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	297.0	178.5	1.7	0.098	-55.2	649.1	-55.2	649.1
Employees	1.5	0.1	16.0	0.000	1.3	1.7	1.3	1.7
Years since founded	-38.9	28.3	-1.4	0.170	-94.8	16.9	-94.8	16.9

Table 12- Multiple regression, step 2, US data (fabricated by author)

We can observe that the parameter comes with a negative coefficient of -38.941, indicating that one additional year between startup inception and year of exit decreases the exit

valuation by $38.9 million on average. This is in line with our last-mentioned intuition that the longer a tech startup has been in business for, the higher the likelihood of potential growth upsides and synergies have already been materialized for a potential acquirer, thus decreasing value.

Although, the parameter is not statistically significant at this point (p-value > 0.05), indicating that we fail to reject the hypothesis that the true population coefficient is in fact equal to 0 and thus should not have a significant impact on exit valuation, we will include the parameter in our model for now as it will become significant later on.

Hypothesis 3: Total number of investment rounds affects startup exit valuation

This hypothesis makes good intuitive sense. The assumption here being that more successful technology startups would arguably have received a higher number of investment rounds compared to less successful tech startups. A higher number of investment rounds indicate a higher level of faith in the company from outside investors who believe the company to have a significant potential.

One would assume that a company that manages to attract multiple investment rounds has a significant potential to become highly valuable, due to either a very innovative or disruptive business model solving a real-world pain for its end-customers combined with, for example, a high level of defensibility and competitive advantage. As a relevant example, the recent billion-dollar 'unicorns', such as tech startups Airbnb or Uber, which both have received several investment rounds, indicate a high level of faith from outside investors.

SUMMARY OUTPUT - USA

USA - Regression Statistics	
Multiple R	0.79
R Square	0.62
Adjusted R Square	0.62
Standard Error	863
Observations	188

ANOVA

	df	SS	MS	F	Significance F
Regression	3	225118438	75039479.34	100.6688	1.33782E-38
Residual	184	137155385.4	745409.7031		
Total	187	362273823.4			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-31.6	190.0	-0.2	0.868	-406.4	343.2	-406.4	343.2
Employees	1.4	0.1	15.2	0.000	1.3	1.6	1.3	1.6
Years since founded	-85.6	29.6	-2.9	0.004	-143.9	-27.3	-143.9	-27.3
Number of deals	167.8	41.7	4.0	0.000	85.6	250.0	85.6	250.0

Table 13- Multiple regression, step 3, US data (fabricated by author)

From including this parameter in our model, we can observe exactly what we expected. The coefficient of the variable "number of deals" appears to add an additional $167.8 million on average to the exit valuation across the observed companies in our data. The coefficient is highly significant with a p-value of 0.00 indicating that we can faithfully reject the hypothesis that the true coefficient for this parameter is zero. Finally, we can conclude that this parameter, compared to the remaining two parameters, has had the biggest impact on our Adjusted R^2, increasing it from 0.584 to 0.615.

Additionally, from adding this parameter to our model, we observe that "Years since founding" suddenly becomes significant too (p-value changed from 0.170 to 0.004).

Hypothesis 4: Total number of investors funding the startup, affects startup exit valuation

This parameter is very closely related to the previous one added to our model (number of previous investment rounds).

However, we believe that this variable (Total number of investors backing the company) deserves some fair attention in our model. The reason being that although our model considers the number of previous investment rounds, it does not tell us anything about how *many* different investors have shown faith in the company – it only tells us that the company

has received several rounds of investments, which all potentially could be from the same investor, which would decrease the integrity of the previous parameter (Number of investment rounds).

Furthermore, in the VC world, it is often argued that investors bring know-how and network to the company (“smart-money”), contributing to the value creation. Some VC funds even have in-house resources like big data scientists, HR consultants and so on at the disposal of the portfolio companies. We therefore believe that there is a positive correlation between the number of investors and the firm value.

In contrast (assuming more investors means more outside equity with voting rights), Agency Theory stipulates that, as outside equity increases, the value of the company will decrease because the cost of non-pecuniary benefits of the firm will decrease. This hypothesis is therefore closely related to Agency Theory.

Consequently, we believe that "Total number of investors backing the company" should have a significant impact on the exit valuation since a higher number of outside investors indicate a higher potential in the tech startup.

It is our intuition that a higher number of different outside investors should add positively to the overall model. Thus, we expect this parameter to carry a positive coefficient.

SUMMARY OUTPUT - USA

USA - Regression Statistics	
Multiple R	0.79
R Square	0.63
Adjusted R Square	0.62
Standard Error	859
Observations	188

ANOVA

	df	SS	MS	F	Significance F
Regression	4	227191284	56797820.99	76.94556	3.66628E-38
Residual	183	135082539.4	738155.953		
Total	187	362273823.4			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-136.0	199.1	-0.7	0.495	-528.8	256.7	-528.8	256.7
Employees	1.4	0.1	15.3	0.000	1.3	1.6	1.3	1.6
Years since founded	-86.3	29.4	-2.9	0.004	-144.4	-28.3	-144.4	-28.3
Number of deals	160.4	41.7	3.8	0.000	78.2	242.7	78.2	242.7
Total #Investors	38.7	23.1	1.7	0.095	-6.9	84.3	-6.9	84.3

Table 14 - Multiple regression, step 4, US data (fabricated by author)

As expected, the parameter has a positive effect on the exit valuation. The interpretation here being that one additional outside investor increases exit valuation by $38.7 million on average. However, we cannot reject the hypothesis that the true population parameter is significantly different from zero as the p-value exceeds the 95% significance level (p-value > 0.05).

The parameter manages to add to our Adjusted R^2 by only 0.04, which may indicate that the parameter doesn't add much to the overall model and its attempt to estimate exit valuation on average. However, at this point, we are convinced that the parameter has a say on exit valuation and will be included in our model at this point.

Hypothesis 5: The state of the US GDP affects the startup exit valuation

From our initial research of the overall tendencies associated with technology startup exits, we considered whether or not the economic climate could prove to have an impact on technology company exit valuations. The intuition would be that exit valuations would be higher during economic prosperity. Additionally, one could also envision that the acquisition rationale among companies would be higher during economic upturns compared to economic downturns.

It is evident that there is a trend when comparing the development between US GDP (Google Finance, 2016) and number of US exits from our dataset. We can observe a pattern, which indicates that the number of exits is somewhat correlated to the economic climate of the United States from 2006 – 2016. From our data, we can observe a strong correlation of 0.95 between the number of quarterly exits and the level of the US GDP in that same period, which is also illustrated in Figure 10 below.

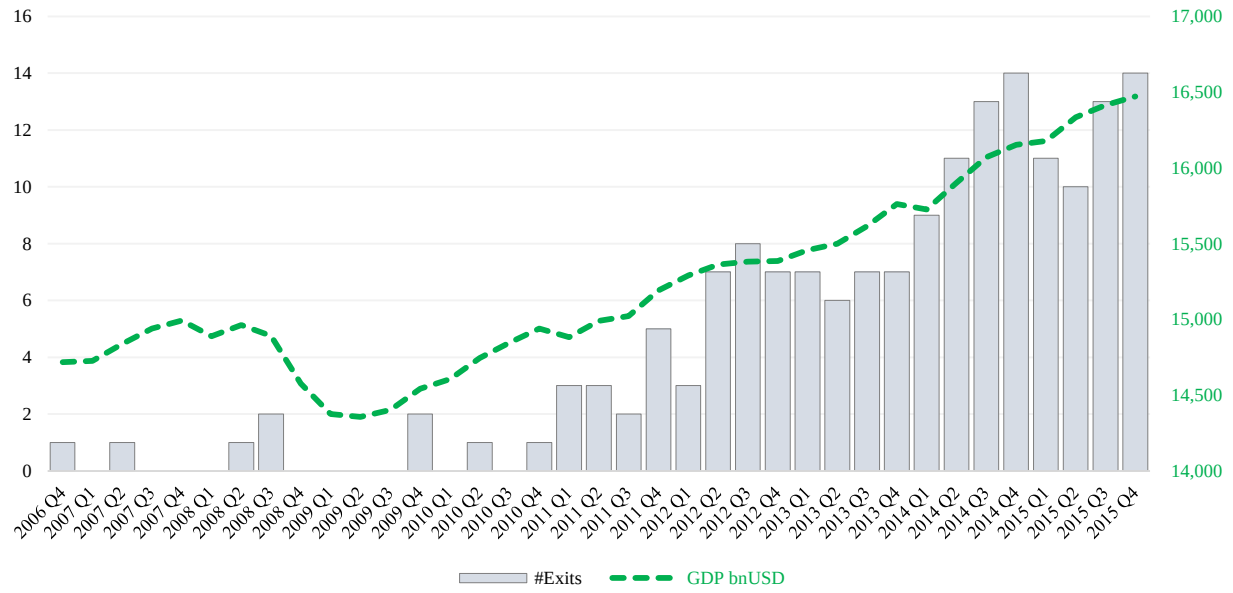


Figure 10 - Correlation between number of exits in the US and the development in US GDP (fabricated by author)

Also, from the perspective of a seller, in order to maximize his or her potential wealth or utility from a sale, one would try to time the point of selling accordingly to maximize said utility. Thus, it would arguably make economic sense waiting to sell one's company until the economy undergoes an economic upturn, allowing for a potentially higher price for said seller's company.

On the contrary, one could argue that acquisition rationale from a buyer's perspective is higher during economic downturns. The reason for this would be, that potential acquisition targets could be acquired at a below-market value due to tough economic conditions, which would challenge the profitability and survival-rate of many young companies, thus decreasing their bargaining power when negotiating with a potential acquirer.

From comparing the average exit value to the movements of the US GDP, it can be discussed whether there is a relationship among the two trends. As depicted in the graphs below, there

tends to be a slightly positive relationship between average exit value and the level of US GDP (left diagram).

On the contrary, when comparing the average value creation (difference between exit value and penultimate valuation, measured as percentage) to the development of the US GDP, there tends to be a higher positive value creation during economic prosperity (right diagram).

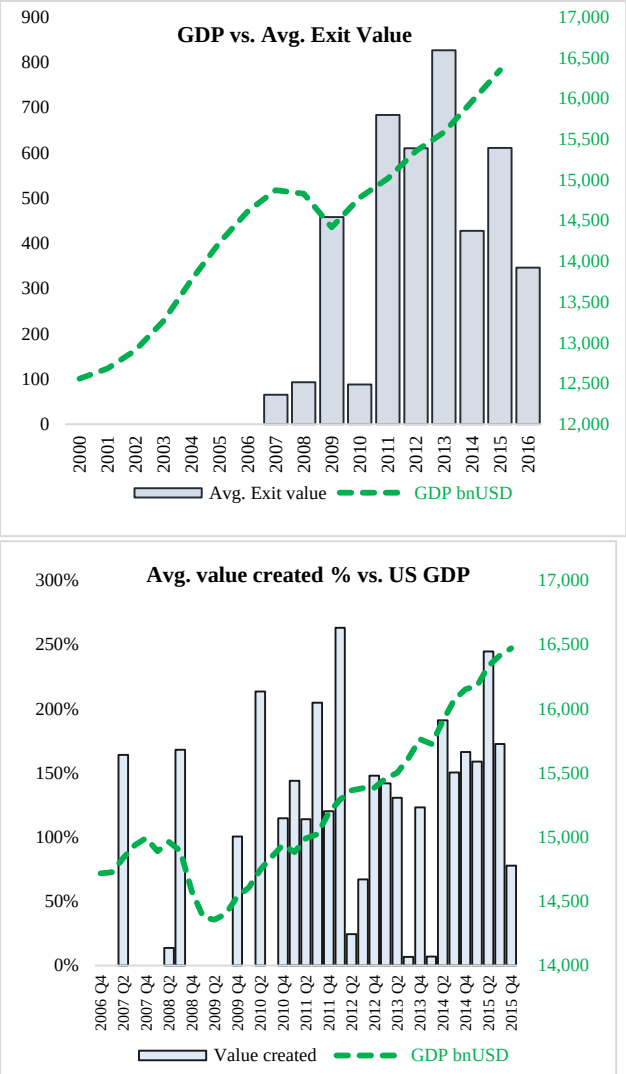


Figure 11- Correlations between avg. exit values (left), avg. value created as % (right) and US GDP

Thus, at this point, it is hard to decipher exactly how we should expect the US GDP to impact exit values and value creation directly. However, we expect the coefficient to have a slight positive impact, all else equal, due to the observation and intuition that average exit value tends to follow economic prosperity.

SUMMARY OUTPUT - USA

USA - Regression Statistics	
Multiple R	0.80
R Square	0.64
Adjusted R Square	0.63
Standard Error	850
Observations	188

ANOVA

	df	SS	MS	F	Significance F
Regression	5	230845626.6	46169125.31	63.93438	2.90106E-38
Residual	182	131428196.8	722132.9495		
Total	187	362273823.4			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-316.7	212.6	-1.5	0.138	-736.3	102.8	-736.3	102.8
Employees	1.4	0.1	15.5	0.000	1.3	1.6	1.3	1.6
Years since founded	-84.0	29.1	-2.9	0.004	-141.4	-26.5	-141.4	-26.5
Number of deals	153.5	41.4	3.7	0.000	71.9	235.1	71.9	235.1
Total #Investors	42.7	22.9	1.9	0.064	-2.6	87.9	-2.6	87.9
US GDP Change (%)	87.1	38.7	2.2	0.026	10.7	163.5	10.7	163.5

Table 15- Multiple regression, step 5, US data (fabricated by author)

As expected, the coefficient is positive. The parameter (US GDP Change (%)) is based on the percentage change in US GDP between the quarters of company exit to the preceding quarter. We have decided to deploy this particular approach, as we believe it gives an adequate representation of whether or not economic prosperity is present at the time during company exit.

Thus, the interpretation of a coefficient of 87.1 is that per 1-percentage quarterly change in GDP, the exit valuation tends to increase by $87.1 million, on average.

Reasoning and testing behind GDP quarterly percentage change:

To some readers, this parameter might appear difficult to grasp, and one could rightfully question why we did not choose to just have the US GDP as a nominal parameter instead of the percentage quarterly change in our model.

Initially, this is also what we did. In our US data set, we originally included the quarterly nominal level of the US GDP (measured in billion USD) at the time of exit to each of our US observations, respectively. Initially, we believed this would be the most intuitive and easy-to-interpret approach, as the coefficient would translate into how a $1 billion USD increase in

GDP would affect exit valuation. Thus, we would like to justify why we have swapped this parameter with the quarterly percentage change in GDP instead.

When we initially carried out the multiple regression with the quarterly nominal level of the USD GDP, our findings turned out to be not only counter-intuitive, but also insignificant. As expected, the coefficient was positive – albeit only slightly. As it turned out, if the US GDP increased by $1 billion USD, we should expect a $0.01 million ($10,000) increase in exit valuation of a technology startup (remember, our dependent variable, exit value, is measured in million USD). From our own judgment and intuition, this did not seem correct and intuitive, and we were baffled to observe such a low value at all.

Additionally, the parameter did not prove to be statistically significant due to a strikingly high p-value (0.946) suggesting that we fail to reject the hypothesis that the true population coefficient for US GDP on exit valuation was in fact equal to zero. Additionally, the inclusion of the variable *decreased* our Adjusted R^2 by 0.02.

It is for these reasons, that we returned to the drawing board and wondered how to best calibrate and fit the US GDP parameter in our model since our intuition clearly suggested that there should be a significant relationship between economic prosperity and exit valuation.

Consequently, we decided to adopt the approach of quarterly percentage change in US GDP instead and deployed this as the relevant GDP parameter in our model – which not only proved to show a much more intuitive coefficient of 87.1, but also to be highly significant (p-value < 0.05) while contributing positively to our Adjusted R^2 measure.

Hopefully, this should clarify and explain any wonderings the reader might have concerning our choice of quarterly GDP percentage change as a parameter in our model.

Hypothesis 6: Professional vs. founder CEO affects startup exit valuation

This variable makes the pinnacle of our research as it is around this that our main hypothesis circulates. In this model, we wish to estimate and uncover whether or not a professional CEO

has a significant difference on the impact of exit value for technology startups compared to founder CEOs.

In order to do so, the variable is a dummy variable, which will take the value of 1 for observations with a professional CEO and 0 for observations with a founder CEO. Consequently, the baseline we are measuring up against is thus the *difference* in impact on exit valuation of professional CEOs compared to founder CEOs.

At this point, according to Jensen & Meckling, agency theory would suggest that there should occur an agency cost from having a CEO (agent) acting on behalf of the principal (investor), regardless of whether or not the CEO is a professional CEO or a founder CEO. If so, it would be assumed that a CEO should have a negative impact on the exit valuation of a technology startup, regardless of whether it is a professional CEO or a founder CEO. However, as stated by Jensen & Meckling, the agency cost in this case would be the connection between non-measurable pecuniary benefits and their utility to the managing CEO.

However, what we are aiming at measuring is whether or not there is an observable *difference* between the agency cost of a professional CEO and a founder CEO, and if so, in what direction will the difference lean? The outcome should provide us with some strong indication of whether or not there is a significant difference in agency costs related to having a professional CEO managing the company in the time up to an exit, compared to a founder CEO – and most importantly: if there is a difference, what is the magnitude and ramification of this difference?

At this stage of the analysis, we are unclear about whether to expect the coefficient to be negative or positive. If the coefficient for the professional CEO parameter (dummy variable) turns out to be positive, it would suggest that professional CEOs, on average, tend to add more value to the exit valuation of the companies in our dataset, compared to founder CEOs.

Positive coefficient parameter:

If the coefficient is positive, agency costs associated with professional CEOs are smaller than those associated with founder CEOs.

On the contrary, if the parameter coefficient turns out negative, it would imply that professional CEOs, on average, tend to have a negative effect on exit valuation when compared to founder CEOs.

Negative coefficient parameter:

If the coefficient is negative, agency costs associated with professional CEOs tend to be higher than agency costs associated with founder CEOs.

We are now clear on *how* to interpret the sign of the coefficient, but as stated earlier, at this point of analysis, we are unclear of exactly *what* to expect the sign of the coefficient to be. At the time of writing this paper, no formal or published research appears to have been made on this particular subject. However, from our own experience and insight in the industry, we would be less surprised to observe a negative coefficient rather than a positive. Our reasoning being that, from industry experience, teaching a founder CEO how to maximize the product cycle of a technology company is easier than teaching a professional CEO how to find the new product cycle. The same consensus is shared with the world-renowned venture capital firm Andreesen Horowitz, who argued the exact same justification in their article "Why We Prefer Founding CEOs" (Andreesen Horowitz Website, 2010). Thus, from these arguments, we would anticipate a negative coefficient indicating agency costs associated with professional CEOs to be bigger compared to founder CEOs.

When we ran our regression model and add the dummy variable to our existing model, we obtained the following results:

SUMMARY OUTPUT - USA

USA - Regression Statistics	
Multiple R	0.80
R Square	0.64
Adjusted R Square	0.63
Standard Error	851
Observations	188

ANOVA

	df	SS	MS	F	Significance F
Regression	6	231326559.9	38554426.64	53.29131	1.76468E-37
Residual	181	130947263.5	723465.5442		
Total	187	362273823.4			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-221.8	242.6	-0.9	0.362	-700.5	257.0	-700.5	257.0
Employees	1.4	0.1	15.4	0.000	1.3	1.6	1.3	1.6
Years since founded	-88.3	29.6	-3.0	0.003	-146.8	-29.9	-146.8	-29.9
Number of deals	154.7	41.4	3.7	0.000	73.0	236.5	73.0	236.5
Total #Investors	45.0	23.1	1.9	0.053	-0.7	90.6	-0.7	90.6
US GDP Change (%)	84.0	38.9	2.2	0.032	7.2	160.8	7.2	160.8
Pro. CEO?	-111.0	136.2	-0.8	0.416	-379.7	157.6	-379.7	157.6

Table 16 - Multiple regression, step 6 – resulting in final regression model, US data (fabricated by author)

Accordingly, we can observe that professional CEOs do have a negative impact on exit valuation, initially. On average, exit valuation among technology companies appears to be -$111 million lower if the company has a professional CEO rather than a founder CEO at the time of exit.

The finding does not directly conflict with agency theory, but it is an interesting finding as it sheds new light on an otherwise uncovered area of academia (at the writing of this paper at least).

However, the parameter is not statistically significant at the 5% level (p-value of 0.416) and thus we fail to reject the hypothesis that the true population parameter might in fact be equal to zero, which would suggest that professional CEOs do not have any different impact on exit valuation compared to founder CEOs.

This is also an interesting finding in itself though, as it does not suggest that professional CEOs actually contribute *positively* to exit valuations at all when compared to founder CEOs. The only thing we can determine is that the true population parameter might in fact be equal to zero.

Additionally, we also observe that the variable "Number of total investors" has become more significant after adding the CEO-dummy variable. Although the number of total investors parameter is still slightly insignificant (p-value of 0.053), the interesting observation is that there might in fact be an interaction between the number of investors and professional vs. founder CEO, suggesting that the number of investors might affect exit valuation differently depending on whether or not a professional CEO is managing the company compared to a founding CEO.

Other variables we tested for, but decided to omit:

State-wise location specificity of geographic data (US and EU):

One could argue that there would be a significant difference in the exit valuation when comparing the exit valuation of i.e. Californian (Silicon Valley) technology startups to technology startups in other states (US). However, in our data (both US and Europe), we have not discriminated on either the state or country level. Even though one could arguably expect to observe some valid differences and findings from separating the dataset on a state level, we have not done so for the simplicity of our research. If we were to discriminate on a state level, we would have to include the same amount of dummy variables as number of observable states in our data set. Consequently, we believe this would complicate the model more than necessary, which is why we intentionally have chosen not to do so. The same goes for our regression model for the European data set where we also have chosen not to discriminate on a state/country level even though there would be some valid arguments to suggest doing so.

Recession variable

We have intentionally omitted a dummy variable testing for GDP recession periods, in order to keep a clear focus on the question at hand. Initially, we did include this variable in our model, but we concluded that the parameter created more noise than value to our model and ultimately would lead our research astray. We could have investigated further whether or not recession has a significant impact on the exit valuation, but we believe this would steer our research away from our original mission. By including the recession parameter as a dummy variable, we would be able to pave the way for additional research, which could test if there is any significant difference on exit valuation during annual quarters of recession, something that arguably would make a valid point since our data includes recessionary GDP data in the

wake of the 2007-2009 financial crisis. However, since we only aim to investigate the difference in agency costs between professional and founder CEOs, we have intentionally omitted this variable from our model in order to keep a clear and sharp focus. The subject is nonetheless interesting and deserves its own research paper.

CEO control and ownership of shares

One could argue that it would be relevant to include a variable that represents the ownership share of the managing CEO for each observation. Initially, we wished to include this variable in our model as it arguably could explain some of the possible differences between agency costs of professional CEOs and founder CEOs. All else equal, one would believe that a CEO with a higher share ownership of the company he/she is managing would have an increased incentive to improve the exit valuation. However, it has simply not been possible to obtain this data across enough observations for it to make sense to include. Additionally, we will touch upon this particular subject in the discussion section of our paper, as it definitely has an important say in our research and findings. The same goes for deal terms and their possible effect on CEO incentive and exit valuation, which we too will embrace in our discussion section.

Summary of US regression analysis

In this section, we have crafted our multiple regression model for our US observations (n=188) and argued for our choice of variables and parameters. Furthermore, the section has been communicated in a stepwise manner in order for the reader to optimally comprehend and understand our underlying decisions and argumentation behind our analysis and final model. Lastly, we have uncovered some interesting findings in relation to agency costs between professional CEOs and founder CEOs in terms of exit valuation of US technology companies.

This rounds off our analysis section, and we will now put our regression model to the test to evaluate whether or not it can be considered statistically valid.

Putting Our Model to the Test

In this section, we will put our overall regression model to the test. Our model has enabled us to uncover some interesting findings in our quest to investigate the potential difference in

agency costs between professional and founder CEOs. However, at this point, we are uncertain whether or not our model actually lives up to the attributes of a "good model". Thus, we will take our model through an exhaustive testing in order to evaluate its overall solidity and scientific integrity.

Attributes of a good model

As reflective and critical academics, we adhere to the ethical code of sound scientific and empirical integrity. As stated in our introduction to this paper, our research methodology is based on a neo-positivist approach characterized by an epistemological paradigm. It has been our goal to remain as objective as possible in relation to our observations and the empirical research undertaken in this paper. Consequently, the model we have crafted in our analysis should reflect this intention, too. However, whether our chosen model is "good", or appropriate or the "right" model for our research cannot be determined without some criteria of reference. How can we determine whether or not our chosen model is in fact the optimal choice for our research? How can we control whether or not our model is not flawed in any way? In order to answer these questions, we have decided upon a set of guidelines and reference criteria set forth by noted econometrician A. C. Harvey, who lists the criteria below by which we can judge and evaluate the solidity of our model (Hobdari, 2014).

The attributes of a good model:

- **Parsimony**: Harvey argues: "*a model can never completely capture the reality. Some abstraction or simplification is inevitable in any model building. The principle of parsimony suggests that a model be kept as simple as possible*" (Hobdari, 2014). The principle of parsimony is exactly why we have chosen to omit the afore-mentioned certain variables from our model. It was our evaluation that these variables simply added unnecessary complexity to our model without adding noteworthy usefulness in answering our research question. We believe our model thus fulfills the criteria of parsimony.

- **Identifiability**: According to Harvey, this ultimately means that, for a given set of data, the estimated parameters must have unique values or, what amounts to the same thing, only one estimate per parameter. In our model, this has been adequately fulfilled.

- **Goodness of Fit**: Harvey argues, that *"since the basic thrust of a regression analysis is to explain as much of the variation in the dependent variable as possible by explanatory variables included in the model, a model is judged to be 'good' if this explanation, as measured, say, by the Adjusted R^2 is a high as possible"*. We have strived to apply the Adjusted R^2 as a Goodness of Fit measure for our model throughout our analysis. In the subsequent section we will touch further upon our justification of why the Adjusted R^2 has been our chosen Goodness of Fit measure.

- **Theoretical Consistency**: *"No matter how high the goodness of fit measures, a model may not be judged to be good if one or more coefficients have the wrong signs."* Harvey argues. In short, Harvey highlights the importance of having some theoretical underpinning when constructing any model since "measuring without theory" often leads to very disappointing results. Taking this into consideration when evaluating our model at this initial stage, we will argue that we have maintained a theoretical consistency throughout our reasoning and justification when it comes to our chosen, and omitted, variables. Most importantly, in our model, the finding of a negative coefficient associated with the dummy variable for professional CEOs is in line with our anticipated expectation based on 1) our own industry experience, 2) extracted knowledge from a thorough study of Agency Theory and 3) economic intuition, which is also shared by Andreesen Horowitz. We therefore evaluate our model to fulfill the attribute of theoretical consistency at this stage.

- **Predictive Power**: Harvey finalizes his argumentation by paraphrasing Nobel laureate Milton Friedman: *"The only relevant test of the validity of a hypothesis (model) is comparison of its prediction with experience".* Since our model is not intentionally crafted with the purpose of predicting exit valuations of technology companies, it can be discussed whether or not our model actually fulfills the attribute of Predictive Power. However, since our model aims at uncovering new research on the subject of differences in agency costs between professional CEOs and founder CEOs, we will argue that our model as a matter of fact does fulfill the attribute of Predictive Power since our findings of a negative coefficient for professional CEOs does in fact align with industry experience and anticipation.

At this stage, we can now confirm that our model does in fact live up to the stated attributes of a "good model". However, as we mentioned, we will briefly go into further explanation of our choice of Adjusted R^2 as our preferred Goodness-of-Fit measure.

Paying attention to the R^2

Both the R^2 and the adjusted R^2 value served as a "goodness-of-fit" measure in our model. They measure the percentage of variation in the dependent variable (Exit valuation) explained by the combined set of explanatory variables (Employees, Year since founded, Number of investment rounds, Number of total investors, US GDP Quarterly Change (%) and professional vs. founder CEO).

Although the R^2 value is one of the most frequently quoted values from a regression analysis, it does have one major drawback: R^2 will always increase when extra explanatory valuables are added to the equation. Consequently, this can lead to the unfortunate situation where you keep adding variables to an equation, just to inflate the R^2 value, even though some of the variables have no conceptual relationship to the dependent variable, in this case, exit valuation.

As the name suggests, multiple regression deals with multiple explanatory variables. However, to avoid adding extra variables that do not really belong in the model, we use the Adjusted R^2 value. Even though the Adjusted R^2 value has no direct interpretation as *"*percentage of variation explained*"*, it *can* decrease when unnecessary explanatory variables are added to a model, which we also observe during our stepwise regression (unlike the regular R^2 value, which keeps increasing).

Therefore, the Adjusted R^2 serves as an index one should monitor when fitting a multiple regression model. If one adds variables and the Adjusted R^2 decreases, then the extra variables are essentially not pulling their weight and should probably be omitted from the model.

Thus, when dealing with multiple regression, we will argue it to be more accurate to use the Adjusted R^2 compared to the regular R^2. The Adjusted R^2 is simply a measure that adjusts R^2

for the number of explanatory variables in the model. Thus, it is used primarily to monitor whether extra explanatory variables really belong in the equation.

F-Test of Overall Significance

In order to evaluate whether the *b* terms in our respective model are statistically different from zero, we conducted an F-test to test the hypothesis that H_0: $\beta_1 = \beta_2 = \beta_3 = \beta_4 \ldots \beta_i = 0$. Since the F-statistic(s) far exceeded the respective critical value(s), we can conclude that our model confidently rejects H_0 at the 5% significance level, that all partial slopes are simultaneously equal to zero. That is, we can conclude that at least one of the b terms is not zero, thus suggesting that there is a significant relationship between exit valuation and the explanatory variables in our model (H_1: $\beta_1 = \beta_2 = \beta_3 = \beta_4 \ldots \beta_i \neq 0$).

	Explanatory variables	Observations	v1	v2	Critical Value	F-ratio	Conclusion
US Regression	6	188	6	181	2.149	53.291	*Reject H0*

Table 17- Test of overall significance: F- test of US regression model (fabricated by author)

Thus, we confidently reject the hypothesis that our chosen variables have zero effect on exit valuation.

Gauss-Markov Theorem

In order to further evaluate the overall fit and solidity of our model, we conducted a thorough analysis and proof-testing of our model to evaluate whether or not it aligns with the conditions and factors that contribute to the respective effectiveness of the multiple regression methodology. In order to do so, we adopted the Gauss-Markov Theorem (GMT), which focuses on how to test whether or not our multiple regression model satisfies the requirements for being a Best Linear Unbiased Estimator (BLUE).

We do expect the reader to have a rudimentary knowledge regarding ordinary least squares (OLS) multiple regression and its underlying composition. The Gauss-Markov Theorem states the following five multiple regression assumptions: (Woolridge, 2009):

Assumption MLR1: Linear in Parameters

The model in the population can be written as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots \beta_k X_k + u$$

Where β_0, β_1, ... β_k are the unknown parameters (coefficients) of interest and u is an unobservable random error or disturbance term.

According to the GMT, this assumption formally states the population model to allow for possibility that we might estimate a model that differs from $Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots \beta_k X_k + u$. The key feature however is that the model is linear in the parameters ($\beta_0, \beta_1, \dots \beta_k$). We can thus conclude that our model does in fact fulfill MLR1, as it is indeed linear in the parameters.

Assumption MLR2: Random Sampling

In order to fulfill the criteria of being a Best Linear Unbiased Estimator (BLUE), our applied data must also originate from a random sample of n observations $\{(X_{i1}, X_{i2}, \dots, X_{ik}, Y_i) : i = 1, 2, \dots n\}$, following the population model in Assumption MLR1 (Woolridge, 2009). Since our data set consists of randomly available observations (n=188 for US data set), we will argue that our data does in fact fall within the category of random sampling.

Assumption MLR3: No Perfect Collinearity

In the sample (and therefore in the population), none of the independent variables is constant, and there is no *exact linear relationship* among the independent variables in our fitted model. This assumption is highly important since perfect collinearity will result in parameters not being able to be estimated via OLS. However, it is important to note that MLR3 *does* allow independent variables to be correlated; they just cannot be *perfectly* correlated.

Test of our model: Test for multicollinearity

Multicollinearity, in statistics, is the occurrence of several independent variables in a multiple regression model closely correlated to one another. Multicollinearity can cause strange results when attempting to study how well individual independent variables contribute to an understanding of the dependent variable. In general, multicollinearity can cause wide confidence intervals and odd p-values for independent variables, and it is thus

crucial to conduct a thorough analysis before making any finalizing conclusions from our model.

Correlation of variables:

	Exit valuation	*Employees*	*Years since founded*	*Number of deals*	*Total #Investors*	*US GDP Change (%)*	*Pro. CEO?*
Exit valuation	1.000						
Employees	0.764	1.000					
Years since founded	0.126	0.247	1.000				
Number of deals	0.379	0.319	0.439	1.000			
Total #Investors	0.118	0.037	0.069	0.127	1.000		
US GDP Change (%)	0.107	-0.001	-0.012	0.054	-0.069	1.000	
Pro. CEO?	-0.074	-0.076	-0.182	-0.049	0.117	-0.099	1.000

Table 18- Correlation matrix of variables in US regression model (fabricated by author)

Table 18 represents the correlations between the explanatory variables. This table can help us to identify possible multicollinearity issues between the included explanatory variables in our model. The correlation coefficients between the different independent variables must be low in order to avoid multicollinearity.

In our setting, there tends to be some correlation among several of our explanatory variables – most notably the somewhat strong correlation between "Years since founded" and "Number of deals", which equals 0.439.

In general, we can observe that "Number of deals" tends to be highly correlated with several of our other independent variables, suggesting the probability of multicollinearity to be present (i.e. when measuring "Number of deals" against "Employees" and "Years since founded", we can observe correlation coefficients of 0.310 and 0.439 respectively). If multicollinearity was present in the dataset, we could make the decision to remove one or several independent variables based on the correlations. Thus, in order to further investigate the possible presence of multicollinearity, we have carried out additional collinearity diagnostics by using the statistical software package, SAS.

Collinearity Diagnostics:

In order to conduct further diagnostics on whether multicollinearity is present among our explanatory variables, we have imported and analyzed our dataset in the statistical software package SAS. When an explanatory variable is nearly a linear combination of other

explanatory variables in our model, the coefficient estimates from the regression model can be unstable, resulting in high standard errors and an overall lack in empirical integrity.

The collinearity diagnostics table (Table 19) from SAS enables us to identify these potential multicollinearity issues in our model. A reasonable multicollinearity problem may arise when the Condition Index (highlighted in yellow) of the final model exceeds the value of 30. In general, we know that the higher the Condition Index, the greater the multicollinearity issue is; in our model and if we observe a Condition Index value greater than 30, then we ultimately should be reviewing the reliability of our independent variables and our overall model.

Collinearity Diagnostics									
			Proportion of Variation						
Number	Eigenvalue	Condition Index	Intercept	Employees	Years since founded	Number of deals	Total #Investors	US GDP Change (%)	Pro. CEO?
1	5.070	1.000	0.002	0.008	0.004	0.004	0.010	0.010	0.008
2	0.801	2.516	0.001	0.811	0.000	0.000	0.008	0.009	0.022
3	0.428	3.442	0.000	0.004	0.001	0.000	0.192	0.541	0.107
4	0.312	4.033	0.000	0.029	0.005	0.003	0.459	0.000	0.561
5	0.251	4.498	0.009	0.112	0.107	0.094	0.306	0.324	0.067
6	0.090	7.517	0.054	0.023	0.341	0.893	0.000	0.003	0.003
7	0.048	10.237	0.933	0.014	0.542	0.005	0.024	0.114	0.230

Table 19 - SAS Output showing collinearity diagnostics of US regression model (fabricated by author)

From our SAS output in Table 19 we can observe that the Condition Index of our final model is 10.237.

Thus, we can conclude that there is substantial evidence against multicollinearity issues in this case and our model does indeed satisfy MLR3 of no perfect collinearity among the independent variables.

Assumption MLR4: Zero Conditional Mean

This assumption dictates that the error *u* has an expected value of 0 given any values of the explanatory variables (Woolridge, 2009).

In other words:

$$E(u|x_1, x_2, \ldots x_k) = 0$$

One typical way that MLR4 can fail is if the functional relationship between the explained variable (in this case Exit Valuation) and the explanatory variables is misspecified in the overall model $Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots \beta_k X_k + u$. A classic example would be if we had included a variable in nominal form, which should have been specified in some other functional form such as i.e. a quadratic or logarithmic functional form. Omitting an important factor that is correlated with any of the $x_1, x_2, \ldots x_k$ causes assumption MLR4 to fail (Woolridge, 2009).

Thus, we have conducted an in-depth residual analysis of our data and model in order to evaluate whether or not our fitted model and data shows signs of violating MLR4.

Residual analysis

In order to evaluate the integrity and academic merit of our proposed model we will analyze the residual associated with our data sample regression results.

We aim to deliver a regression model that does not violate any of the BLUE assumptions (Best Linear Unbiased Estimator). Consequently, we will start by analyzing the residuals from our model.

A Comment on the Central Limit Theorem

We know that when the errors are normally distributed, the sampling distribution of the OLS estimator is also normal. What if the errors are not normally distributed?

As long as the errors are "well behaved" (the classical assumptions are more than enough to guarantee this), then we can rely on the Central Limit Theorem again:

As the sample size gets "big" (technically, as $n \to \infty$), the sampling distribution of the least squares estimator is well approximated by a normal distribution.

So even if the errors are not normal, the sampling distribution of the beta-hats is approximately normal in large samples. We can use this result to do hypothesis tests even when the errors are non-normal.

Residual distribution

As stated from the Gauss-Markov Theorem, we need to evaluate whether our residuals are normally distributed in order to avoid violation of the 4th Gauss-Markov assumption ($\varepsilon_i \sim N(0,\sigma^2)$ Our fourth assumption is that the error term has a normal distribution with mean zero and variance σ^2.

From our SAS output, we can visually analyze the distribution of our residuals.

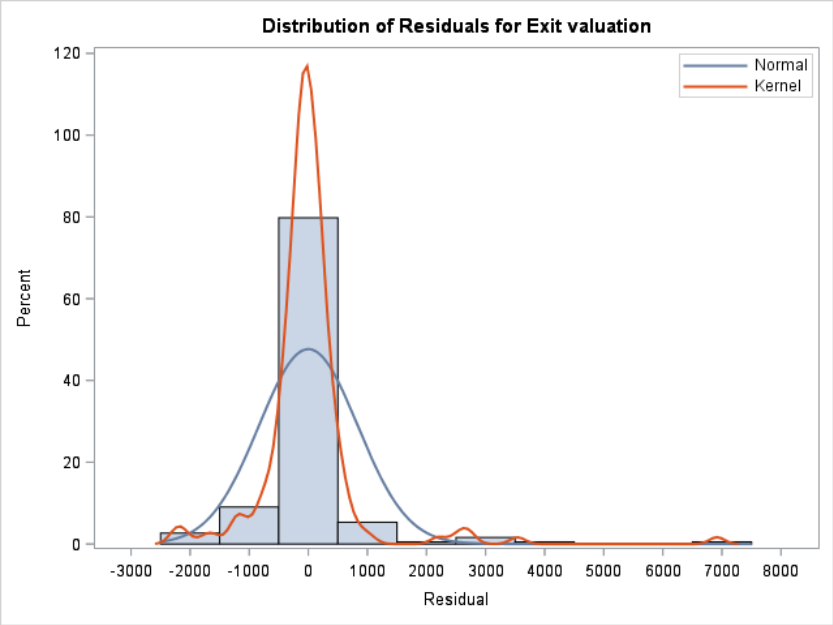


Figure 12- SAS Output: Residual distribution for US regression model (fabricated by author)

Figure 12 could answer the question of whether the error term ε is normally distributed with a mean of 0. Figure 12 is a histogram of the residuals from our linear regression model. By comparing the empirical, Kernel distribution (red line), with the theoretical normal distribution, we can verify whether the residuals of our model are normally distributed or not. When the Kernel distribution follows the theoretical normal distribution, there is an indication that the residuals are normally distributed. In our case, the latter appears to be true. From our SAS output we can observe a strong indication that our residuals appear to be normally distributed with a mean of 0, thus fulfilling the 4th assumption of the Gauss-Markov Theorem.

Residuals – Outliers:

We would like to give some attention to the analysis of potential outliers in our dataset. It is evident that our dataset might contain a handful of outliers, which can be easily visualized from the residual charts below.

Outliers – R-Student Plot

The Rstudent is the externally studentized residual from our model. This is a studentized residual in which the error variance for the i^{th} observation is estimated as the error variance without this i^{th} observation, where the studentized residual is defined as the division of the residual by an estimate of its standard deviation. (Coussement, Demoulin, & Charry, 2011, p. 237).

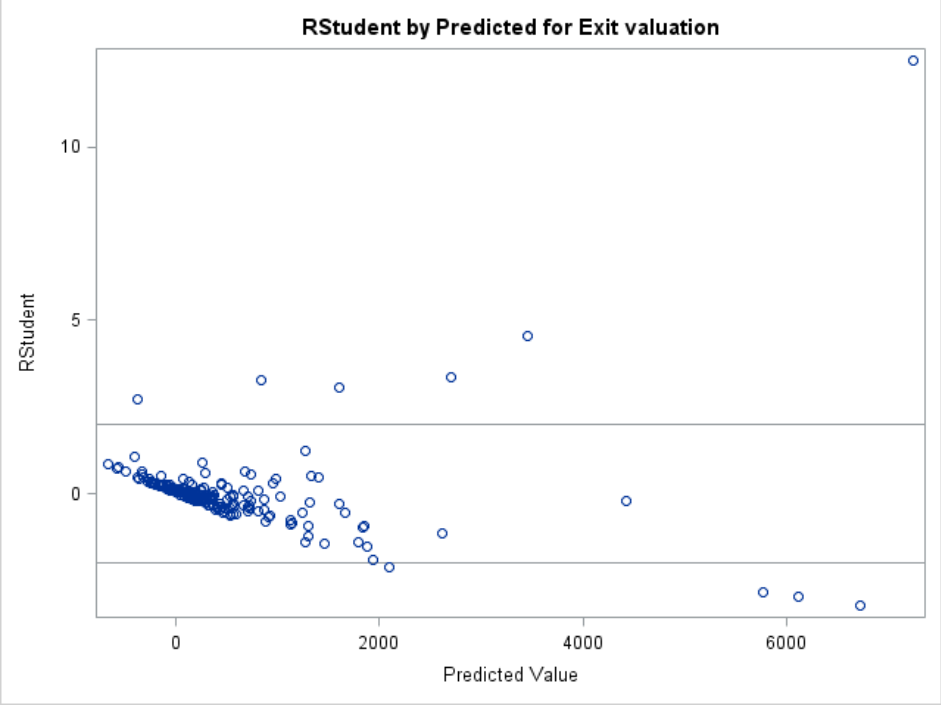


Figure 13- SAS Output: R-Student Residual plot for US regression model (fabricated by author)

The above diagram in Figure 13 from our SAS output delivers a visual representation of the predicted value of an observation versus its Rstudent. One should start worrying about an observation when the absolute value of the studentized residual exceeds the value of 2. When studentized residuals exceed +/- 2.5, one should be cautious about these observations because they could indicate potential outliers (Coussement, Demoulin, & Charry, 2011, p. 237). In our current situation, some observations fall below -2 and above +2. Some of our

observations fall significantly above +2.5. These observations could be considered as potential outliers, and we have thus asked ourselves whether or not these should be removed from our dataset.

The anatomy of exit valuations among US-based technology startups can be characterized as being of an extraordinary volatile nature, which is witnessed in our dataset where we have exit valuations ranging between $9 million and $1.4 billion, with the average exit valuation being $556 million. This underpins just how vibrant the technology space is, characterized by excessive growth found within the technology sector during the past ten years. Consequently, we believe that the current state of our sample data optimally reflects the true population. There will arguably be some significant outliers within our chosen sector focus, but since that is the natural state of the technology space, we accept the outliers in our dataset and have thus chosen not to remove them as we would find it to be an unnecessary, and dishonest, manipulation of our data.

Residuals – outliers and normal distribution

We stated earlier that our residuals were normally distributed with a mean of 0 ($N(0,\sigma^2)$) in order not to violate the MLR4 assumption of the Gauss-Markov Theorem. Since we can now conclude that our dataset potentially contains some significant outliers we decided to do another in-depth analysis of the distribution of the residuals in our model.

In order to truly evaluate whether or not the outliers distort the distribution of our residuals, we have conducted a Q-Q plot from SAS. The Q-Q plot is useful for testing the normality of residuals and for identifying potential outliers. The Q-Q plot shows the quantiles of the theoretical normal distribution against quantiles of the empirical distribution of the residuals (Coussement, Demoulin, & Charry, 2011, pp. 241-242).

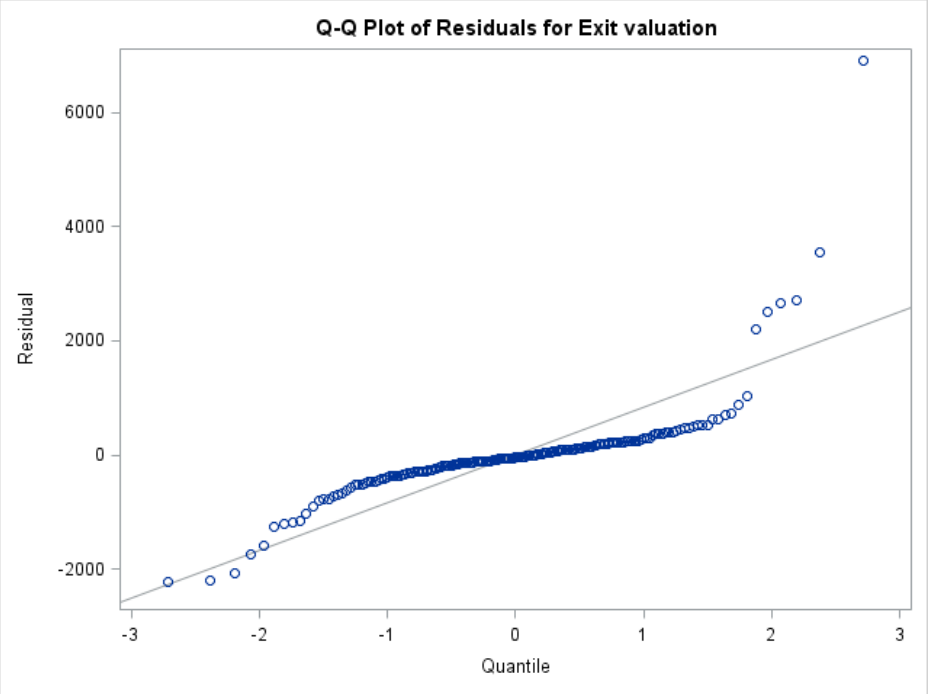


Figure 14 - SAS Output: Q-Q Plot of Residuals for US regression model (fabricated by author)

If the scatter follows the 45-degree line, there is an indication that the distribution of the residuals is normal (Coussement, Demoulin, & Charry, 2011, p. 241). In our current sample data, the Q-Q plot shows that the residuals are approximately normally distributed since the scatter plot arguably follows the 45-degree line. However, it can be discussed whether or not alignment between the 45-degree line and the scatter plot is truly overlapping. Granted, there is evidence against our assumption that the residuals truly are normally distributed – especially considering the handful of outliers visible in the plot (especially in the top right corner). If particular observations show extremely large positive or negative values, it could indicate that these observations are outliers. In sum, outliers are considered as points that are far away from the overall pattern of points (Coussement, Demoulin, & Charry, 2011, p. 241). In our situation, a handful of observations could be considered outliers, which we accept.

As argued in the above section, the US technology startup space is known for its flamboyant and volatile nature in terms of valuations, so again we accept the concern that our dataset does in fact contain outliers, which may have a distorting effect on the distribution of our residuals. However, we do not consider the impact from said outliers to truly distort our residuals in such a way that they can no longer be characterized as normally distributed.

Assumption MLR5: Homoscedasticity

The final GMT assumption states that the error *u* has the same variance (homoscedastic) given any values of the independent variables (Woolridge, 2009).

$$\text{In other words: } \mathrm{Var}(u|x_1, \ldots x_k) = \sigma^2.$$

Assumption MLR5 ultimately dictates that the variance in the error term *u* that is conditional on the independent variables is constant (the same) for all combinations of outcomes of the independent variables. In the case of violation of this assumption, the model will exhibit heteroscedasticity.

Analysis of homoscedasticity and autocorrelation

Autocorrelation is usually a problem when one is analyzing error terms. When building a model, we expect that the error term will have no significant autocorrelation. It is simple to understand: If the error term still has autocorrelations, it means that we are likely omitting some information that should be introduced in our regression model.

Using the statistical software SAS for our analysis, we have run our regression model again, producing the relevant residual plot. From a visual perspective, if autocorrelation is present in our model, then we should be able to identify a pattern in our residuals.

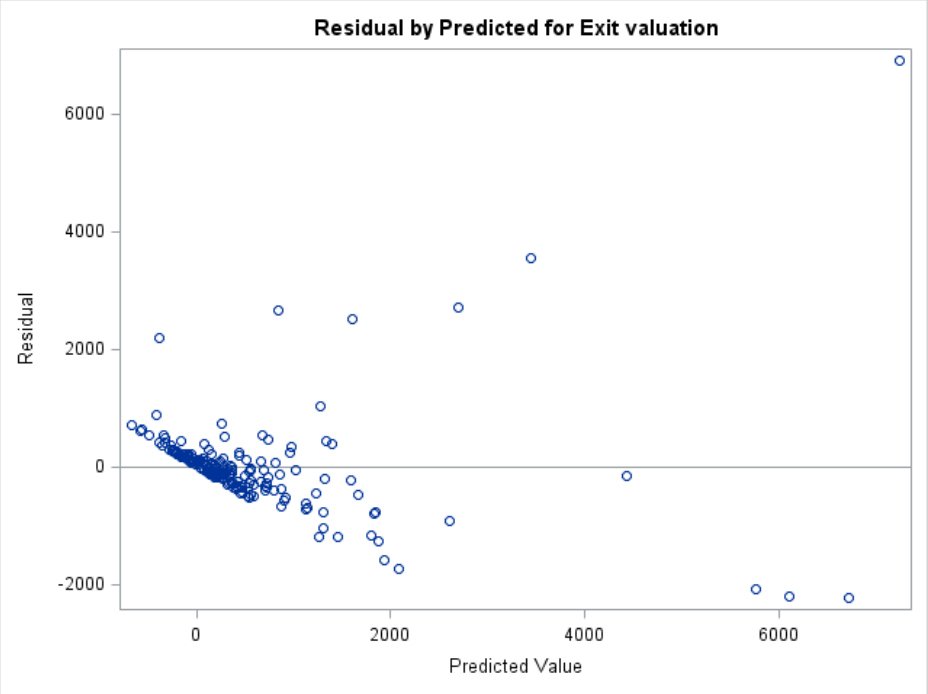


Figure 15- SAS Output: Residual plot to test for homoscedasticity and autocorrelation (fabricated by author)

It's arguable whether or not a pattern exists in our residuals plot. One could argue that a downward linear trend appears to a certain extent. This could be a pure coincidence or it could be indication of a wrongly omitted variable. Consequently, we cannot purely rely on our visualized residual analysis and will thus turn to two additional in-depth diagnostics of our residual analysis:

a. **Homoscedasticity Testing – First and Second Moment Specification**

b. **The Durbin-Watson test - in order to better evaluate whether or not our model is victim to autocorrelation.**

Homoscedasticity test: First and Second Moment Specification

We aim to develop a regression model of high academic and empirical integrity and merit. Consequently, in order to not violate any of the BLUE assumptions, we will now be testing whether or not homoscedasticity is prevailing among our residuals. Any statistical evidence of homoscedasticity will consequently suggest that our model contains heteroscedasticity and thus violates the BLUE assumptions.

The hypotheses that we are testing are formulated as follows:

H_0: There is evidence of homoscedasticity in our model

H_1: There is evidence of heteroscedasticity in our model

If it should be the case that our model proves evidence of heteroscedasticity, we will then fail to reject H_1 at a 0.05 significance level, and our model is thus violating the BLUE assumption of no heteroscedasticity.

Test of First and Second Moment Specification		
DF	Chi-Square	Pr > ChiSq
26	26.59	0.4309

Table 20- SAS Output: Homoscedasticity test: First and Second Moment Specification for US regression model (fabricated by author)

From our output in Table 20, we can observe that this is not the case. The p-value of our heteroscedasticity test is 0.4309 and is thus larger than 0.05. Consequently, this means that we can reject the H_1 hypothesis concluding that there is homoscedasticity in the error terms of our model and our model does not violate the BLUE assumption of homoscedasticity.

Durbin-Watson test: Autocorrelation.

The Durbin-Watson test will provide us with a more reliable quantitative evaluation of whether or not autocorrelation is present in our model.

In brief, the Durbin-Watson statistic is always between the values 0 and 4 where a value of 2 means that there is no autocorrelation in the sample data. Additionally, Durbin-Watson values approaching 0 suggests a positive correlation among our residuals. On the contrary, a Durbin-Watson statistic close to 4 indicates a negative correlation among our residuals. Thus,if we wish to observe evidence against autocorrelation in our model, we wish to gain a Durbin-Watson statistic as close to 2.0 as possible.

Again, from using SAS to analyze our sample data, we can directly retrieve the Durbin-Watson statistic for our model.

Durbin-Watson D	1.917
Number of Observations	188
1st Order Autocorrelation	-0.006

Table 21- SAS Output: Durbin-Watson statistic for US regression model (fabricated by author)

Now, from our SAS output we can observe a Durbin-Watson statistic of 1.917. We will argue that this value is strongly converging towards the value of 2.0, which suggests that our sample data (and thus consequently our model) does *not* contain autocorrelation among our residuals – either positive or negative. This is good news as it strongly suggests that our model has not omitted any significant variables and also manages to not violate any of the BLUE assumptions (Best Linear Unbiased Estimator).

Summary of model testing

In this section, we have put our fitted model to the test in order to evaluate its empirical and academic integrity.

We have undertaken in-depth analysis of the overall model, from model specification to residual analysis and can confidently confirm that our model does indeed show a high level of academic and empirical integrity.

Additionally, we have investigated whether or not our model violates any of the assumptions stated by the Gauss-Markov Theorem (GMT) and can confirm that our model satisfies the classical assumptions MLR1-ML5 resulting in the least squares (OLS) estimator having the smallest variance of all **linear unbiased estimators** of β_j, for $j = 0,1,2,...,k$.

Conclusively, we can hereby say the least squares estimator and our fitted model are **BLUE**: the **B**est **L**inear **U**nbiased **E**stimator where "best" means most efficient.

This concludes this section in which we tested the empirical and academic integrity and validity of our model. Hopefully, by now, the reader will have gained a thorough insight into

the approach used in our analysis and methodology and how we can confidently conclude the validity of our model.

We will now compare the findings from our US data to our European data.

Analysis – US vs. European Technology Company Exits

In this section we will apply the exact same analysis approach and methodology used in our US analysis to our European data.

The aim of this section is to highlight valuable findings, which may or may not contribute to the academic research on the subject of whether or not CEO-specific agency costs in the exit valuation of technology startups tend to differ between American and European companies.

For the sake of avoiding unnecessary repetition in this paper, we have allocated the output from our stepwise regression of the European data set to Appendix 1. The approach for the analysis is identical to the approach from our US analysis, except for one minor change.

Since the European Union does not have one consistent estimator for GDP, which we used for the US data, we have instead replaced the GDP variable with the Standard & Poor's 350 European Technology Index (year 2005 = Index 100). It is our belief that this serves as a compatible proxy for the GDP variable.

Replacing GDP with S&P350 European Technology Index

When deploying the same intuition as from our American analysis, the hypothesis is that the exit valuation of technology companies throughout the European sector tends to be strongly correlated with economic prosperity.

In order to investigate this hypothesis, we started by comparing the number of exits of technology companies to the development of the SP350 European Tech Index (Google Finance, 2016).

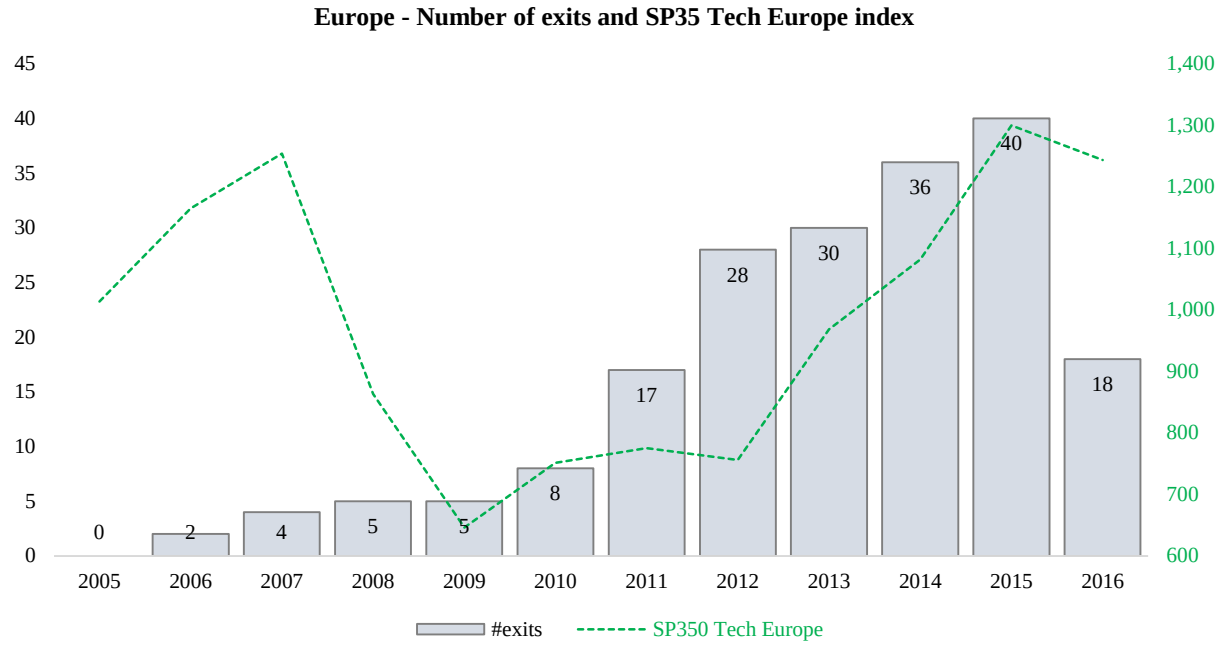


Figure 16 - Correlation between number of EU exits and S&P 350 Tech Europe Index (fabricated by author)

As can be observed in above diagram, there tends to be some correlation between number of exits and the economic prosperity of the European technology sector (correlation = 0.21).

From running the regression analysis with this proxy variable for GDP, calibrated so that year 2005 = index 100, we can obtain the final results for our European model:

SUMMARY OUTPUT - EUROPE

Europe - Regression Statistics	
Multiple R	0.71
R Square	0.51
Adjusted R Square	0.47
Standard Error	364
Observations	103

ANOVA

	df	SS	MS	F	Significance F
Regression	6	13043488.12	2173914.687	16.37172503	6.65434E-13
Residual	96	12747331.73	132784.7055		
Total	102	25790819.85			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	ower 95.0%	pper 95.0%
Intercept	428.5	215.3	2.0	0.049	1.0	856.0	1.0	856.0
Employees	1.2	0.1	8.8	0.000	0.9	1.5	0.9	1.5
Years since founded	0.5	17.9	0.0	0.977	-34.9	36.0	-34.9	36.0
Number of deals	19.4	74.2	0.3	0.794	-127.9	166.7	-127.9	166.7
Total #Investors	-63.3	51.1	-1.2	0.219	-164.8	38.3	-164.8	38.3
SP350 EU Tech Index 2005	-2.8	1.8	-1.6	0.111	-6.4	0.7	-6.4	0.7
Pro. CEO?	-91.2	80.9	-1.1	0.262	-251.8	69.4	-251.8	69.4

Figure 17- Multiple Regression, final model - Europe (fabricated by author)

At a first glance at Figure 17, it's obvious that the European model proposes several implications. Firstly, we can observe that the vast majority of our included variables are highly insignificant with p-values well above 0.05. Additionally, we can observe a relatively low Adjusted R^2 of only 0.47.

Lastly, the economic interpretation of the SP350 EU Tech Index 2005 coefficient of -2.8 does not make much economic sense. Why would economic prosperity have a negative effect on exit valuation?

It can be argued that this model does not fulfill many of the criteria that constitute a solid model of high academic and empirical merit and integrity. Maybe our model contains specification errors and should contain other variables than those used in the US model. The fact that our dataset consists of 103 observations (n=103) however arguably rejects the argumentation of an inadequate sample size.

However, since we aim to compare the coefficients, which can help us uncover relevant findings in potential differences between agency costs of US and European CEOs, we are

mainly concerned about the coefficient attached to the dummy variable (Pro.CEO). Thus, for now we will maintain the current functional form of our model in order to sustain a uniform platform from which we can compare our US findings to our European findings.

Comparison of two final models: US vs. EU

As our research is mainly concerned with the potential difference in agency costs associated with professional CEOs and founder CEOs in technology companies by the time of exit, we will now make a comparison of the findings from our US model and European model.

Thus, for simplicity, the reader can find both models depicted side-by-side, below.

United States:

SUMMARY OUTPUT - USA

USA - Regression Statistics	
Multiple R	0.80
R Square	0.64
Adjusted R Square	0.63
Standard Error	851
Observations	188

ANOVA

	df	SS	MS	F	Significance F
Regression	6	231326559.9	38554426.64	53.29131	1.76468E-37
Residual	181	130947263.5	723465.5442		
Total	187	362273823.4			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-221.8	242.6	-0.9	0.362	-700.5	257.0	-700.5	257.0
Employees	1.4	0.1	15.4	0.000	1.3	1.6	1.3	1.6
Years since founded	-88.3	29.6	-3.0	0.003	-146.8	-29.9	-146.8	-29.9
Number of deals	154.7	41.4	3.7	0.000	73.0	236.5	73.0	236.5
Total #Investors	45.0	23.1	1.9	0.053	-0.7	90.6	-0.7	90.6
US GDP Change (%)	84.0	38.9	2.2	0.032	7.2	160.8	7.2	160.8
Pro. CEO?	-111.0	136.2	-0.8	0.416	-379.7	157.6	-379.7	157.6

Figure 18- Final Regression Model, US (fabricated by author)

Europe:

SUMMARY OUTPUT - EUROPE

Europe - Regression Statistics	
Multiple R	0.71
R Square	0.51
Adjusted R Square	0.47
Standard Error	364
Observations	103

ANOVA

	df	SS	MS	F	Significance F
Regression	6	13043488.12	2173914.687	16.37172503	6.65434E-13
Residual	96	12747331.73	132784.7055		
Total	102	25790819.85			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	ower 95.0%	pper 95.0%
Intercept	428.5	215.3	2.0	0.049	1.0	856.0	1.0	856.0
Employees	1.2	0.1	8.8	0.000	0.9	1.5	0.9	1.5
Years since founded	0.5	17.9	0.0	0.977	-34.9	36.0	-34.9	36.0
Number of deals	19.4	74.2	0.3	0.794	-127.9	166.7	-127.9	166.7
Total #Investors	-63.3	51.1	-1.2	0.219	-164.8	38.3	-164.8	38.3
SP350 EU Tech. Index 2011	-2.8	1.8	-1.6	0.111	-6.4	0.7	-6.4	0.7
Pro. CEO?	-91.2	80.9	-1.1	0.262	-251.8	69.4	-251.8	69.4

Figure 19- Final Regression Model, Europe (fabricated by author)

Overview of F-tests for both models:

	Explanatory variables	Observations	v1	v2	Critical Value	F-ratio	Conclusion
US Regression	6	188	6	181	2.149	51.240	*Reject H0*
EU Regression	6	103	6	96	2.195	15.560	*Reject H0*

Table 22 - Overview of F-test for both US and European regression model (fabricated by author)

Since the F-statistic(s) far exceed the respective critical value(s) for both our models, we can conclude that our models confidently reject H_0 at the 5% significance level and that all partial slopes are simultaneously equal to 0. That is, we can conclude that at least one of the b terms is not 0, thus suggesting that there is a significant relationship between exit valuation and the explanatory variables in both our models (H_1: $\beta_1 = \beta_2 = \beta_3 = \beta_4 \ldots \beta_i \neq 0$).

Despite the fact, that the EU variable is insignificant (p-value > 0.05), the coefficient shows the same finding as what we observed from our US model, namely a negative coefficient, which in this case carries a value of -91.2.

This value is not that different from our finding in the US model where the coefficient was -111.0. Thus, if we assume that our estimates are to some extent reliable, we can conclude that there tends to be a uniform characteristic in the nature of agency costs between professional CEOs and founder CEOs in both the US and Europe.

Ultimately, the finding of a consistent negative coefficient in both the US and European model suggests that agency costs associated with professional CEOs are, on average, bigger than those associated with a founder CEO uniformly across the American and European technology startup sector.

Now, this lays a solid foundation for discussion. For instance, why is there a difference in the coefficient between the US findings and the European findings? If we again assume that our estimates are in fact trustworthy, it's arguable whether the difference in agency costs (coefficient) between professional CEOs in the US and Europe can actually be explained by cultural differences. It is almost common knowledge that the American technology scene manages to spawn more "billion-dollar unicorns" compared to the European technology scene. This could ultimately boil down to the fact that the entrepreneurial spirit and mentality characterizing American technology startups are vastly more aggressive and liberal compared to that of European startups. If we follow this train of thought, it could translate into the fact that the mentality, culture and business acumen of European founder CEOs is less different from professional CEOs when compared to their American counterparties.

This is just one point of discussion on this subject. We will touch further upon this discussion in a later section of the paper.

This concludes the comparison of our American and European models. We will now turn the attention to our analysis of Tobin's Q as the dependent variable in our model, rather than exit valuation.

US – Tobin's Q

Aim

The aim of this second analysis is to assess whether defining value creation as Tobin's Q will have any impact on which parameters are important. Analogous to the previous section, we will work our way from the top and then trickle down.

Overall summary of companies

Of the previously defined sample group firms, 42 were publicly listed companies, which would give access to their annual accounts. However, due to inaccuracies of data or incompleteness, we had to delete some observations. We also cleansed the data for extreme outliers. This left 28 firms. Of these, 20 (71%) had a professional CEO at the time of exit, while the remaining 8 (29%) had a founder CEO at the time of exit.

By far, the biggest industry group was again software. Out of the 28 firms observed, 18 (64%) of the firms classified themselves as software companies. Additionally, 3 (11%) classified themselves as a commercial service firm, and the rest (25%) as communications and networking companies and service firms.

It is our belief that these data adequately fulfill the parameters of our research. We believe our assumptions and hypotheses outlined later on to be fair and fully aligned with the purpose of our thesis when applied to this data. We do, however, also recognize that our sample here is extremely small, although it is fair to say that it comprises a large part of the actual population.

Hypothesis 1: Tech firms with a founder CEO will have more valuable exits than those with a professional CEO

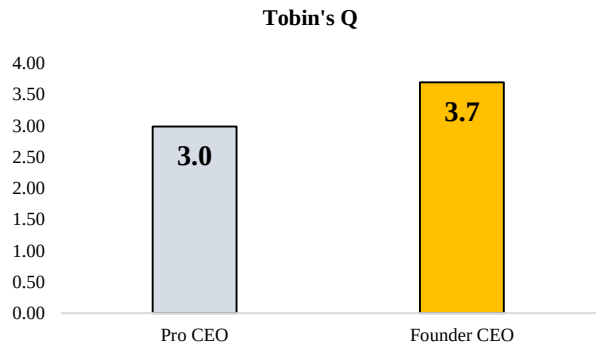


Figure 20- Overview of avg. Tobin's Q coefficients from our US sample data, divided into professional CEOs and founder CEOs (fabricated by author)

In our case, the founder CEOs have delivered slightly more value in terms of the Tobin's Q than professional CEOs (Figure 20). This finding aligns well with agency cost theory and our previous findings from the analysis with the multiple regression analysis and exit valuation as dependent variable.

Reasons behind this finding can be diverse. Some practitioners (Horowitz, 2010) argue that their approach is to prefer founding CEOs over professional CEOs. Horowitz mentioned a wide range of firms in which they invested (including but not limited to Acer, Adobe, Amazon, Apple, Dell, HP, IBM, Microsoft, Oracle, Salesforce.com, Sony and SUN) where the CEO has been the founder (or driving force from very early on in the case of Intel and IBM) as well.

Horowitz argued the higher efficiency of founder CEOs to have several reasons.

Firstly, technology companies are born because there is a better way of doing something. If something subsequently can be done in a better, smarter way, the former technology will die. This realization is pivotal to the first argument of Horowitz. He argued that professional CEOs are effective at "maximizing, but not finding, product cycles" and that "founding CEOs are excellent at finding, but not maximizing, product cycles" (Horowitz, 2010). He furthermore argued, that it is less cumbersome to teach a founder to be effective at maximizing product cycles than it is to teach a professional CEO to discover new product cycles. His argument, therefore, is that founder CEOs can better understand the technology at hand, how to utilize it and can more easily be taught how to maximize its potential. One example could be Apple, which in the mid 90's brought back Steve Jobs. In the 90's it was

the dominant dogma in the PC industry to separate hardware from software. When Steve Jobs took over, he reversed that process by integrating hardware and software, while adding peripherals (iPod, iPad). As it is known, this turnaround was extremely successful and serves as an example of how founder CEOs are better acquainted with the market, the technology and how to be at the forefront.

Obviously, innovation is important in almost all industries. However, in technology the innovation moves faster than all other industries because everybody with a computer and some programming knowledge can potentially produce a "billion dollar unicorn". Therefore, it makes sense to have a founder CEO in this industry rather than a professional CEO.

However, this analysis is not enough to justify our hypothesis that founder CEOs are more effective than professional CEOs. Therefore, we have run a regression on the matter, based on the same independent variables used in our exit value regressions, the results of which are presented below, where Tobin's Q is the dependent variable instead of exit valuation. The final regression output for our Tobin's Q regression model, is depicted in Table 23 below:

SUMMARY OUTPUT - TOBIN'S Q, US

Regression Statistics	
Multiple R	0.623
R Square	0.388
Adjusted R Square	0.131
Standard Error	1.739
Observations	28

ANOVA

	df	SS	MS	F	Significance F
Regression	8	36.4676	4.558449665	1.507	0.2196
Residual	19	57.45823	3.024117572		
Total	27	93.92583			

	Coefficients	ndard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	27.961214	18.094	1.545	0.139	-9.91	65.83	-9.91	65.83
Revenue/assets	0.734627	1.078	0.681	0.504	-1.52	2.99	-1.52	2.99
Cost/Sales ratio	0.966939	0.737	1.312	0.205	-0.58	2.51	-0.58	2.51
No. Employees	0.000113	0.000	0.293	0.773	0.00	0.00	0.00	0.00
Years since founding	0.860057	0.300	2.869	0.010	0.23	1.49	0.23	1.49
Investment rounds	0.021127	0.243	0.087	0.932	-0.49	0.53	-0.49	0.53
Total number of investors	-0.068769	0.167	-0.412	0.685	-0.42	0.28	-0.42	0.28
US GDP	-0.000002	0.000	-1.718	0.102	0.00	0.00	0.00	0.00
Pro CEO?	-0.445301	0.748	-0.595	0.559	-2.01	1.12	-2.01	1.12

Table 23- Tobin's Q, final regression model, US data (fabricated by author)

Sub-Hypothesis 1: Number of employees affects tech startup exit valuation

Our second hypothesis states that the more employees a startup has, the more value it creates. This comes from the notion that for technology startups, its employees are most likely high-value in terms of education or self-taught programming experience. We would therefore expect to see some coherency between the value created and the number of employees. One might, however, imagine that the marginal value of an employee is a reducing factor. Facing this fact, companies with a high number of employees may not have the same high Tobin's Q value that smaller firms have.

This factor has a variety of interpretations in respect to Tobin's Q. If the coefficient is larger than 0, it indicates that the firms of this sample can increase their market value by hiring more employees. If the coefficient is smaller than 0, it indicates the firm has been over-hiring and is destroying value. If the coefficient is 0, the firm has the right amount of employees.

As can be observed from Table 23, however, the number of employees does not statistically have an effect on the Tobin's Q value. This contradicts the analysis we made in the first part, focusing purely on exit values. One might say that the correlation between exit value and number of employees makes sense, since a company with many employees is larger than a firm with fewer employees, and therefore commands a higher exit value. For the value creation in terms of maximizing the market value to asset ratio however, number of employees does not seem to have any impact. This indicates that firms are adept at hiring the exact number of employees needed to maximize value.

Sub-Hypothesis 2: Years since the firm was founded affects startup exit valuation

Our expectation is that the more time passes, the more value will have been created in the startup. There is a key differentiation between this hypothesis in the current setting with Tobin's Q and the hypothesis in the previous setting, which is absolute exit value, in that "years since founded" measures how the return on assets has been shaped over a period of time.

We expected this variable to be positively correlated with Tobin's Q because of the gradual adaptation that assets go through. A company may receive some assets, but time passes before the firm knows exactly how to utilize those assets in a productive manner.

As evident from Table 23, the coefficient is indeed positive with a p-value smaller than 5%. We can therefore conclude that firms over time get better at utilizing their asset base to create market value.

Sub-Hypothesis 3: Total number of investment rounds affects startup exit valuation

As previously mentioned, the intuition behind this hypothesis is that the more rounds of financing a firm has raised, the more successful it is.

How does this relate to Tobin's Q and technology firms? Technology firms usually do not require large amounts of capital to conduct operations since the largest cost is usually wages. There are no specific entry barriers in most sectors in which technology firms operate. Hence, the number of rounds is not expected to exhibit significant impact on Tobin's Q since potential add-on investments may not be used for incremental operating assets, but rather for operating liquidity. Consider Maersk, the Danish shipping conglomerate. When they issued their first stocks in 1904, Peter Mærsk Møller went door to door in Svendborg trying to gain capital to procure a ship. In other words, the investment in Mærsk in 1904 was used specifically towards equipment to gain a return. With technology companies, this is rarely the case, and therefore the number of rounds is simply an expression of the company being unprofitable or growing at a pace that is too slow, and therefore in need of more cash.

From Table 21, it can be seen that the coefficient is not significant.

Sub-Hypothesis 4: Total number of investors funding the startup affects startup exit valuation

In concordance with the previous test on absolute exit value, we have included the total number of investors funding the firm, as an independent variable. We argued previously that the more investors involved, the bigger the faith in the company and the larger access to know-how and support. If one assumes that more investors translate into more outside equity,

we should observe a negative correlation between number of outside investors and market value if agency theory holds.

It seems however, that for the US companies in this test, the number of investors does not have any say in how well a company adds value. It seems as if more intrinsic rather than extrinsic factors contribute in creating value from the asset base.

Sub-Hypothesis 5: The state of the US GDP affects the startup exit valuation

If the GDP is high, then the market value of the assets should also be larger. A growth in GDP reflects higher economic activity, and venture capital, especially tech firms, are dependent on a favorable economic climate. This makes sense, because in an economically beneficial climate, the growth prospects that are so important to tech firms are better. Therefore, we would expect the US GDP to be one of the crucial predictors of Tobin's Q.

It, therefore, comes as a surprise that the US GDP is not significant, although we do observe some effect. Statistically, we can reject that the GDP has an influence on Tobin's Q, but the rejection is rather weak.

Sub-Hypothesis 6: Professional vs. founder CEO affects startup exit valuation

The prime piece of the puzzle is: Does leadership matter? According to Jensen & Meckling (1976), it should. A professional CEO will use the firm for his own private benefit and buy the Mercedes. A founder CEO, on the other hand, will try to maximize firm value and buy the Toyota to save money.

From Table 21, it is evident that we cannot see if professional CEOs add more or less value than founder CEOs. There can be several reasons for this. Like Horowitz (2010) argued, founder CEOs are more adept at spotting trends. Therefore, young companies may not benefit from a professional CEO whose main skill is to maximize the existing company. Speaking against this postulation is that professional CEOs can more easily be given incentives to align their actions with those of the board.

Sub-Hypothesis 7: Firms with professional CEOs have higher cost/revenue ratios

In order to prove the textbook definition of agency costs, we also wished to determine some parameters, which our data in the first part of the analysis did not highlight. Hence, with income statements readily available, we have tested whether a firm with a professional CEO has higher cost/revenue ratios than firms with a founder CEO. According to agency theory, we should expect to observe the above described. This is because a professional CEO would be more prone to use his firm's assets to his own benefit (thus a higher cost/revenue ratio).

With this in mind, we formulated a simple regression model:

$$Y = \beta_0 + \beta_1 X_1 + \varepsilon$$

$$\hat{Y} = b_0 + b_1 D_1 + e$$

Where D_1 indicates dummy variable (0 or 1)

Our overall model will take the following shape when including our chosen factors:

Y-variable: cost/sales ratio

This results in our overall population model are the following:

$$\text{Cost/Sales} = \beta_0 + \beta_1 X_1 + \varepsilon$$

$$\text{Cost/Sales} = \beta_0 + \beta_1(\text{Professional CEO})*D + \varepsilon$$

Where D_1 indicates dummy variable (1 = Professional CEO; 0 = founding CEO).

The estimation model looks as follows:

$$\widehat{Cost/sales} = b_0 + b_1 x_1 + e$$

$$\widehat{\text{Cost/Sales}} = b_0 + b_1(\text{Professional CEO})*D + \varepsilon$$

The output of our regression model can be seen in Table 24.

SUMMARY OUTPUT - COST/SALES RATIO, US

Regression Statistics	
Multiple R	0.007
R Square	0.000
Adjusted R Square	-0.038
Standard Error	0.520
Observations	28

ANOVA

	df	SS	MS	F	Significance F
Regression	1	0.000368	0.000368464	0.001	0.9708
Residual	26	7.031718	0.270450689		
Total	27	7.032086			

	Coefficients	*andard Err*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	1.3581	0.173	7.835	0.000	1.00	1.71	1.00	1.71
Pro CEO	-0.0078	0.2	0.0	0.971	-0.4	0.4	-0.4	0.4

Table 24- Final regression model, Costs/Sales ratio, US (fabricated by author)

As evident from the output, it has little influence on the Cost/sales ratio if the CEO is professional or a founder. We attribute this to several facts. Firstly, a CEO cannot run things by himself. Although he does have large power within the organization, he still needs to have acceptance of the board. Secondly, the companies that we have sampled are of a size where a single CEO's overspending might only be a drop in the ocean. Thirdly, the chosen sample companies might have dissimilar cost structures because of their respective industries, a factor which could potentially distort the picture.

We can, therefore reject the notion that professional CEOs yield a relatively higher cost/revenue structure in the organization.

Sub-Hypothesis 8: Firms with founder CEOs are better at utilizing assets

Another revealing factor that could show if agency costs are prevalent is the revenue/asset ratio or the asset turnover ratio. This ratio measures how effective a given firm is at generating sales from its assets. Jensen & Meckling (1976) stated that one potential agency cost could be the complacency of a founder to source new areas of revenue and pursue new sales opportunities. In order to test this hypothesis, we have developed a model similar to the one above.

The estimation model looks as follows:

$$\widehat{Sales/Assets} = b_0 + b_1x_1 + e$$

$$\widehat{Sales/Assets} = b_0 + b_1(\text{Professional CEO})*D + \varepsilon$$

A disclaimer to the model here is that Assets should be calculated as an average of two years' reported assets. We have not done this due to data constraints, but simply used the assets in a given year with a given revenue.

The results can be found in Table 25 below.

SUMMARY OUTPUT - SALES/ASSETS, US

Regression Statistics	
Multiple R	0.050
R Square	0.002
Adjusted R Square	-0.036
Standard Error	0.368
Observations	28

ANOVA

	df	SS	MS	F	Significance F
Regression	1	0.008747	0.008747425	0.065	0.8012
Residual	26	3.514067	0.135156439		
Total	27	3.522815			

	Coefficients	*andard Err*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.7061	0.123	5.762	0.000	0.45	0.96	0.45	0.96
Pro CEO	-0.0378	0.1	-0.3	0.801	-0.3	0.3	-0.3	0.3

Table 25 - Final regression model, Sales/Assets, US (fabricated by author)

As evident, this parameter is not significant in our sample of firms.

Europe – Tobin's Q

Aim

While we do wish to conduct this exercise in the same manner as we did for the US firms, we acknowledge that our research design is too avant-garde for the EU market. Our sample contains a mere 7 observations, and we therefore evaluate that the analysis would not yield valid results.

Summary of analysis

This concludes the overall analysis of our paper. We have conducted an in-depth research via multiple regression modeling in order to evaluate potential differences in agency costs between professional CEOs and founder CEOs in technology startups in both US and Europe.

Additionally, in doing so, we have modeled our approach onto two different dependent variables; exit valuation and Tobin's Q, respectively. We believe the reader has been able to comfortably follow our intuition and logical reasoning behind our research. Albeit our findings are noteworthy in the effort of breaking new ground on this particular area of academia, they do have shortcomings, which can make them prone to criticism and valid discussion.

In the following section we will outline our findings and discuss some imperative factors which might – or might now, affect out findings. This will be followed with a section where we evaluate possible criticism of our findings form an objective perspective followed by a final conclusion.

Findings in this paper

It is hard to argue against the fact that our research might contain important shortcomings. In our endeavors to break new ground and shed new light on the relatively untouched academic area of agency cost in relation to venture capital and the contemporary world of technology startups, we do in fact believe that our paper carry some findings of highly contributing nature to the world of academia.

Finding 1: Difference in agency costs between professional CEOs and founder CEOs

This makes the pinnacle of our research and the primary aim of our paper. We aspired to investigate potential differences in agency costs between professional CEOs and founder CEOs. From our analysis we can observe a uniform and consistent tendency that agency costs tend to be larger for professional CEOs compared to founder CEOs.

Across all our models and analysis, we can observe a consistent negative coefficient attached to professional CEOs which strongly suggest that professional CEOs tend to yield higher agency costs when compared to founder CEOs.

Finding 2: Differences between US and Europe

Furthermore, our research has uncovered several noteworthy findings in relation to differences between US and European technology startups. From our analysis and research, we can observe the following differences:

a) Difference in agency costs across US and European professional CEOs:

   From our models, we can observe that there tends to be consistent evidence that agency costs for professional CEOs are higher than those of founder CEOs. However, the difference tends to be less in European technology startups than American ones. This in itself is an interesting finding as it may suggest that there is in fact a cultural difference in how American CEOs manage a company compared to European CEOs.

b) Difference in significance of parameters between US and European data:

   There's no denying the fact that our multiple regression model for US companies carries a lot more academic and statistical merit than our European model. Almost all parameters in our US model are significant, whereas for our European model the opposite tends to be the case. This suggests that our approach and model is not transferable or universal, despite the fact that our approach seems highly valid for US technology companies. One would assume the model to be universal across US and European technology companies, but it appears that European technology companies deserves a model which differs significantly in nature and anatomy from the one used in the US, in order to better uncover potential differences in agency costs between professional CEOs and founder CEOs.

Finding 3: Tobin's Q is a more sound measurement than exit valuation

Lastly, as reflective and critical academic we set out to suggest Tobin's Q as the dependent variable instead of exit valuation as we believe it would offer a less static model in numerous ways. Accordingly, by applying Tobin's Q to our modeling approach we believe to have uncovered a noteworthy awareness on how to conduct further research on the subject of differences in agency costs between professional CEOs and founder CEOs. In our initial, static model, the dummy variable manages to give a static picture of how professional CEOs

tend to affect exit valuation on average, in nominal terms. By setting Tobin's Q as the dependent variable we believe to have found a more sound way to measure potential agency costs. Although our model is highly insignificant, we believe our findings regarding Tobin's Q makes a noteworthy platform from which further research should be conducted.

Discussions and criticism of paper

The following intends to discuss the findings in the previous sections in relation to the problem statement set forth in our paper. We welcome any discussion and criticism of our paper as we accept the notion that our research by no means intend to dictate a new truth or paradigm shift, but merely intend to openly discuss the research for external practitioners to built upon. Thus, the section will include a discussion of the validity of our developed models, the applied data and its general attributes along with potential factors our paper fail to take into consideration, which could limit the feasibility of our research and findings.

Discussion of causation and correlation:

As reflective and critical academics, we have constantly been reminded how correlation doesn't imply causation; yet, differing the two remains a widespread blunder in scientific and social-related studies. In theory, these are easy to distinguish - an action can cause another (such as number of investment rounds causes higher exit valuation), or it can correlate with another (such as a higher number of investment rounds is correlated with higher exit valuation). If one action causes another, then we know from academia, that they are most likely correlated. But just because two events tend to occur together does not imply that a causal relationship exists, even if it appears to make sense. The same goes for our model, analysis and paper.

We wish to bring attention to this imperative subject as it certainly can have a significant impact to our findings. Firstly, we cannot reject the fact that our model may in fact demonstrate nothing but a correlationary relationship between our chosen dependent – and independent variables. However, from our own experience bias, combined with a faint consensus from the world of venture capital (Horowitz, 2010), we strongly believe that the relationship between our chosen variables offers more than just arbitrary correlation.

So how can we be so sure? Many studies are designed to test a correlation, but cannot necessarily lead to a causal conclusion; and yet, palpable motivations for the correlation proliferate, alluring researchers toward unfitting conclusions. However, we would like to emphasize that we fully accept the possibility that our models are not necessarily designed to conclude whether or not a causal relationship exists between our dependent and independent variables. On the contrary, we welcome the fact that there might exist numerous reasons why conclusions about cause and effect in our models, might be wrong. As an example, from our multiple regression model on US companies, we decided to include "number of employees" as an independent variable being regressed onto "exit valuation" as the dependent variable. Would it make common sense to argue, that more employees would have a positive impact on exit valuation? Probably not. As a matter of fact, the opposite scenario being that exit valuation would have a positive impact on number of employees in the company, might make more economic sense.

In many cases, it seems obvious that one action triggers a reaction in another; however, there are also many cases when it is not so clear – and when it comes to venture capital and technology companies, many things can appear very unclear compared to conventional corporate finance.

Thus, the reason why we have chosen to include such independent variables (number of employees, etc. red.) is that we believe that our chosen independent variables, when combined together, make a more sensible combination of factors, which collectively have a meaningful effect on exit valuation. From having worked in venture capital, we can only rely on our own experience of what is being discussed within the four walls of a VC-firm when evaluating possible investments. However, this still doesn't make a sound argument that our analysis and findings are causal instead of purely correlational.

One could argue that our linear model simply doesn't fit the issue we are researching. This too could be a very valid point since some of our variables certainly might have a non-linear effect or relationship on the dependent variable. So how then, can we, as academic researchers, ever establish or prove causality?

There is no doubt that this is one of the most daunting tasks within the social sciences. If we adopt the best practices form the health – and medical sciences, the most effective way could

be through a controlled study. In a controlled study, we would include two subjects who would be comparable in almost every way, and expose them to two different sets of experiments or scenarios and compare the outcomes. If the two subjects turn out to have significantly different outcomes, then there would be strong evidence that the different sets of experiments or scenarios may have caused the difference in outcomes which would argue for causality instead of just correlation.

For obvious reasons, this is close to impossible in the research we have conducted. Let's entertain the thought for a minute and pretend to undertake a controlled experiment. Firstly, we would have to find two virtually identical companies comparable in almost every way. Highly unlikely, but not impossible per sé.

Secondly, we would then let the original founder CEO, in one of the companies, be replaced by a professional CEO so that we now have two identical companies where one is managed by a founder CEO and the other by a professional CEO. This raises another concern – how would you choose the professional CEO? Surely not all professional CEOs offer the same characteristics, mentality, personal attributes, leadership skills, innovative thinking skills, industry knowledge, ethical standards etc., so your choice of professional CEO would most likely alter the final outcome too, exposing the experiment to multiple kinds of biases.

Thus, doing a controlled experiment is most likely out of the question, for obvious reasons. The fact that we cannot conduct a controlled experiment, or other controlled tests to falsify whether or not our models exhibit causation or just correlation, is why we evaluate our results and findings in this paper to carry a high level of academic merit and integrity.

We will never be able to obtain the same level of precision or granularity as experiments carried out in other disciplines within the sciences, so we must settle with what we have and approach our findings with a higher level of conclusive caution.

Ownership distribution, term sheets and incentives:

Our paper and research might have several shortcomings when evaluating the possible effect of shareholdings and term sheets. In our datasets, we do not know how the shares are distributed among professional CEOs; founder CEOs or external investors which certainly

can have a major impact during the time leading up to a company exit valuation. We accept the fact, that the magnitude of ownership given to a managing CEO (professional or founding) most likely will result in different incentives. All else equal, a CEO with a higher ownership share must be assumed to have a higher incentive to maximize company valuation and thus minimize agency costs. This relation conflicts directly with our area of research set forth in this paper, which is why we wish to openly discuss its relevance and our lack of insight on the matter.

It has simply not been possible to collect this data as the majority of these are of a highly confidential nature and basically impossible to obtain. Thus, in our research and analysis, one can argue that we have assumed them to be equal/uniform across all observations, which is a very unlikely scenario. Consequently, this can make our analysis and findings distorted compared to the reality. One possibly fatal flaw about our research might be the fact, that founder CEOs, on average, could hold more shares, options or general upside, compared to professional CEOs. This would argue against our findings that professional CEOs tend to yield higher agency costs than founder CEOs, as the comparison between professional CEOs and founder CEOs has not been carried out on equal terms.

On the contrary, one can argue that the possible variances in ownership between professional CEOs and founder CEOs actually supports our findings stating that higher agency costs are related to professional CEOs due to the very fact that they (professional CEOs), on average, are simply less incentivized and thus has very little to do with other factors. Which leads us to the next topic of discussion.

Agency cost – from which perspective?

As mentioned in above discussion point regarding the possible variance in ownership, one also has to consider from which perspective we observe agency costs.

When founder of a tech startup begins to take on external investors, his ownership share will most likely be diluted in different ways depending on the nature of the term sheets (as explained in our Theory chapter, part 2). What is important to consider here is: *when* exactly is the founder an investor, and when is she a CEO? If the founder owns more than 50 percent, is he then to be considered an investor? The opposite applies too - if the founder CEO owns

less than 50 percent of the company is he then "just" a CEO? And if so, would this alter his incentives?

Its important to make up this assessment as it ultimately alters the perspective of who is being exposed to agency costs. In our paper, we cannot distinguish on such a high granularity as we do not have insight regarding the ownership distribution leading up to the exit and we do accept that this might in fact have imperative consequences to our research. If we could obtain this data on our current set of observations, and incorporate this as an additional variable in our models, we might observe completely different results

Again, we accept this potential pitfall of our research and we are aware of the potential criticism it might convey – however, we also see this as a welcoming gesture from outside academia to build upon our research and findings.

Solidity of data – especially limitation from penultimate to exit round:

As mentioned in preceding discussion points, one can argue the solidity of our data. In our research, we have solely focused on the difference in value creation between a technology company's penultimate valuation and its exit round. That is, we have only compared the exit valuation to the valuation of the preceding round, and thus neglecting any prior valuation rounds and the value created/destroyed in-between.

This is an important point to factor in when evaluating the final outcome from our analysis. The main shortcoming of this approach is, that it potentially leaves out rounds of significant value creation, which might have altered the final outcome of our findings, in favor of professional CEOs. However, it is our belief that incentives between founder CEOs and professional CEOs are optimally aligned during the time leading up to an exit valuation, which justifies our chosen approach.

This finalizes our criticism and discussion of this paper and its findings. We believe that we have openly welcomed any criticism and discussion regarding the potential shortcomings and pitfalls our paper might contain. We will now finalize our paper with a conclusion, answering our initial problem statement.

Conclusion

With this paper, we believe to have uncovered new ground within the area of agency theory in a contemporary setting. We sat out to craft a paper, which would offer both academic and practical usage and create a foundation from where further research should be pursued.

For academia, our paper has highlighted some noteworthy findings, which contributes to answer the question of whether or not classical agency theory still applies to the new, vibrant world of technology venture capital. This paper suggests, that there certainly still is some truth to the Jensen-Meckling proposition from 1976, but that the theory should potentially be recalibrated or augmented to take into consideration the structure of the firm and the terms under which the founder gives up control.

Additionally, this paper has managed to uncover new findings and shed light upon the differences in agency costs between professional CEOs and founder CEOs, which carries valuable contribution to the practical area of technology venture capital by showing strong evidence that agency costs associated to professional CEOs tend to be higher, compared to agency costs related to founder CEOs. In a more practical sense, our paper has investigated much of the environment surrounding the firms of interest. This means that venture capitalists should gain valuable knowledge from our paper, regarding the best time to onboard a professional CEO, and whether they even should bother getting a professional CEO on board in the first place. From our analysis, evidence suggests that they should not bother to do so.

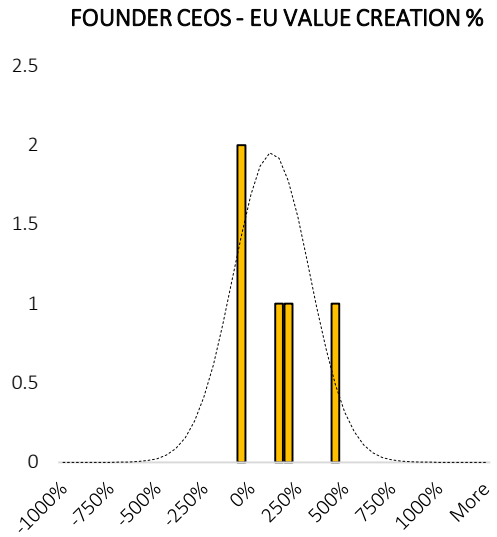
Finally, from our research and analysis in this paper, we have managed to deliver noteworthy new findings which suggests that there tends to be consistent evidence across both US – and

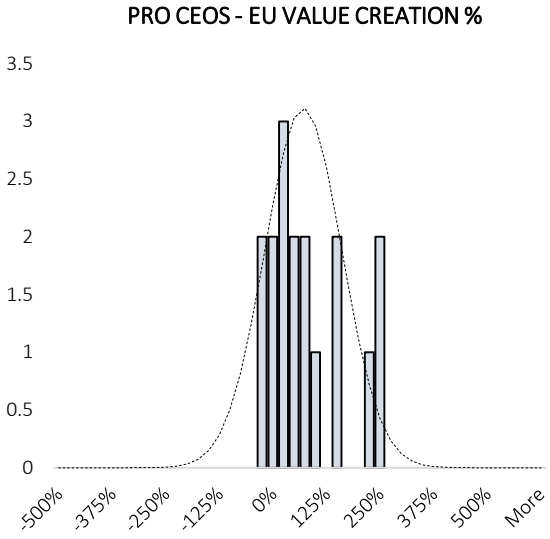
European technology companies, suggesting that professional CEOs tend to yield higher agency costs compared to founder CEOs.

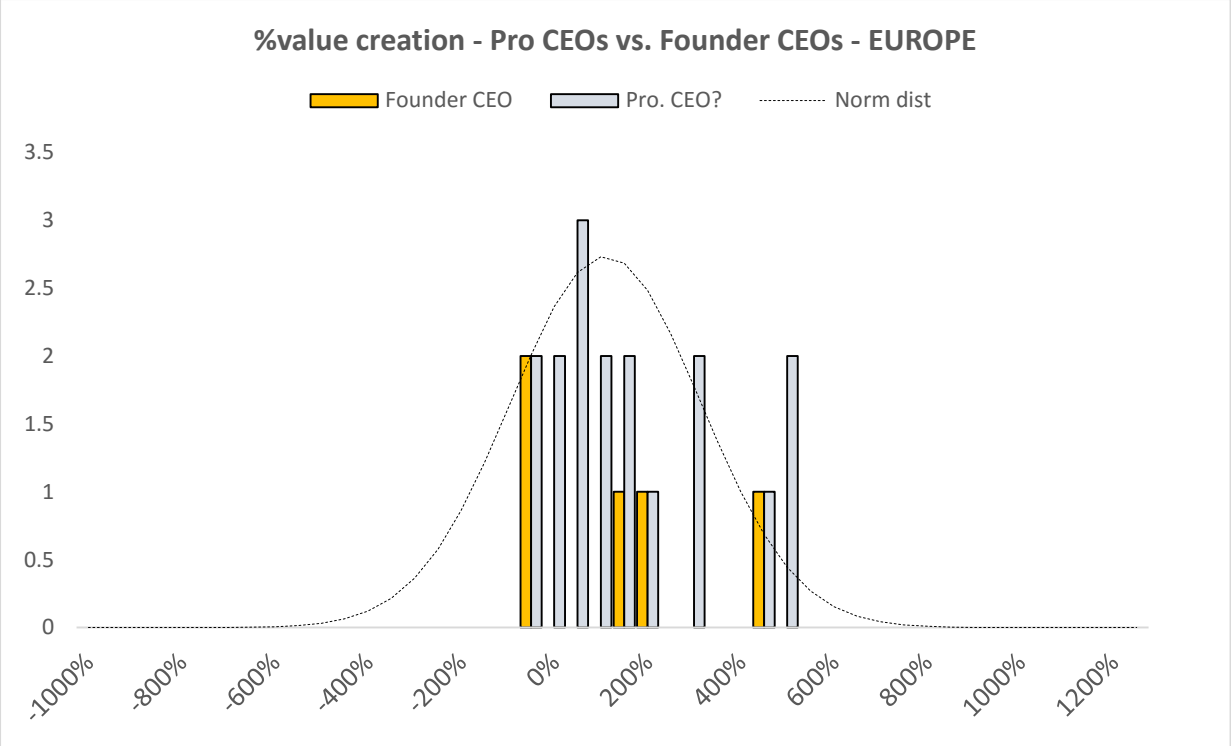
We do however acknowledge the potential shortcomings of our data, research, analysis and paper. Although our initial multiple regression model for the US data sample shows strong attributes as it succeeds in not violating any of the crucial assumptions stated in the Gauss-Markov Theorem, and thus proves a high level of academic and statistical validity.

Nevertheless, our paper never intended to dictate a new paradigm for agency theory, but rather create a platform from which further research can be conducted by the world of academia, and we welcome external contributors to build upon our findings.

Appendix 1: Stepwise regression for Europe







Hypothesis 1: Number of employees affects tech startup exit valuation

SUMMARY OUTPUT - EUROPE

Europe - Regression Statistics	
Multiple R	0.69
R Square	0.47
Adjusted R Square	0.47
Standard Error	368
Observations	103

ANOVA

	df	SS	MS	F	Significance F
Regression	1	12135940.15	12135940.15	89.76497646	1.2907E-15
Residual	101	13654879.7	135196.8287		
Total	102	25790819.85			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	ower 95.0%	pper 95.0%
Intercept	-19.3	41.8	-0.5	0.645	-102.3	63.6	-102.3	63.6
Employees	1.2	0.1	9.5	0.000	0.9	1.4	0.9	1.4

Hypothesis 2: Years since founded affects startup exit valuation

SUMMARY OUTPUT - EUROPE

Europe - Regression Statistics	
Multiple R	0.69
R Square	0.47
Adjusted R Square	0.46
Standard Error	369
Observations	103

ANOVA

	df	SS	MS	F	Significance F
Regression	2	12210081.41	6105040.705	44.95367266	1.1828E-14
Residual	100	13580738.44	135807.3844		
Total	102	25790819.85			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	ower 95.0%	pper 95.0%
Intercept	52.6	106.0	0.5	0.621	-157.6	262.8	-157.6	262.8
Employees	1.2	0.1	9.5	0.000	0.9	1.4	0.9	1.4
Years since founded	-12.2	16.5	-0.7	0.462	-44.9	20.5	-44.9	20.5

Hypothesis 3: Total number of investment rounds carried out affects startup exit valuation

SUMMARY OUTPUT - EUROPE

Europe - Regression Statistics	
Multiple R	0.69
R Square	0.48
Adjusted R Square	0.46
Standard Error	369
Observations	103

ANOVA

	df	SS	MS	F	Significance F
Regression	3	12314555.58	4104851.861	30.15526603	6.213E-14
Residual	99	13476264.27	136123.8815		
Total	102	25790819.85			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	ower 95.0%	pper 95.0%
Intercept	88.2	113.6	0.8	0.439	-137.2	313.7	-137.2	313.7
Employees	1.2	0.1	9.4	0.000	1.0	1.5	1.0	1.5
Years since founded	-7.8	17.2	-0.5	0.650	-42.0	26.3	-42.0	26.3
Number of deals	-52.9	60.4	-0.9	0.383	-172.7	66.9	-172.7	66.9

Hypothesis 4: Total number of investors funding the startup since inception, effects startup exit valuation

SUMMARY OUTPUT - EUROPE

Europe - Regression Statistics	
Multiple R	0.70
R Square	0.49
Adjusted R Square	0.47
Standard Error	367
Observations	103

ANOVA

	df	SS	MS	F	Significance F
Regression	4	12582674.4	3145668.601	23.33980377	1.43139E-13
Residual	98	13208145.45	134776.9944		
Total	102	25790819.85			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	ower 95.0%	pper 95.0%
Intercept	92.4	113.1	0.8	0.416	-132.1	316.8	-132.1	316.8
Employees	1.3	0.1	9.6	0.000	1.0	1.5	1.0	1.5
Years since founded	-6.9	17.2	-0.4	0.690	-40.9	27.2	-40.9	27.2
Number of deals	9.4	74.6	0.1	0.900	-138.6	157.3	-138.6	157.3
Total #Investors	-72.3	51.3	-1.4	0.162	-174.1	29.4	-174.1	29.4

Hypothesis 5: The state of the European Technology Sector effects startup exit valuation

SUMMARY OUTPUT - EUROPE

Europe - Regression Statistics	
Multiple R	0.71
R Square	0.50
Adjusted R Square	0.47
Standard Error	365
Observations	103

ANOVA

	df	SS	MS	F	Significance F
Regression	5	12874700.89	2574940.178	19.33779008	2.6057E-13
Residual	97	12916118.97	133155.8656		
Total	102	25790819.85			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	ower 95.0%	pper 95.0%
Intercept	336.7	199.6	1.7	0.095	-59.5	732.9	-59.5	732.9
Employees	1.2	0.1	9.3	0.000	1.0	1.5	1.0	1.5
Years since founded	1.1	17.9	0.1	0.952	-34.4	36.6	-34.4	36.6
Number of deals	16.2	74.3	0.2	0.828	-131.2	163.6	-131.2	163.6
Total #Investors	-67.1	51.1	-1.3	0.192	-168.6	34.3	-168.6	34.3
SP350 EU Tech Index 2005	-2.6	1.8	-1.5	0.142	-6.1	0.9	-6.1	0.9

Hypothesis 6: Professional vs. founder CEO affects startup exit valuation

SUMMARY OUTPUT - EUROPE

Europe - Regression Statistics	
Multiple R	0.71
R Square	0.51
Adjusted R Square	0.47
Standard Error	364
Observations	103

ANOVA

	df	SS	MS	F	Significance F
Regression	6	13043488.12	2173914.687	16.37172503	6.65434E-13
Residual	96	12747331.73	132784.7055		
Total	102	25790819.85			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	ower 95.0%	pper 95.0%
Intercept	428.5	215.3	2.0	0.049	1.0	856.0	1.0	856.0
Employees	1.2	0.1	8.8	0.000	0.9	1.5	0.9	1.5
Years since founded	0.5	17.9	0.0	0.977	-34.9	36.0	-34.9	36.0
Number of deals	19.4	74.2	0.3	0.794	-127.9	166.7	-127.9	166.7
Total #Investors	-63.3	51.1	-1.2	0.219	-164.8	38.3	-164.8	38.3
SP350 EU Tech Index 2005	-2.8	1.8	-1.6	0.111	-6.4	0.7	-6.4	0.7
Pro. CEO?	-91.2	80.9	-1.1	0.262	-251.8	69.4	-251.8	69.4

Correlation – European data:

	Exit valuation	*Employees*	*Years since*	*Number of*	*Total*	*SP350 EU*	*Pro. CEO?*
Exit valuation	1.000						
Employees	0.686	1.000					
Years since founded	0.046	0.144	1.000				
Number of deals	0.083	0.229	0.310	1.000			
Total #Investors	0.100	0.323	0.241	0.640	1.000		
350 EU Tech Index 2005	-0.165	-0.049	0.332	0.195	0.164	1.000	
Pro. CEO?	-0.209	-0.196	-0.069	0.017	0.014	-0.101	1.000

Appendix 2: SAS Output for European data set

Linear Regression Results

The REG Procedure
Model: Linear_Regression_Model
Dependent Variable: Exit valuation

Number of Observations Read	103
Number of Observations Used	103

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	6	13043488	2173915	16.37	<.0001
Error	96	12747332	132785		
Corrected Total	102	25790820			

Root MSE	364.39636	R-Square	0.5057
Dependent Mean	178.14359	Adj R-Sq	0.4749
Coeff Var	204.55204		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Standardized Estimate
Intercept	1	428.49543	215.34919	1.99	0.0495	0
Employees	1	1.19866	0.13571	8.83	<.0001	0.69593

Years since founded	1	0.52375	17.86002	0.03	0.9767	0.00233
Number of deals	1	19.43096	74.20775	0.26	0.7940	0.02507
Total #Investors	1	-63.27364	51.14964	-1.24	0.2191	-0.11954
SP350 EU Tech	1	-2.84457	1.76892	-1.61	0.1111	-0.12521
Pro. CEO?	1	-91.20356	80.89394	-1.13	0.2624	-0.08360

Covariance of Estimates

Variable	Intercept	Employees	Years since founded	Number of deals	Total #Investors	SP350 EU Tech	Pro. CEO?
Intercept	46375.272288	-5.258336108	-529.1667003	-1278.193564	709.86303532	-306.682184	-6585.930643
Employees	-5.258336108	0.0184181104	-0.235047601	-0.319295467	-1.723584028	0.0390391047	2.4591347262
Years since founded	-529.1667003	-0.235047601	318.98030121	-237.5088753	-18.45482563	-9.285197019	39.540586044
Number of deals	-1278.193564	-0.319295467	-237.5088753	5506.7895369	-2205.35359	-8.707097645	-230.6821692
Total #Investors	709.86303532	-1.723584028	-18.45482563	-2205.35359	2616.2852986	-6.905398712	-276.8529424
SP350 EU Tech	-306.682184	0.0390391047	-9.285197019	-8.707097645	-6.905398712	3.1290666838	17.25022711
Pro. CEO?	-6585.930643	2.4591347262	39.540586044	-230.6821692	-276.8529424	17.25022711	6543.8302063

Correlation of Estimates

Variable	Intercept	Employees	Years since founded	Number of deals	Total #Investors	SP350 EU Tech	Pro. CEO?
Intercept	1.0000	-0.1799	-0.1376	-0.0800	0.0644	-0.8051	-0.3781
Employees	-0.1799	1.0000	-0.0970	-0.0317	-0.2483	0.1626	0.2240
Years since founded	-0.1376	-0.0970	1.0000	-0.1792	-0.0202	-0.2939	0.0274
Number of deals	-0.0800	-0.0317	-0.1792	1.0000	-0.5810	-0.0663	-0.0384
Total #Investors	0.0644	-0.2483	-0.0202	-0.5810	1.0000	-0.0763	-0.0669
SP350 EU Tech	-0.8051	0.1626	-0.2939	-0.0663	-0.0763	1.0000	0.1206
Pro. CEO?	-0.3781	0.2240	0.0274	-0.0384	-0.0669	0.1206	1.0000

Collinearity Diagnostics

			Proportion of Variation						
Number	Eigenvalue	Condition Index	Intercept	Employees	Years since founded	Number of deals	Total #Investors	SP350 EU Tech	Pro. CEO?
1	5.55724	1.00000	0.00084596	0.00722	0.00283	0.00346	0.00496	0.00088492	0.00649
2	0.75453	2.71388	0.00070379	0.65965	0.00081725	0.00000970	0.00448	0.00082599	0.05095
3	0.29176	4.36431	0.00180	0.28469	0.00000502	0.05955	0.22760	0.00027141	0.33575
4	0.22579	4.96113	0.01009	0.00376	0.08206	0.00525	0.18070	0.01707	0.45738
5	0.08767	7.96168	0.00467	0.00704	0.01015	0.92693	0.57503	0.00862	0.00418
6	0.06731	9.08617	0.07626	0.00128	0.89599	0.00450	0.00024207	0.07398	0.06621
7	0.01570	18.81271	0.90563	0.03635	0.00815	0.00030837	0.00699	0.89835	0.07904

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Linear Regression Results

The REG Procedure
Model: Linear_Regression_Model
Dependent Variable: Exit valuation

Test of First and Second Moment Specification

DF	Chi-Square	Pr > ChiSq
26	27.27	0.3954

Durbin-Watson D	1.834
Number of Observations	103
1st Order Autocorrelation	0.081

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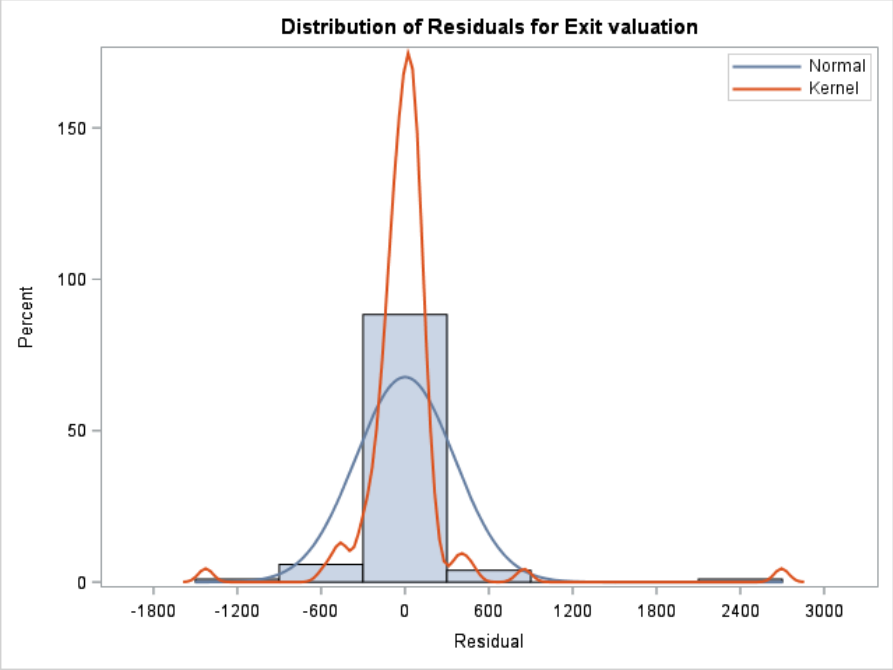
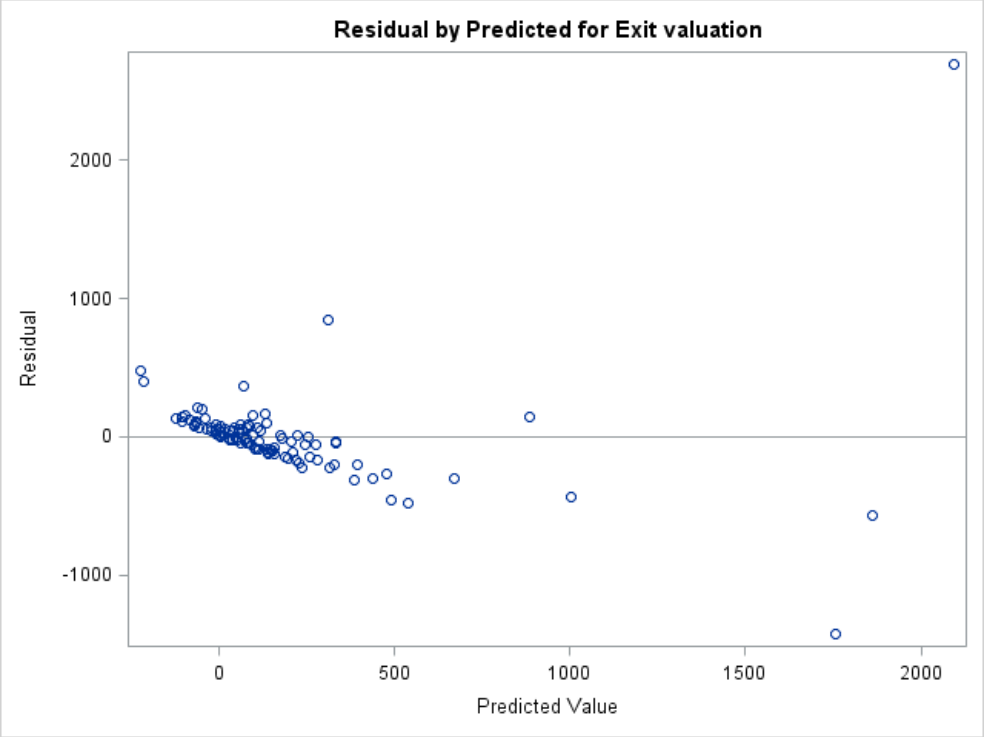
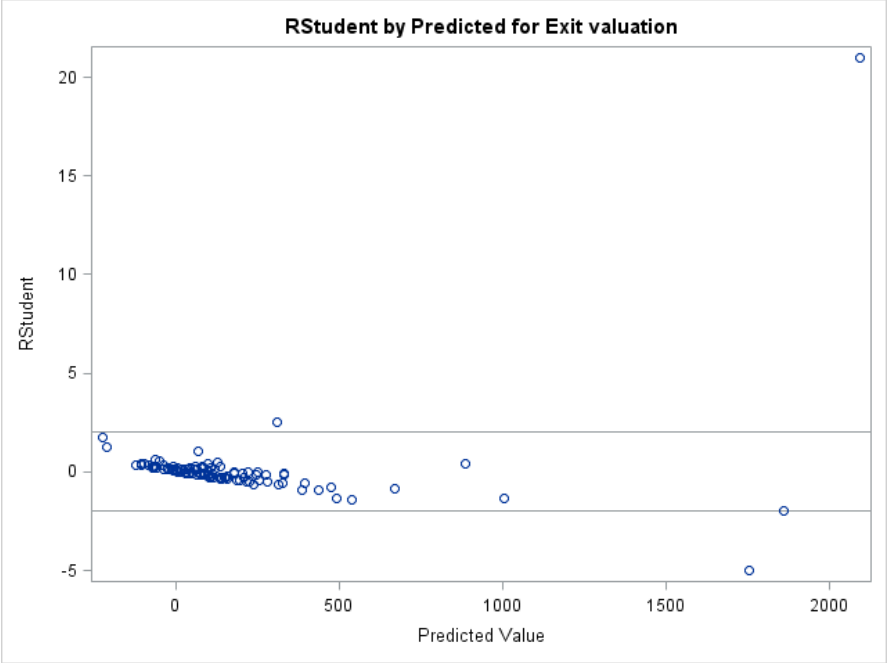
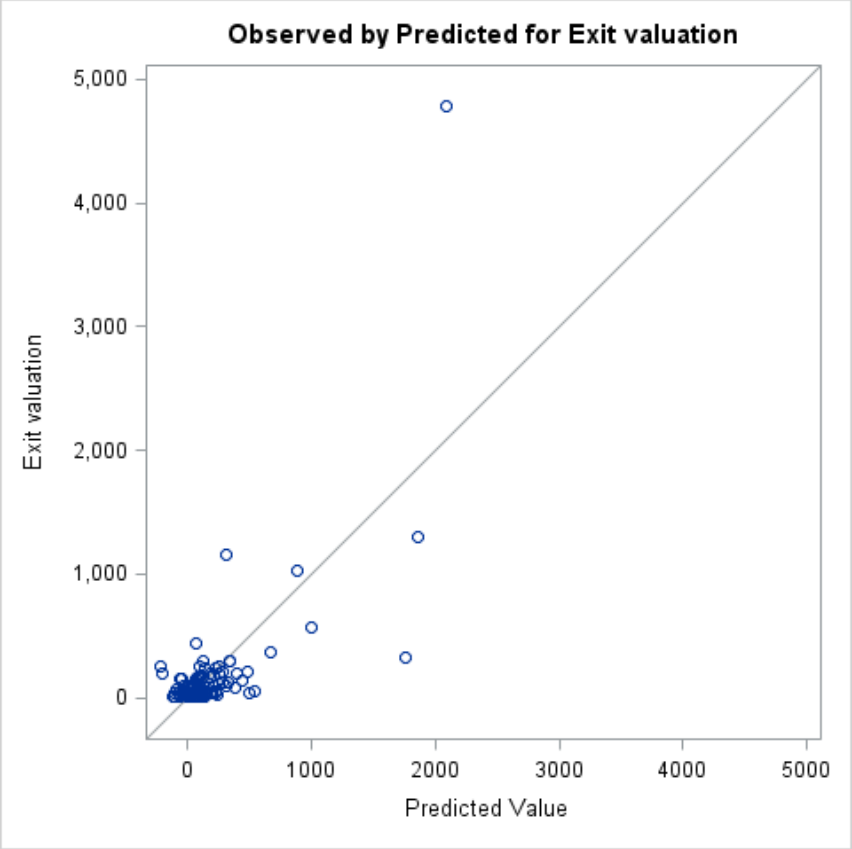
Linear Regression Results

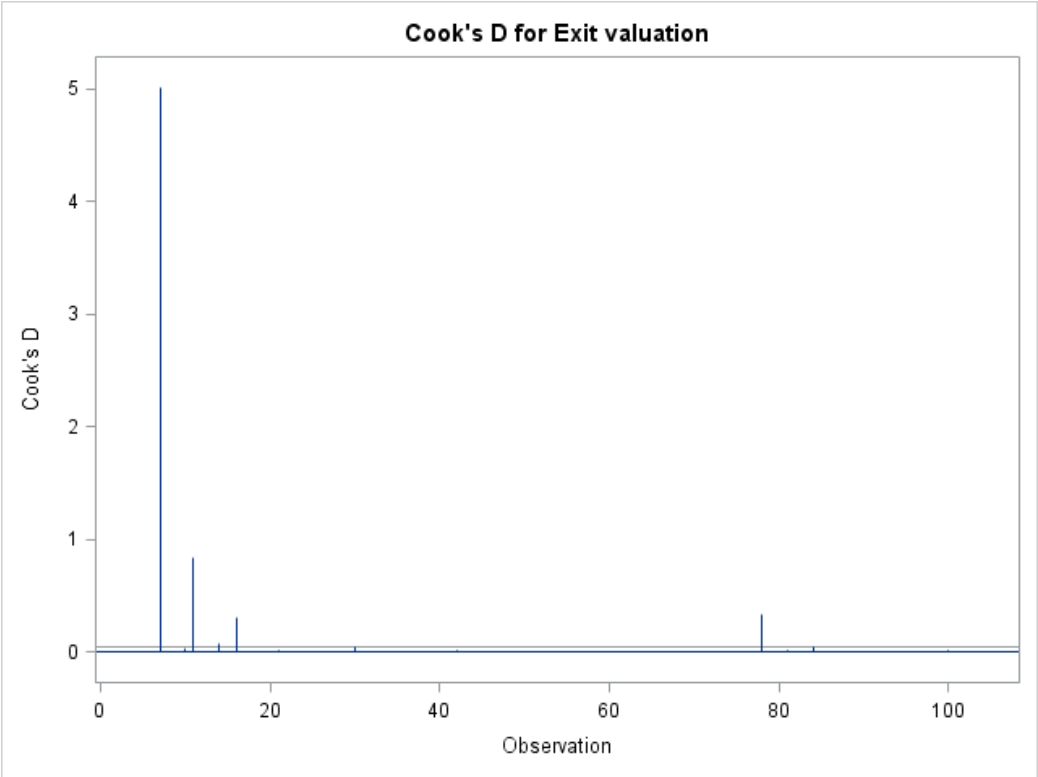
The REG Procedure
Model: Linear_Regression_Model
Dependent Variable: Exit valuation

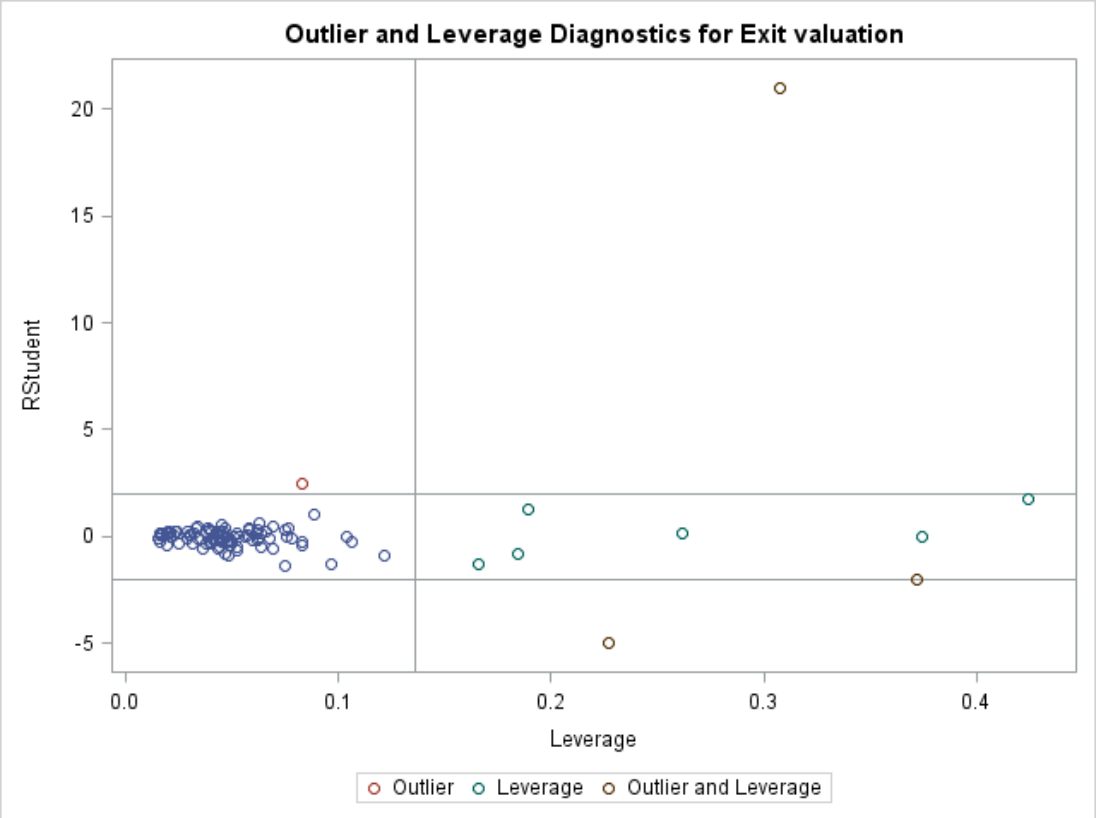


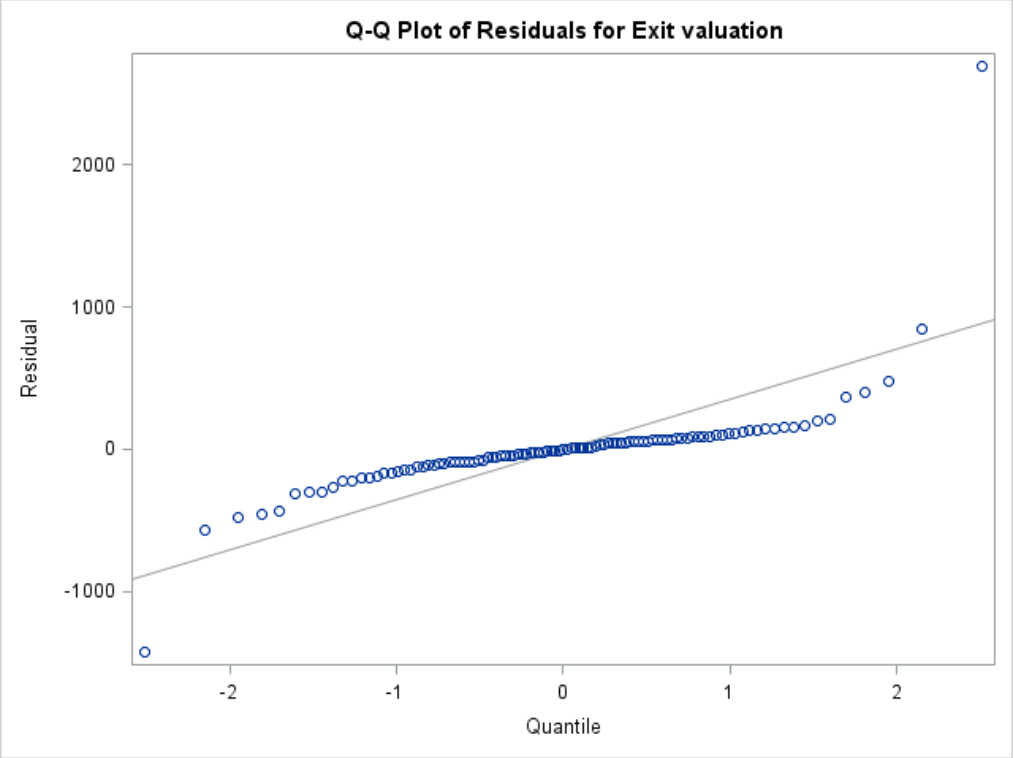


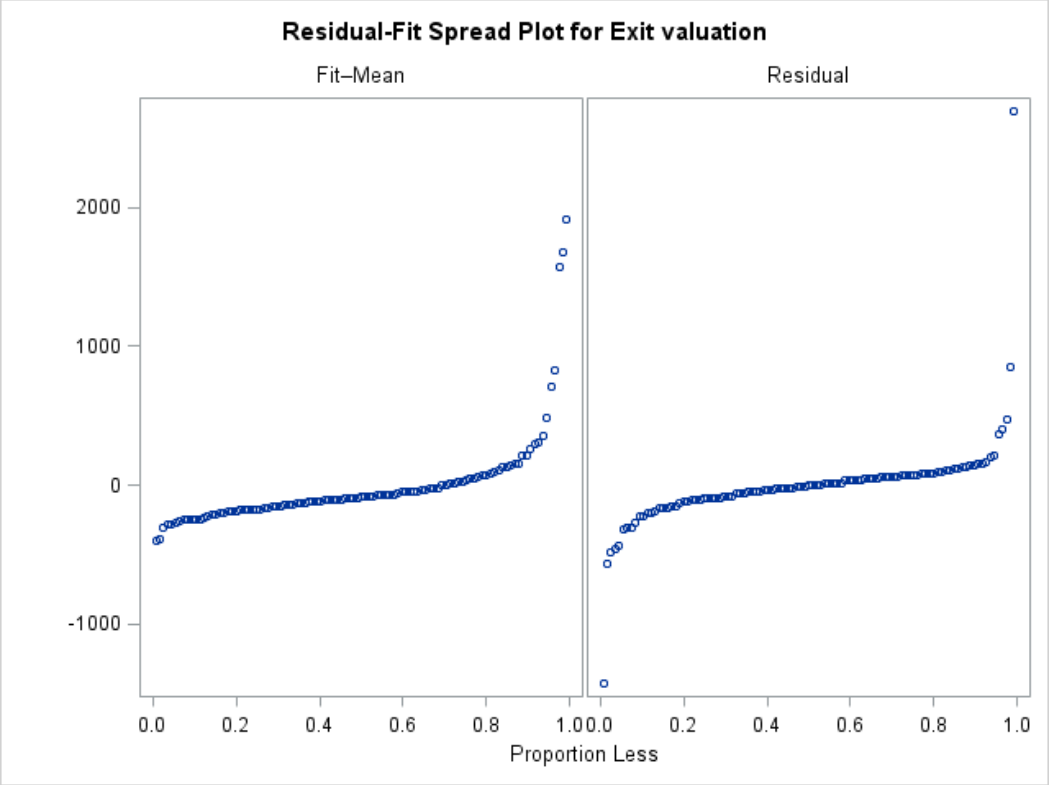

RStudent by Predicted for Exit valuation
RStudent
20
15
10
5
0
-5
0
500
1000
1500
2000
Predicted Value

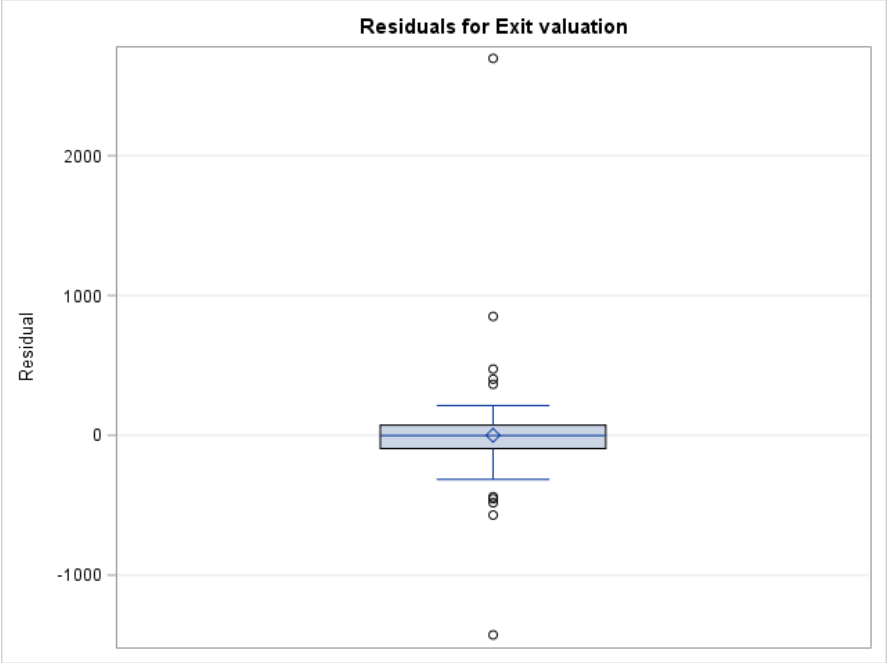

Observed by Predicted for Exit valuation
Exit valuation
5,000
4,000
3,000
2,000
1,000
0
0
1000
2000
3000
4000
5000
Predicted Value

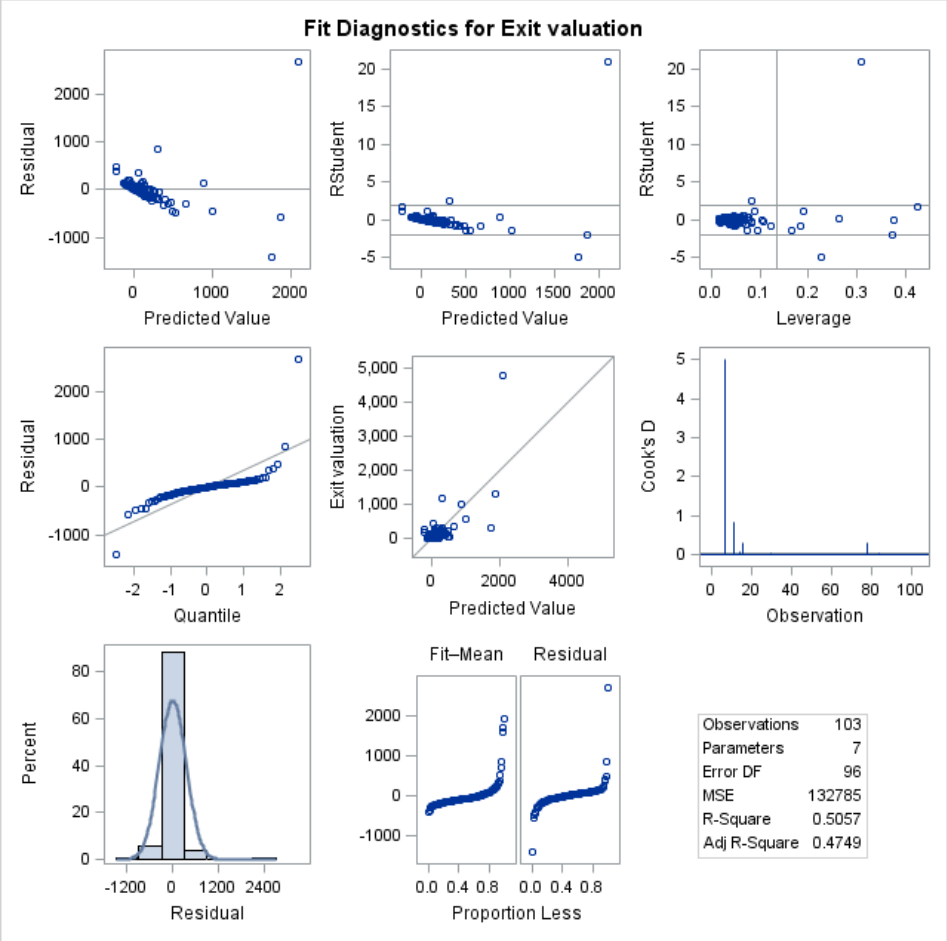

Cook's D for Exit valuation
Cook's D
Observation
0
1
2
3
4
5
0
20
40
60
80
100

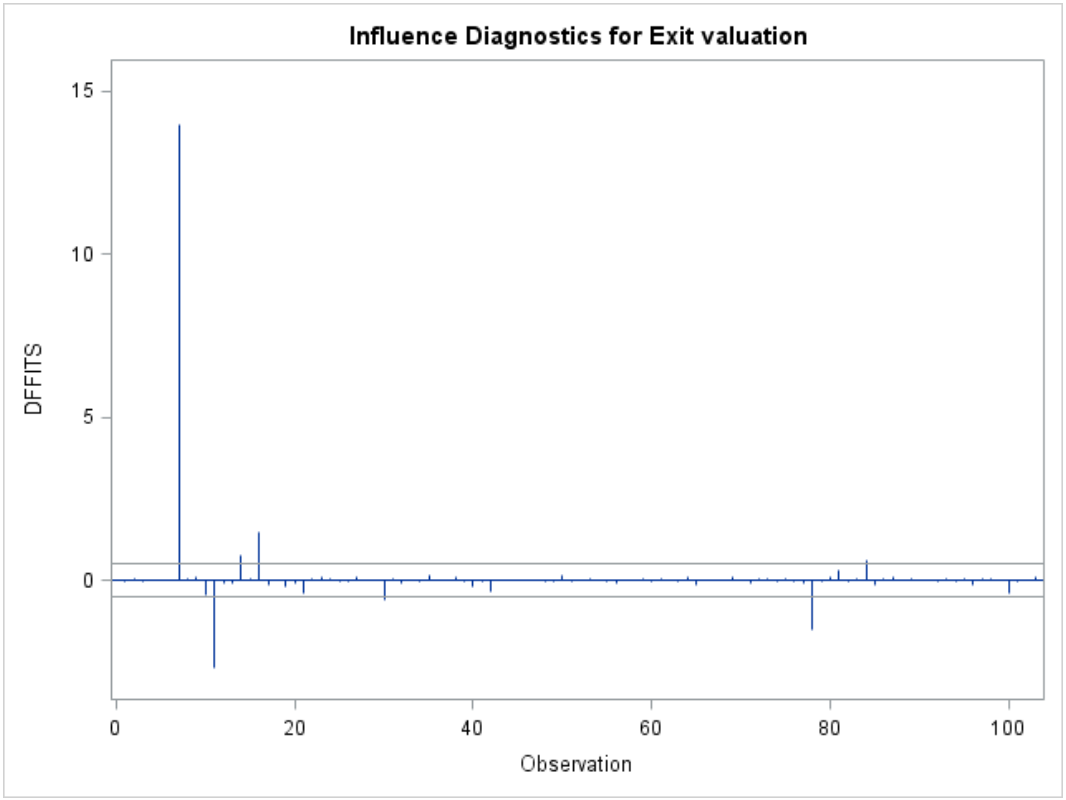

Outlier and Leverage Diagnostics for Exit valuation
RStudent
Leverage
20
15
10
5
0
-5
0.0
0.1
0.2
0.3
0.4
Outlier
Leverage
Outlier and Leverage

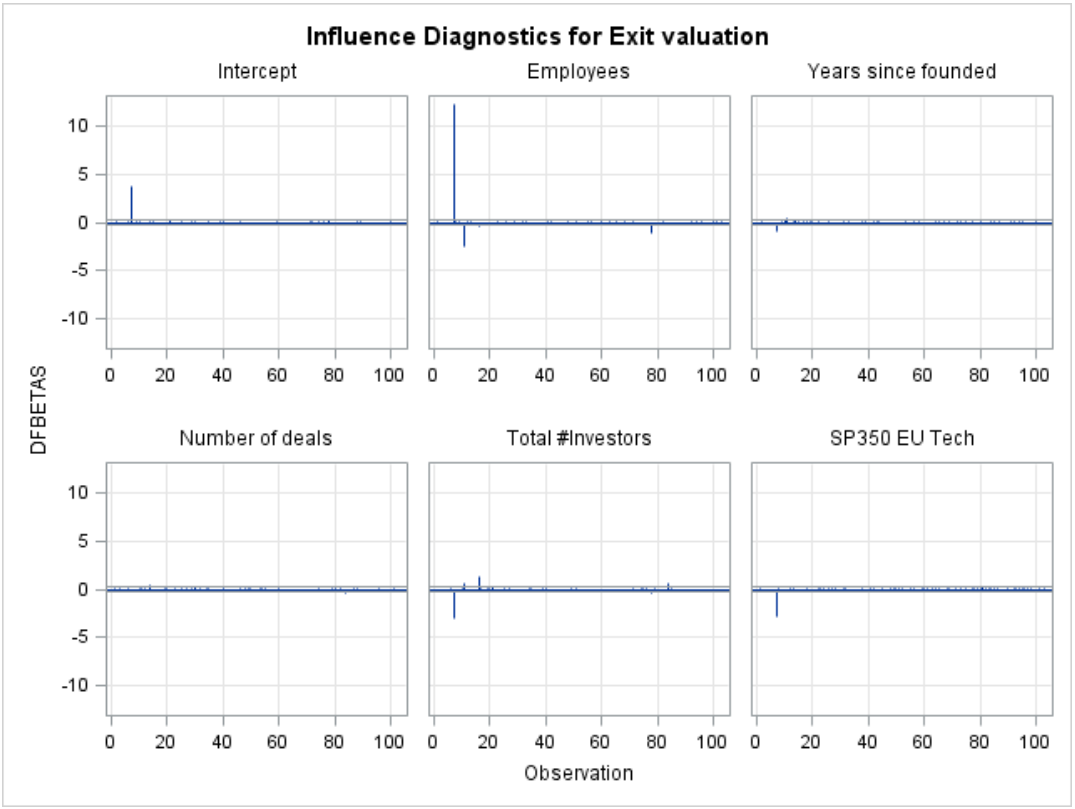

Q-Q Plot of Residuals for Exit valuation
Residual
2000
1000
0
-1000
-2
-1
0
1
2
Quantile

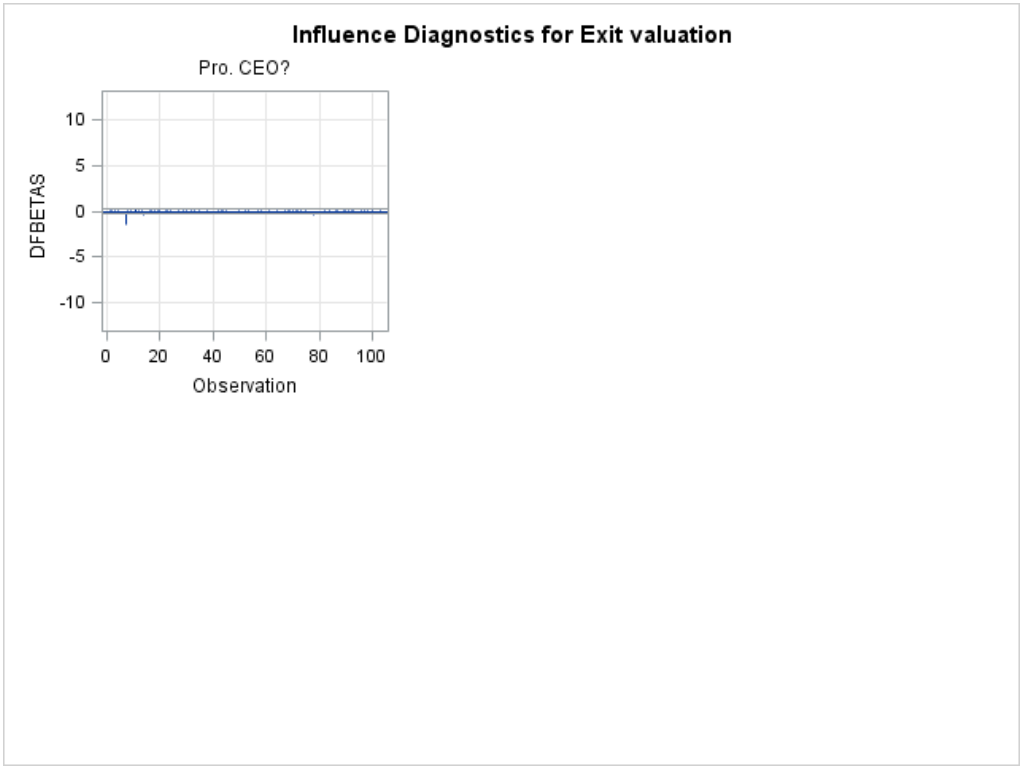

Residual-Fit Spread Plot for Exit valuation
Fit–Mean
Residual
2000
1000
0
-1000
0.0
0.2
0.4
0.6
0.8
1.0
Proportion Less

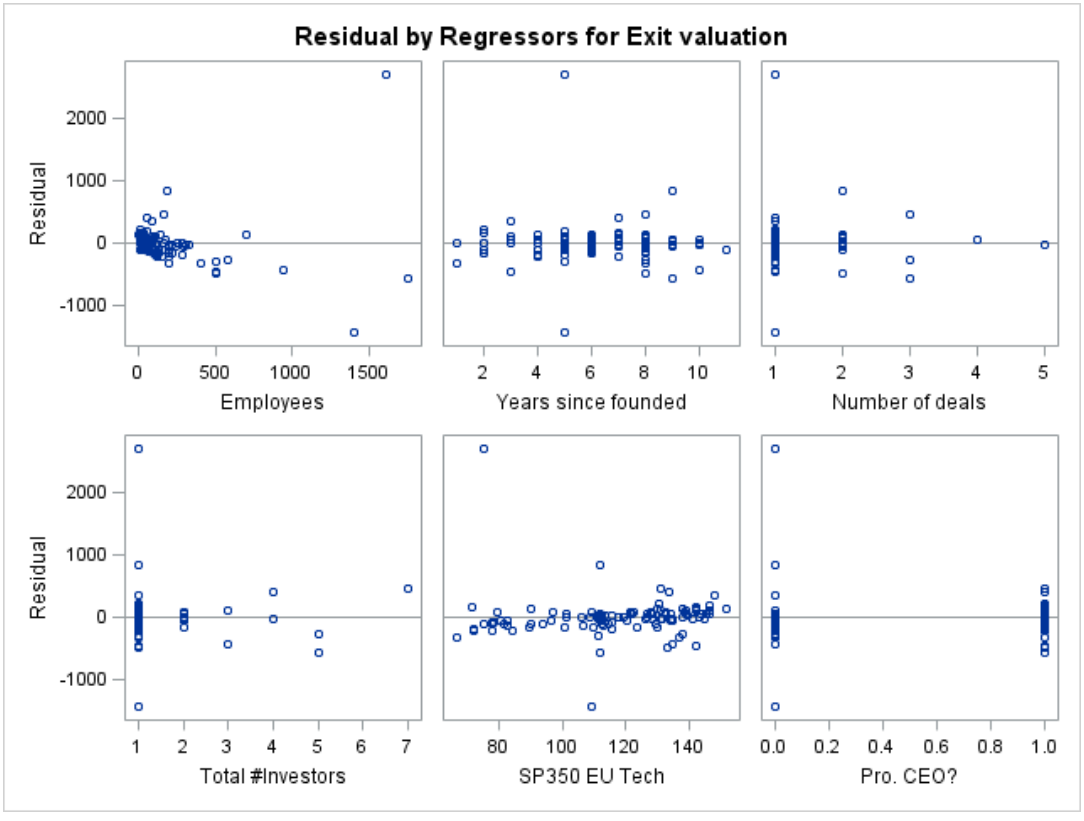

Residuals for Exit valuation
Residual
2000
1000
0
-1000


Fit Diagnostics for Exit valuation
Residual
Predicted Value
RStudent
Predicted Value
RStudent
Leverage
Residual
Quantile
Exit valuation
Predicted Value
Cook's D
Observation
Percent
Residual
Fit–Mean
Residual
Proportion Less
Observations 103
Parameters 7
Error DF 96
MSE 132785
R-Square 0.5057
Adj R-Square 0.4749


Influence Diagnostics for Exit valuation
DFFITS
15
10
5
0
0
20
40
60
80
100
Observation


Influence Diagnostics for Exit valuation
Intercept
Employees
Years since founded
Number of deals
Total #Investors
SP350 EU Tech
DFBETAS
10
5
0
-5
-10
0
20
40
60
80
100
Observation





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Appendix 3: SAS Output for Tobin's Q – US

Linear Regression Results

The REG Procedure
Model: Linear_Regression_Model
Dependent Variable: Tobins Q

Number of Observations Read	28
Number of Observations Used	28

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	8	36.46760	4.55845	1.51	0.2196
Error	19	57.45823	3.02412		
Corrected Total	27	93.92583			

Root MSE	1.73900	R-Square	0.3883
Dependent Mean	3.21487	Adj R-Sq	0.1307
Coeff Var	54.09242		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	27.96121	18.09360	1.55	0.1388
Revenue/assets	1	0.73463	1.07840	0.68	0.5040
Cost/Sales ratio	1	0.96694	0.73673	1.31	0.2050
Years since founding	1	0.86006	0.29981	2.87	0.0098
Total number of investors	1	-0.06877	0.16688	-0.41	0.6849
US GDP	1	-0.00000206	0.00000120	-1.72	0.1021
Pro CEO	1	-0.44530	0.74828	-0.60	0.5588
No. Employees	1	0.00011266	0.00038498	0.29	0.7730
Investment rounds	1	0.02113	0.24279	0.09	0.9316

Covariance of Estimates

Variable	Intercept	Revenue/assets	Cost/Sales ratio	Years since founding	Total number of investors	US GDP	Pro CEO	No. Employees	Investment rounds
Intercept	327.37842199	3.9150399002	-0.0986296481	0.9227481862	0.0688524175	-0.0000212831	0.0486544027	0.0016872635	-0.925833997
Revenue/assets	3.9150399002	1.1629573091	0.1536248339	0.0377231897	0.0482077021	-3.713128E-7	0.1601391223	0.0001391618	0.0515290004
Cost/Sales ratio	-0.098629648	0.1536248339	0.5427754523	0.0788537995	0.0398880134	-9.955451E-8	0.0576145146	0.0000274558	0.000307212
Years since founding	1.9227481862	0.0377231897	0.0788537995	0.0898877005	0.0138164289	-1.767469E-7	0.0336335463	0.000015764	-0.005317482
Total number of investors	0.0688524175	0.0482077021	0.0398880134	0.0138164289	0.0278494163	-2.882133E-8	0.0285410857	0.0000117244	0.0092384848
US GDP	-0.000021283	-3.713128E-7	-9.955451E-8	-1.767469E-7	-2.882133E-8	1.444617E-12	-1.381316E-7	-1.2924E-10	3.2758564E-8
Pro CEO	1.0486544027	0.1601391223	0.0576145146	0.0336335463	0.0285410857	-1.381316E-7	0.5599262384	0.0000615896	0.0261740621
No. Employees	0.0016872635	0.0001391618	0.0000274558	0.000015764	0.0000117244	-1.2924E-10	0.0000615896	1.4820741E-7	-0.000015704
Investment rounds	-0.925833997	0.0515290004	0.000307212	-0.005317482	0.0092384848	3.2758564E-8	0.0261740621	-0.000015704	0.0589493194

Correlation of Estimates

Variable	Intercept	Revenue/assets	Cost/Sales ratio	Years since founding	Total number of investors	US GDP	Pro CEO	No. Employees	Investment rounds
Intercept	1.0000	0.2006	-0.0074	0.3544	0.0228	-0.9787	0.0775	0.2422	-0.2108
Revenue/assets	0.2006	1.0000	0.1934	0.1167	0.2679	-0.2865	0.1984	0.3352	0.1968

Cost/Sales ratio	-0.0074	0.1934	1.0000	0.3570	0.3244	-0.1124	0.1045	0.0968	0.0017
Years since founding	0.3544	0.1167	0.3570	1.0000	0.2761	-0.4905	0.1499	0.1366	-0.0730
Total number of investors	0.0228	0.2679	0.3244	0.2761	1.0000	-0.1437	0.2286	0.1825	0.2280
US GDP	-0.9787	-0.2865	-0.1124	-0.4905	-0.1437	1.0000	-0.1536	-0.2793	0.1123
Pro CEO	0.0775	0.1984	0.1045	0.1499	0.2286	-0.1536	1.0000	0.2138	0.1441
No. Employees	0.2422	0.3352	0.0968	0.1366	0.1825	-0.2793	0.2138	1.0000	-0.1680
Investment rounds	-0.2108	0.1968	0.0017	-0.0730	0.2280	0.1123	0.1441	-0.1680	1.0000

Collinearity Diagnostics

			Proportion of Variation								
Number	Eigenvalue	Condition Index	Intercept	Revenue/assets	Cost/Sales ratio	Years since founding	Total number of investors	US GDP	Pro CEO	No. Employees	Investment rounds
1	7.56391	1.00000	0.00000572	0.00218	0.00148	0.00029999	0.00255	0.00000501	0.00352	0.00365	0.00073220
2	0.55254	3.699928	.093992E-7	0.02304	0.00000183	0.00002533	0.00738	6.451893E-7	0.04455	0.56698	0.00044594
3	0.32454	4.82772	0.00000197	0.01620	0.00128	0.00009821	0.19632	0.00000167	0.54065	0.01294	0.00001694
4	0.26090	5.38437	0.00000150	0.21714	0.00785	0.00065870	0.34955	0.00000172	0.13935	0.00227	0.00124
5	0.16889	6.69216	0.00001423	0.28109	0.25971	0.00000276	0.02626	0.00000829	0.10016	0.19474	0.01612
6	0.08612	9.37153	0.00007966	0.15538	0.40737	0.03585	0.08116	0.00006954	0.02498	0.13350	0.13379
7	0.03368	14.98611	0.00024109	0.14229	0.00283	0.20411	0.04822	0.00030312	0.03838	0.00000340	0.67005
8	0.00926	28.58547	0.01235	0.10120	0.31609	0.57194	0.28069	0.00844	0.09422	0.01634	0.15215
9	0.00015544	220.59166	0.98730	0.06148	0.00339	0.18701	0.00787	0.99117	0.01419	0.06957	0.02545

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Linear Regression Results

The REG Procedure
Model: Linear_Regression_Model
Dependent Variable: Tobins Q

Test of First and Second Moment Specification		
DF	Chi-Square	Pr > ChiSq
28	27.07	0.5143

Durbin-Watson D	2.297
Number of Observations	28
1st Order Autocorrelation	-0.162

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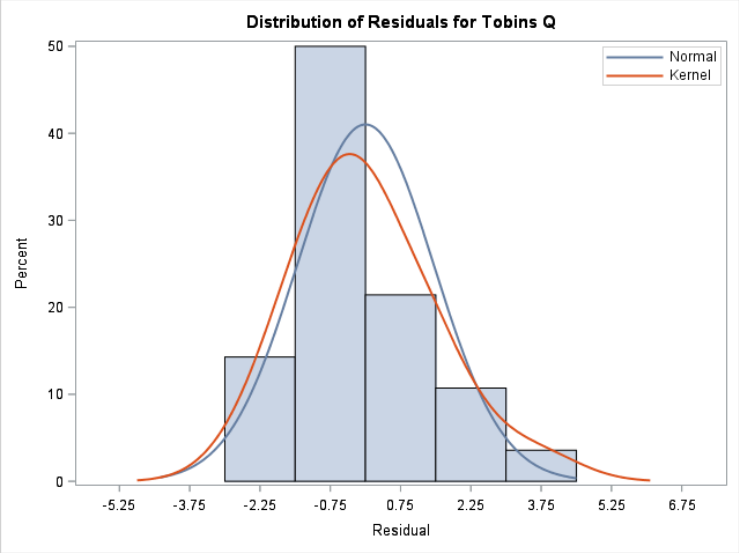
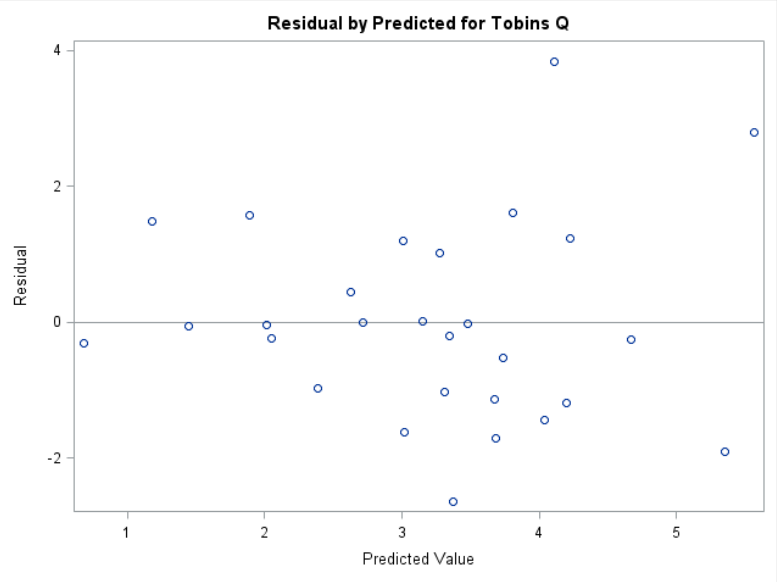
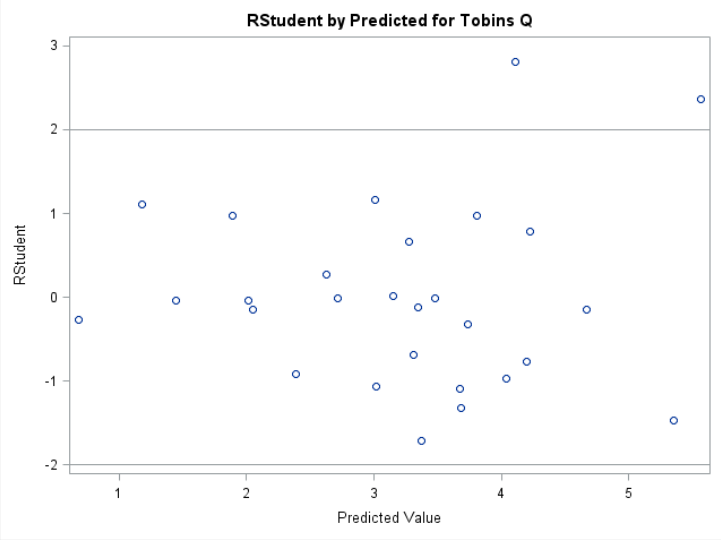
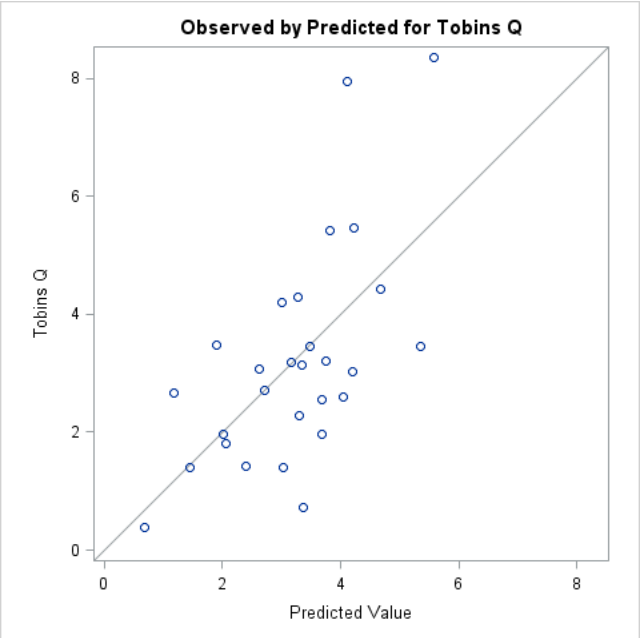
Linear Regression Results

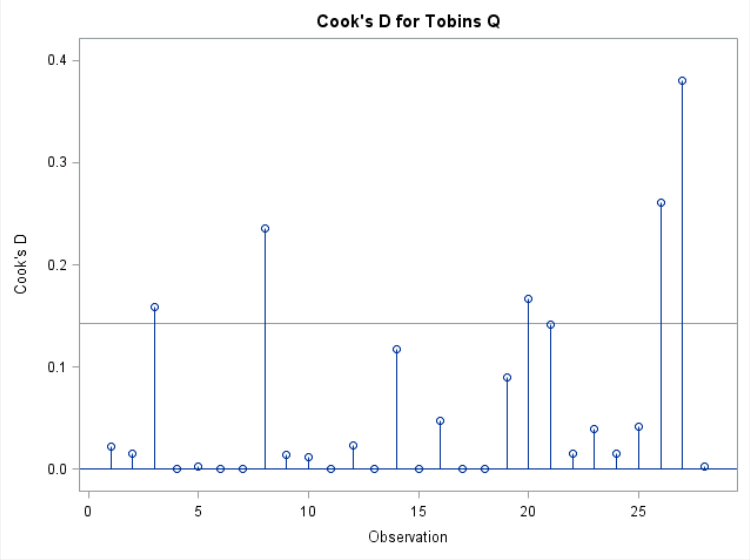
The REG Procedure
Model: Linear_Regression_Model
Dependent Variable: Tobins Q

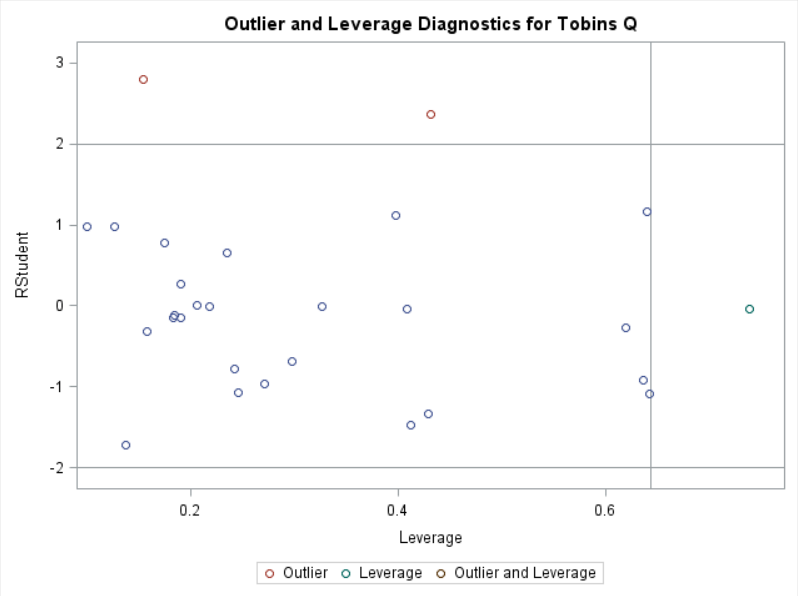

Distribution of Residuals for Tobins Q
Normal
Kernel
Percent
50
40
30
20
10
0
-5.25
-3.75
-2.25
-0.75
0.75
2.25
3.75
5.25
6.75
Residual

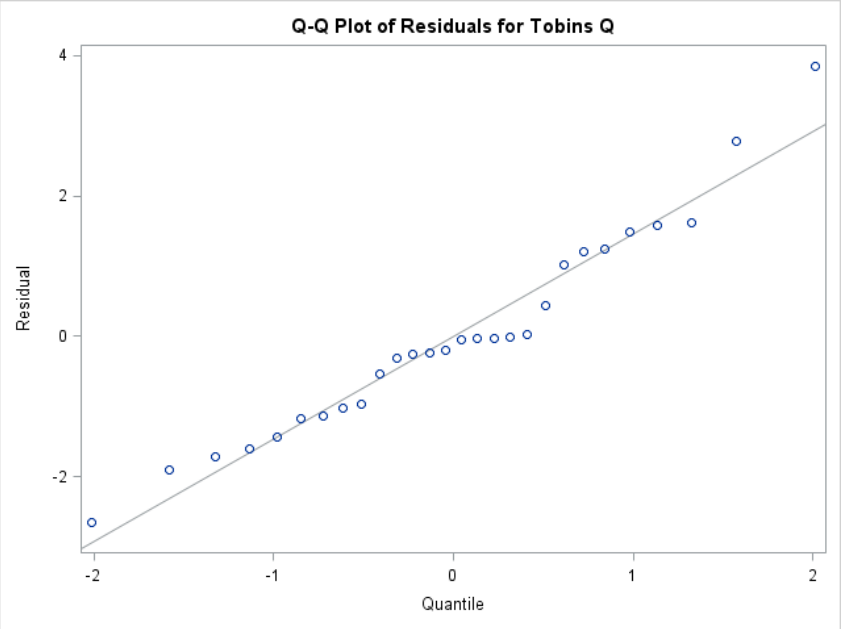

Residual by Predicted for Tobins Q
Residual
4
2
0
-2
1
2
3
4
5
Predicted Value

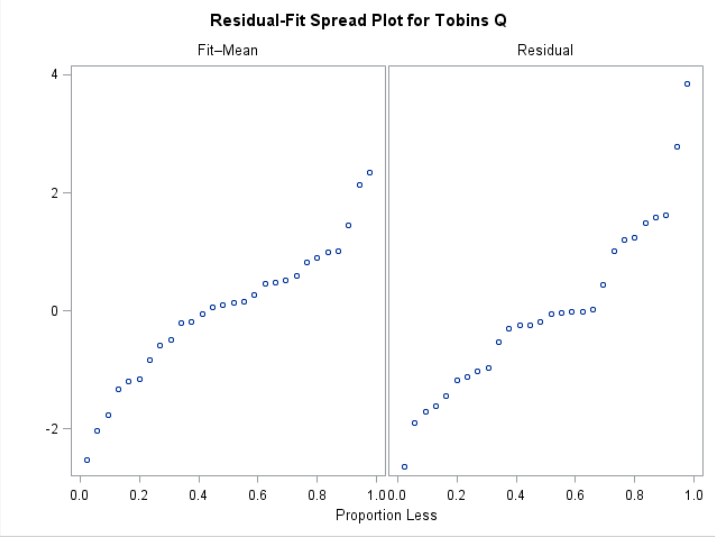

RStudent by Predicted for Tobins Q
RStudent
3
2
1
0
-1
-2
1
2
3
4
5
Predicted Value

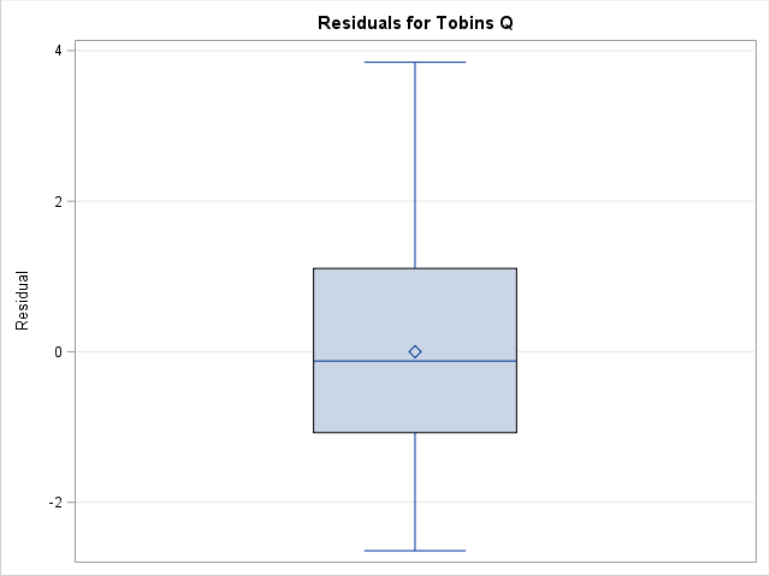

Observed by Predicted for Tobins Q
Tobins Q
Predicted Value
0
2
4
6
8

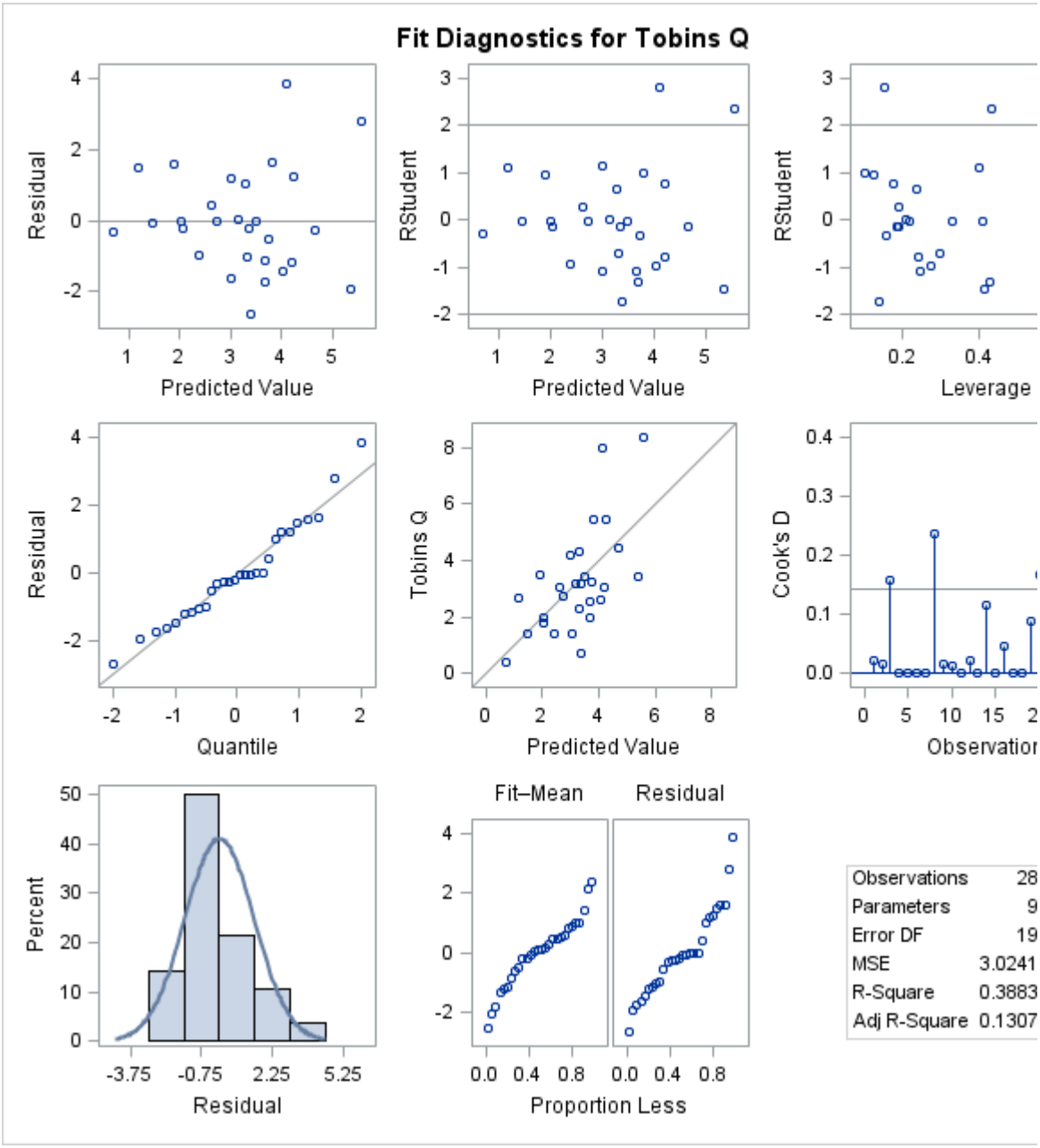

Cook's D for Tobins Q
Cook's D
Observation
0.0
0.1
0.2
0.3
0.4
0
5
10
15
20
25

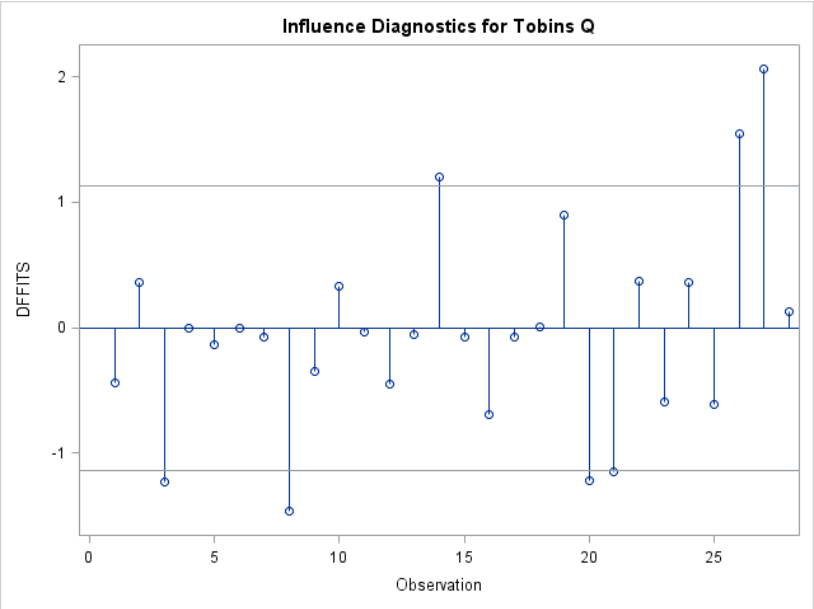

Outlier and Leverage Diagnostics for Tobins Q
RStudent
Leverage
Outlier
Leverage
Outlier and Leverage

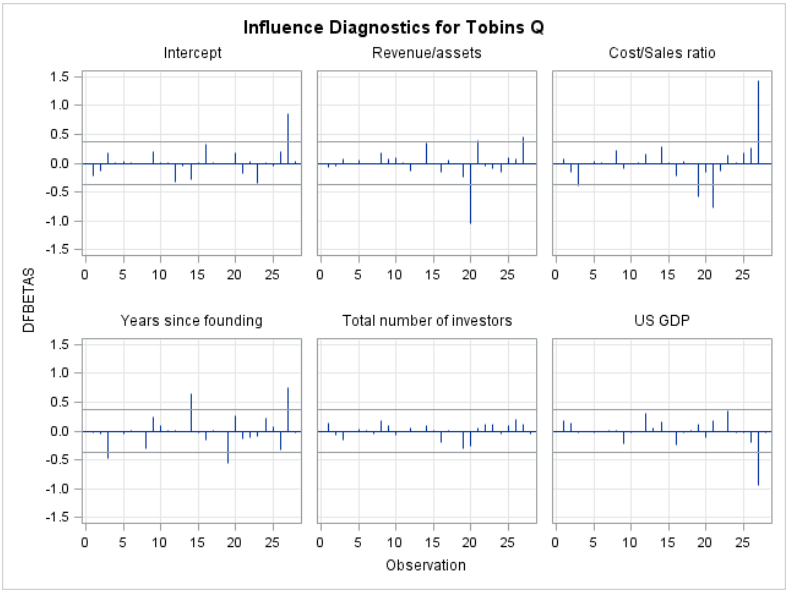

Q-Q Plot of Residuals for Tobins Q
Residual
Quantile

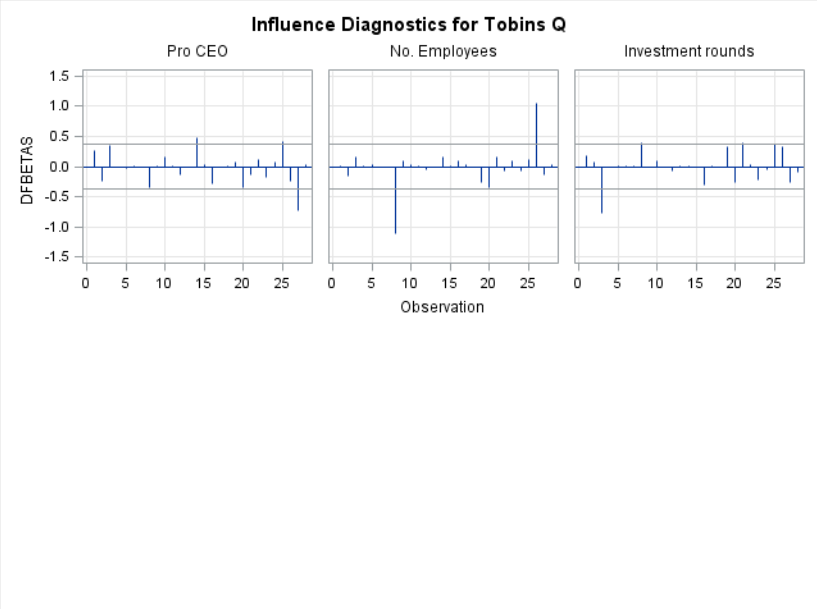

Residual-Fit Spread Plot for Tobins Q
Fit–Mean
Residual
Proportion Less

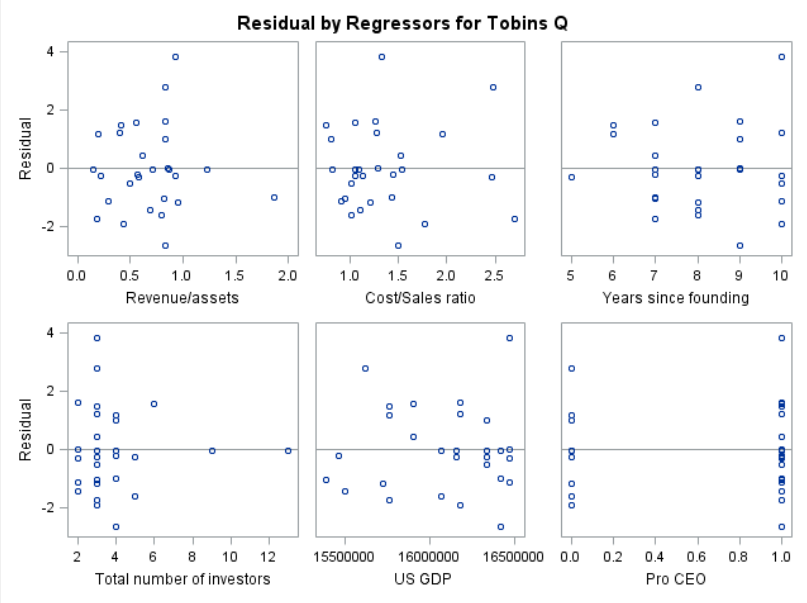

Residuals for Tobins Q
Residual
4
2
0
-2

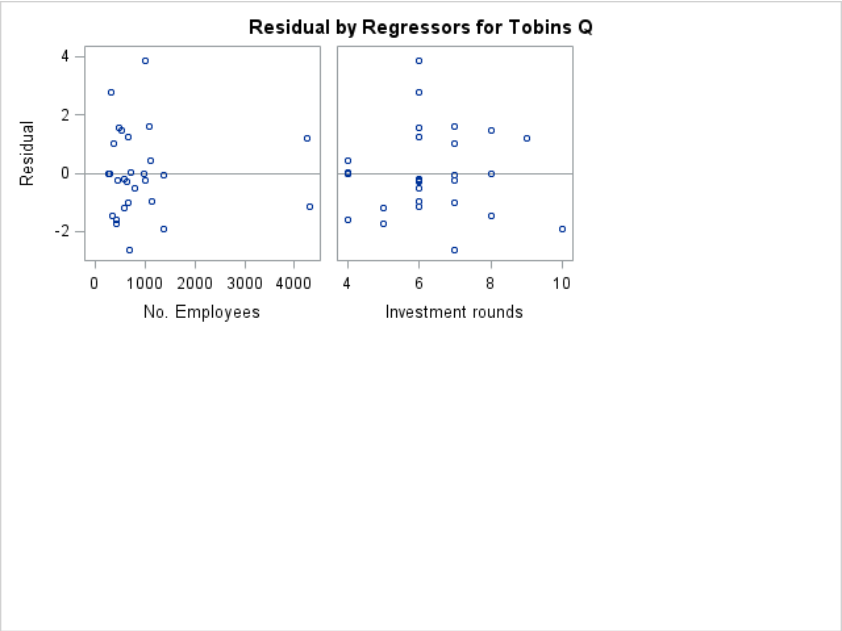

Fit Diagnostics for Tobins Q
Residual
Predicted Value
RStudent
Predicted Value
RStudent
Leverage
Residual
Quantile
Tobins Q
Predicted Value
Cook's D
Observation
Percent
Residual
Fit–Mean
Residual
Proportion Less
Observations 28
Parameters 9
Error DF 19
MSE 3.0241
R-Square 0.3883
Adj R-Square 0.1307


Influence Diagnostics for Tobins Q
DFFITS
2
1
0
-1
0
5
10
15
20
25
Observation


Influence Diagnostics for Tobins Q
Intercept
Revenue/assets
Cost/Sales ratio
Years since founding
Total number of investors
US GDP
DFBETAS
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
0
5
10
15
20
25
Observation


Influence Diagnostics for Tobins Q
Pro CEO
No. Employees
Investment rounds
DFBETAS
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
0 5 10 15 20 25
Observation


Residual by Regressors for Tobins Q
Residual
4
2
0
-2
0.0 0.5 1.0 1.5 2.0
Revenue/assets
1.0 1.5 2.0 2.5
Cost/Sales ratio
5 6 7 8 9 10
Years since founding
2 4 6 8 10 12
Total number of investors
15500000 16000000 16500000
US GDP
0.0 0.2 0.4 0.6 0.8 1.0
Pro CEO



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