

R&D Investment in New Product Development
within the Technology Sector

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October 2014

“I believe in innovation and that the way you get innovation is you fund research and you learn the basic facts.”

Bill Gates

Acknowledgments

Despite being an individual thesis, there were several people that in one way or another were unconditional important. Consequently, I would like to express my true gratitude. First of all, I would like to thank my parents for their guidance and friendship. A special gratitude to my brother for being patient and an amazing friend.

To my supervisors Dr Sofia Ramos and Dr Paulo Rita, both from ISCTE Business School (Portugal), for all the advices they gave me and all the time they invested to guide me.

To my fantastic friends for accepting me with all my faults and virtues. I carry you all in my heart. And a special note to my good friend Diogo Moreira for his help.

Finally, I would like to thank God for giving me my life on this earth.

Abstract

Through the fast growing globalization, the consumption of technology is showing a massive increase year after year. Since the beginning of this millennium, the number of people using all kinds of technology products is being spreading through all around the world. The consumers unsustainable needs for new and better technology products are the reason to the product life cycle decrease. In order to have a competitive product, companies have to focus their resources to new product development process by investing in research and development.

This dissertation was made with the purpose to understand the technology companies growth when investing in research and development. There are different technology sectors where the companies growth effects are different when they invest in research and development. Also, depending on the companies profitability, the research and development investment may have more or less effect in their growth. Consequently, the propose of this dissertation is to understand how the research and development investment has effect in the technology companies growth. In order to accomplish equitable results, we analyzed a few financial variables such as the asset growth, the return on assets and the return on equity.

To achieve accomplish the study results, it was conducted a linear regression model and a quantile regression model to analyze the variables relations.

This study shows which type of companies can accomplish higher results when investing in research and development. It also estimate a general positive effect from the research and development investment.

Keywords: Technology, Research and Development, New Product Development, Innovation

Resumo

Através do rápido crescimento da globalização, o consumo da tecnologia tem apresentado ano após ano um forte crescimento. Desde o início do milénio, que o número de pessoas a utilizarem produtos tecnológicos tem vindo a aumentar por todo o mundo. A insustentável necessidade por novos e melhores produtos tecnológicos tem originado uma redução do ciclo de vida do produto. Com o objectivo de possuírem um produto competitivo, é crucial às empresas focarem os recursos no processo de desenvolvimento de novos produtos através do investimento em pesquisa e desenvolvimento.

Esta dissertação foi elaborado com o propósito de perceber o crescimento das empresas tecnológicas quando estas investem em pesquisa e desenvolvimento. Dependendo dos vários sectores tecnológicos, o crescimento das empresas varia quando estas investem em pesquisa e desenvolvimento. Além disso, o efeito apresentado no crescimento das empresas quando investem em pesquisa e desenvolvimento depende da sua rentabilidade. Consequentemente, esta dissertação tem como objectivo perceber o efeito do investimento em pesquisa e desenvolvimento no crescimento nas empresas tecnológicas. Afim de atingir resultados fiáveis, analisámos algumas variáveis financeiras nomeadamente o crescimento dos activos, o retorno sobre os activos e o retorno sobre o património.

Para atingir os resultados pretendidos, foi executado o modelo de regressão linear e o modelo de regressão de quantílica com o propósito de analisar a relação entre as variáveis.

Este estudo apresenta que tipo de empresas conseguem atingir melhores resultados dependendo no investimento efectuado em pesquisa e desenvolvimento. Além disso, estima ainda que no geral existe um efeito positivo quando se investe em pesquisa e desenvolvimento.

Palavras-chave: Tecnologia, Pesquisa e Desenvolvimento, Desenvolvimento de Novos Produtos, Inovação

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Executive Summary

The main goal of this research is to understand how does the research and development (R&D) investment has influence in technology companies' growth by studying the return on assets, return on equity and the asset growth. In this present economic environment where technological advances happen very quickly and products life cycle is cut short, companies need a strategy for new product development (NPD), but also need to know the factors that determine the market success of new products (Roehrich, 2004). NPD is one of the most crucial aspects in companies, particularly in the technology industry where companies must invest in R&D in order to achieve competitive success.

This study reports the R&D effect in technology companies depending on which sector they belong to. Therefore it was analyzed five different sectors: Telecommunication and Equipment, Computer Hardware, Internet, Semiconductors and the Software. It was also integrated an analysis to each sector by two different markets the United States (U.S.) and the rest of the World (ROFW) market.

From the vast research that was made to previous studies about R&D, it was not found any study about this specific topic. Never the less, several authors have studied the R&D effect. In Eberhart, Maxwell and Siddique (2002), Miltersen and Schwartz (2004) and Damianova (2005) studies and also, with different approaches, Fain, Kline and Duhovnik (2011) and Meyer (2011) studies, by analyzing numerous companies, the authors perceived a positive effect in the companies' growth when investing in R&D. More skeptical studies Chan, Lakonishok and Sougiannis (2001) Jaruzelski, Dehoff, and Bordia, (2005) and Cryan and Theriault, (2012) suggest no link between the R&D investment and the companies' growth.

To collect the entire essential financial data from the technology companies relevant for the study, it was used the *Datastream* software. To perform this analysis, it was decided that we would study the years between 2003 and 2013. After collecting all the data, it was chosen to eliminate all the companies that were in the stock market for less than five years due to lack of data to study. With those restrictions, the total number of companies is 336.

By performing the descriptive statistics analyses, it was concluded that there was a strong relation between the R&D ratio and the financial variables chosen to study, being those variables: the asset growth and the return on assets. There were also two other conclusions, first it would make sense to study each sector separately, secondly, due to higher number of observations on the U.S. market compared to any other country, it would be interesting to compare it with the ROTW.

Considering the aim of this study, it was conducted a linear regression model with three different analyses. In the first it was studied the relation between the R&D investment and the asset growth for each sector. In this analysis, it was noticed a general positive relation between both variables. The second analyses consisted in studying the relation between the R&D ratio and the return on assets for each sector. In a first approach it was noticed that there were no statistical significance level, therefore it was decided to eliminate all the observations where the return on assets were negative, this restriction was used in all the dissertation which have produced more accurate results. The results showed also a positive effect of the R&D investment. The third analysis was focused on study the relation between the R&D, the return on assets and the return on equity, a variable introduced here, to study each sector.

Consequently it was used a quantile regression model to perform the same three analysis. By using this model, it was decided to divide the companies into three different groups. The first group consists of companies with low profitability and is showed by the 10th quantile while the second group consists of companies with average profitability and is showed by the 50th quantile or the median and the last group consists of companies with high profitability and is showed by the 90th quantile.

Finally, after perform booth models, an analysis has been made inside each model to conclude which sector have shown the highest growth when investing in R&D. In the quantile regression model, it was compared the companies' profitability with their performance. Finally, it was compared each model to understand which would show more accurate results by evaluate its statistical significance level.

Considering all the analyses that were conducted, it was concluded that the computer hardware sector had the highest results when investing in R&D and, in general, the Internet sector showed the lowest results. It was also noticed that companies with higher profitability from certain sectors showed higher performances, but the lowest performance were also shown from companies with higher profitability but from different sectors. The results that were obtained in this study show conformity with previous studies.

The results obtained exceeded our perspectives. The main reason for these positive results is, probably, the fact that this study is an analysis to a fast growing industry with a low product life cycle. R&D spending has higher impact in technology and science-oriented firms, which from their studies represent 17 percent of sales and two times earnings (Eberhart, Maxwell and Siddique 2007). Several authors Hof (1992), Verity (1992) and Steffens (1994) concluded that the products' life cycle is shrinking in all kinds of industries but especially in the technologic ones. To be more competitive, companies have to increase their investments in R&D, in order to create new products. Consequently, the results obtained show how this industry is affected by R&D investment.

1) Introduction

To maintain their competitive position, technology companies rapidly innovate in order to introduce new products by investing in R&D. It is estimate that in the beginning of 2000, 5% of the world population had access to the internet, fourteen years later the percentage of population with access to the internet have increased to 41% (source: Internet World Stats). This shows the massive increase of technology in people lives.

A large empirical literature has studied the R&D impact in all types of industries. With the goal of being more competitive, companies align their strategies to meet consumer's needs. This thesis investigates the effect of R&D investment on company's growth. R&D investments contribute directly to the development of new products and support indirectly the successful adoption of technologies developed outside the firm. In particular, R&D investments aim to improve the profitability of the firm (Damianova 2005). The decision to invest in R&D can be difficult to managers, especially not only because there is an uncertainty affected by the market unpredictability but also because the R&D investment may take long time to show returns. R&D investment projects typically take a long time to complete and since there is a learning process about the R&D project as investments proceed, there is large uncertainty about the investment costs required for the R&D project (Miltersen and Schwartz, 2004).

After collecting and analyzing all the available data, it was necessary to ignore some companies due the lack of data, therefore this study focus in five different sectors:

Telecommunication and Equipment

Computer Hardware

Internet

Semiconductors

Software

Because this is a fast growing industry, the importance to innovate and create new products is a crucial aspect in order to be competitive. Faster technological development, shorter product life cycle, and more intense global competition have transformed the current competitive environment for the most firms (Cassiman, Guardo and Valentini, 2006). Particularly in this industry, consumers are always looking for new products with new features to turn their lives easier and to create new products, it is essential to invest in R&D. Consumers are always ready to buy new product if those products fill their needs. The

consumer forms his preferences for a specific technology by evaluating technologies with respect to his perceptions of all available technologies that may fulfill his needs (Hauser, 1984). So, to survive to this fast growing market and to be more profitable, companies have to innovate by creating new products with new features, but profits come from sales and sales come from products that fill consumer's needs.

This research has the purpose of unveil how the investment in R&D has impact in the technology companies' growth. To understand the relation between the R&D investment and the technology growth, some variables such as the **asset growth**, the **return on assets (ROA)** and the **return on equity (ROE)** will be used. To analyze the technology market, we have used the *Datastream* software to collect data from companies with more than five years on stock market, from all stock markets in the world. As result of the large number of variables, it was necessary to use the *Stata* software to analyze it. Regarding the Datastream data, the technology market was divided by sectors in order to allow the study of each sector and to understand the R&D effect. It was also divided into two different markets, the United States (U.S.) and the rest of the World (ROFW) market. By conducting a study to those five technology sectors, by choosing those three variables in order to understand the relation with the R&D and by differentiating the U.S. market from the ROTW we hope to fill an existent gap of the R&D studies.

2) Literature Review

2.1) Introduction

Companies that establish the required organizational structures and processes in order to be more productive in creating new products are more likely to respond to what costumers need. Without a substantial investment in R&D, companies may fail in the new product development process. In several studies, authors tried to evaluate companies' financial performances when investing in R&D. The objective of this study is also to evaluate how R&D affects companies' financial performances by analyzing a specific type of industry. It is known that technology and healthcare industries invest more in R&D than any other industry. In Eberhart, Maxwell and Siddique (2008) studies, concluded that R&D spending has higher impact in technology and science-oriented firms, which from their studies represent 17 percent of sales and two times earnings. Having this in mind, this study conducts an analysis to the R&D investment in the technology industry. To link the importance of this study, this literature review has three main pillars: the NPD, the product life cycle and the R&D importance.

2.2) New Product Development

“When we create stuff, we do it because we listen to the customer, get their inputs and also throw in what we'd like to see, too. We cook up new products.” (by Steve Jobs. Beahm, 2011).

Creating new products is a critical factor in business activity where companies struggle to compete in a high level. As Patrick (1997) suggest, new products help maintaining growth and thereby protect the interests of investors, employees and suppliers of the organization. The R&D and marketing combination are considered to be a crucial factor within NPD. The more innovative the NPD projects are, the greater is the needed to integrate marketing and R&D functions within the company (Fain, Kline and Duhovnik 2011). An accurate representation of cross-functional relationships in NPD must include all three functional perspectives: R&D, marketing and manufacturing (Song 1997). R&D and marketing are important factors to the NPD. While the R&D has the main purpose of produce solutions during the NPD process, the marketing objective is to build and maintain relations with customers as also to analyze market changes and trends. Cooper and Kleinschmidt (2007) studied 161 companies and concluded that R&D spending for product development was the

main determinant at the product development effort. Do not expect to have a high-impact effort if management is not prepared to commit the R&D dollars as a percentage of sales (Cooper and Kleinschmidt 2007). NPD process has direct impact in companies' competitiveness, but depending on the type of industry the new products may have higher or lower life cycle.

2.3) Product Life Cycle

The life cycle refers to the period from the product's first launch into the market until its final withdrawal and it is split in phases (Komninos, 2001). The fast technology development and the global competitiveness have decreased the product life cycle. This unbroken change is forcing companies to a continuous innovation by investing in R&D. Consequently, knowledge has become an important aspect in companies strategic management. Several authors state that product life cycle is getting shorter over time. I can't document it, but every industry we look at seems to be undergoing shorter life cycles (Fraker, 1984), marketing consultants say product life cycles are shortening every year (Alsop, 1986). Most technology companies are experiencing highly volatile markets with increasingly shortening product life cycle due the rapid technological innovation and market competition (Aytac and Wu, 2013). The product life cycle decreasing, in the technology industry, is perceived by several authors such as Steffens (1994) NS Verity (1992). By noticing the life cycle decreases, companies had to develop and implement new strategies in order to accelerate the innovation and NPD process, consequently to become more competitive. Shrinking product life cycle brings critical changes in industries such as "increase in the percentage of revenues that should be spent on R&D and new product development" (Pierz,1995). To summarize, the fast creation of new products to replace older ones is shrinking products' life cycle. In industries where high competitive awareness is a critical factor to survive, the NPD process has a crucial importance in companies' success and therefore it is crucial to invest in R&D.

2.4) Research and Development

Creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of men, culture and society, and the use of this stock of knowledge to devise new applications. (OECD 2002)

The main purpose of this thesis is to focus in the R&D investment and understand how it contributes to technology companies' financial growth. With the conduct a relevant study, it was important to analyze previous research.

In order to grow and proliferate, companies must innovate by creating new products. Companies 'growth comes from sales and sales come from products that are, according to costumers needs. According with Utterback (1974), where the author studied over 2000 products and 100 industries and concluded that 60% to 80% of the successful innovations is drive by the perception and recognition of the consumers needs. The recognition of those needs, will simplify the effectiveness of the R&D processo to fulfill the consumers expectations. The R&D task was to refine the technology to increase consumer acceptance (...) R&D can focus on knowing physical characteristics or adapt, adopt, or invent new physical characteristics in order to deliver the consumers' benefits (Hauser, 1984). Struggling to survive in the market, companies must understand what people need and how can they deliver a product to answer to those needs.

Product competition during the marketing phase has a major importance for the R&D investment decision during the developing phase considering also that the competing products have to go through a similar development phase (Miltersen and Schwartz, 2002). Low competition between companies in the same market makes a more passive innovation and lower costs with R&D. Specially in "bad" times they (managers) are likely to protect their markets rather than expand their markets through innovative products (Geroski and Gleeg, 1997). Which means, when the market has a higher competition, there is more pressure through innovation and so companies will spend more with R&D so they can compete in the market. Specially, when we are talking about technology markets where the product life cycle is continuously shrinking. Markets like these are made by trends that are always evolving. According to Lee (2009) study, where the author analyzed 1021 firms in several countries, he notice that the response of companies to the competitive market pressure is related with the company level of technology competence, when a company has a high level of technological competence it will increase their R&D effort but when a company has a low level of technological competence it will reduce the costs with R&D. According with Tang (2005) study of 8916 Canadian companies between the period of 1997 and 1999, the author concludes that there are different effects of competition on innovation which depend on the competition measures and the innovation variables used. He showed

that “easy substitution is negatively correlated with innovation activities, the constant arrival of competing products is positively associated with R&D or products innovation, and, that quick obsolescence of products is positively related to R&D and product innovation, but negatively to acquisition of technology and process innovation”. Kukuk and Standler (2005) studied, based on a cross-section of 2.775 German companies where they analyzed the effects of relationships on innovation, by using two types of competition measures: a rivalry measure on a five points Likert Scale of the intensity of technology and the second one the market power as measured by the quantity of competitors. They concluded that technology competition boosts the innovative effort, but the effect of market power showed to be ambiguous.

Uncertainty is the key word between companies and the decisions to invest. Investing in R&D is not only an important aspect for companies to be updated with the new trends as also to improve the consumer’s perception and confidence. But there is several factors that can influence the investment decisions. The impact of R&D investments on the future economic performance of the firm is highly unpredictable since it is affected by market and technology uncertainty but also by firm’s ability to exploit emerging opportunities created by the uncertain environment (Damianova, 2005). Based on articles from Porter (1992), Hall (1993) and Hall and Hall (1993), they state that investors have short-term view and so they do not forecast future returns from long term investments such as R&D. Companies have opportunities to boost their R&D expenditures but they struggle with it because of the negative impact in short-term earnings per share (Cryan and Theriault, 2012).

There are several authors that analyze the R&D effect in companies by using a few financial data. A few studies concluded that the R&D investment has no effect in companies’ performance, Cryan and Theriault (2012) studied the 250 largest U.S. non financial companies, and concluded that just by increasing the R&D expenditures of a company, will not consequently lead to increase long-term value. Chan, Lakonishok and Sougiannis (2001) concluded, based on their analyses, that there is no direct link between R&D spending and future stock returns. For firms engaged in R&D, the evidence on an association between R&D intensity measured relative to sales and future returns is not strong (Chan, Lakonishok and Sougiannis, 2001), which means that high R&D plays a distinguished role arises from stocks with high R&D relative to the market value of equity. Another skeptical study was made by Jaruzelski, Dehoff, and Bordia, (2005) and it points out that there is no statistical conjunction within R&D intensity and a series of corporate performance indicators such as

sales growth, profits, market capitalization, or yield. It is also important to mention how difficult it is to perceive the R&D impact in the stock market. Returns to innovation are mostly earned by embodying it in a tangible good or service, which is then sold or traded for other information that can be embodied (Pakes, 1984). Consequently, it is very difficult to understand the direct impact of innovation, it is not like sales variables or costs variables. Different results were obtained from several authors, such as Eberhart, Maxwell and Siddique (2002) where they studied 8.313 companies and concluded that between the five-year period following companies R&D increases, there was consistently strong evidences that firms experience significantly positive abnormal operating performance. They also concluded that investors continually underrate the benefit and importance of an R&D increase. From others studies, we notice that there is a link between R&D investment and the market value, companies that report positive profits receive a higher market evaluation for their R&D activities than companies with negative profits. Miltersen and Schwartz (2004) used a model to show that competition in R&D in most cases not only increases production and reduces prices, but also shortens the time of developing the product and increases the probability of a successful development. The empirical evidence reported in this study confirms that there is a certain direct link between R&D investments and the market value of the firm, as reported in previous studies (Damianova 2005). Some other studies are also relevant to this research, such as the Fain, Kline and Duhovnik (2011) study that concludes by performing a questionnaire survey that people perceive the R&D effort in new products. Meyer (2011) studied the R&D in a global vision and concluded “Countries with high R&D elasticity also experience much faster technological progress with corresponding productivity gains”.

Several authors have studied the importance of R&D in several markets and industries leaving some gaps to being study. A large empirical literature suggests the importance of the R&D in the NPD particularly in industries where the product life cycle is shrinking. Therefore an analysis to the R&D effect into the technology industry could potentially offer knowledge to better understand this subject.

3) Methodology

Technology companies are growing year after year not only in number but also in profit. The main aim of this analysis is to understand how the investment in R&D affects the technology market.

To conduct the thesis study, we had to collect the technology companies' financial data from the *Datastream Professional*. After gathering all the technology companies' financial data, we used the *Stata* software to perform the analysis.

3.1) Regression Models

3.1.1) Linear Regression

In order to achieve the best results, this study starts by doing a **linear regression**. Linear regression is a statistical tool for modeling the relationship between a dependent variable and one or more independent variables (Klein & Amos, 1999). When performing a linear regression model, the dependent variable is a linear function of one or more independent variables and it is given by the following equation:

$$y = \beta_0 + \sum \beta_i X_i$$

Equation 1: Equation in the Linear Regression

The linear regression is a model that analyzes the past period helping to forecast. Practitioners have been found to be very familiar with linear regression and to employ it as a forecasting tool in tasks such as sales prediction (Mentzer and Cox, 1984 Sanders, 1994). By using the Linear Regression we made three different analyses:

1. A linear regression to study the relation between the Asset Growth and the Research and Development ratio for each sector.
2. A linear regression to study the relation between the Return on Assets and the Research and Development ratio for each sector.
3. A linear regression to study the relation between the Return on Assets, the Return on Equity and the Research and Development ratio for each sector for all the companies inside the United States and for those Outside the United States.

3.1.2) Quantile Regression

After performing the linear regression, it was decided to perform a **quantile regression**. The quantile regression is a model that divides the population provides a convenient way to introduce a type of heterogeneous treatment effect (e.g. Abramovitch 1979, Doksum 1974, Koenker 2005). By using this model it was possible to divide the population in three different quantile:

1. Technology companies with lower profitability are shown in quantile10.
2. Technology companies with average profitability are shown in quantile50, which also represent the median.
3. Technology companies with highest profitability are shown in quantile90.

The analysis of those three quantiles it will give some conclusions of how the investment in R&D affects the technology companies depending on their profitability.

4) Method

This study registered a total of **376 technology companies within six different sectors**. Of those companies, a total of 30 were considered invalid because they had been in the stock market less than five years, which displays a lack of data. Therefore this study was conducted with a total of **346 valid technology companies**, representing 92% of all technology companies in the stock market from all around the world.

4.1) Time Period

While collecting the financial data it was decided to study a specific period of time, following that decision it was chosen to use the years between 2003 until 2013. It was determined to study this period of time because of three things, it is the most recent years that we have, secondly it gives us an understanding of the beginning of the century through the great crisis of 2009 and finally it was decided to exclude the period of the dot.com bubble because there was a high speculation about the technology companies which makes it irrelevant to study.

4.2) Filter

According to the previous studies that were analyzed from some authors, it was decided to impose a filter on our sample. All the technology companies in this study have been in the exchange market for more than five years. There are two reasons that made us suppress all the technology companies who entered the market exchange in the past five years, firstly because it would have some companies with lack of results to study, secondly because this way we have more mature technology companies. With this restriction we have more consolidated results. Of the 376 technology companies listed in all stock markets around the world, it will be studied a total of 336.

4.3) Sectors

Each technology company that was collected from *Datastream* belongs to a specific industry sector inside the technology market. The 336 technology companies are divided by six different industry sectors, as it is shown in table 1.

Table 1: Percentage of the total observations in each sector

Technology sectors	% of the total observations
Telecommunication and Equipment	14%
Computer Hardware	12%
Computer Service	19%
Internet	8%
Semiconductors	21%
Software	26%

Through the differentiation of the technology companies by each sector, it is possible to analyze the different R&D effects depending on the technology sector. Therefore, this study will show in which sector the R&D investment has more impact in the companies' growth.

4.4) Variables

The main purpose of this study is to understand how technology companies' growth is being affected when it is invested in R&D. According to that, it was necessary to collect some data from each company to study their financial performance. Table 2 shows the variables that were used in this study.

Table 2: Variables

Variables	Definition	Formula	Type of Variables
R&D ratio	Direct and indirect costs related to the creation and development of new processes, techniques, applications and products with commercial possibilities. Being these costs categorize as basic research, applied research and development costs of new products	R&D expenses / Assets	Explanatory
Asset Growth	It is a variable that represent the performance of the companies assets	(Assets / Assets t-1) -1	Dependent
Return on Assets	It is an indicator that relates how profitable is a company with its total assets, it give as what earnings were generated from invested capital	EBIT / Assets	Dependent
Return on Equity	The volume of net income that is returned as a percentage of shareholders equity. It measures a company profitability by acknowledge how much profit a company originate with the money that shareholders have invested	Net profits /	Dependent

While studying our sample, it was found some missing values of some companies' financial data, therefore we had to eliminate the outliers when performing the analysis in *Stata* by using the command *winsorize*.

4.5) Sample Segmentation

Like other researches, this first phase will segment all the data that was collected from the Datastream network through a descriptive statistic analysis.

4.5.1) Variables by Sector

Following the main goals of this research, it is mandatory to start the descriptive statistics by analyzing the three most important variables by sector, consequently, the subsequent tables will show the mean, standard deviation, the median and the observations number of each variable by each sector

4.5.1.1) Research and Development Ratio by Sector

Table 3 shows the R&D ratio variable by sector where it is possible to verify a total of 1299 observations. By measuring the mean with the median, p50, it is notable that there is a central tendency, which indicates symmetry of the R&D ratio data. It is possible to verify the low number of Computer Service observations comparing to the fact that this sector represents 19% of the total companies. The Semiconductor registered the highest mean from all the sectors followed by the Software and the Telecommunication sector. The Software sector accounts for 39% of all the R&D ratio observations.

Table 3: R&D Ratio Statistics by Sector

Sector	R&D Ratio			
	mean	sd	p50	N
Computer Hardware	0,09	0,03	0,09	107
Computer Service	0,09	0,03	0,08	63
Internet	0,08	0,02	0,07	24
Semiconductors	0,16	0,11	0,13	395
Software	0,14	0,08	0,11	509
Telecommunication and Equipment	0,14	0,10	0,11	201
Total	0,14	0,09	0,11	1299

*** p<0.01, ** p<0.05, * p<0.1

4.5.1.2) Asset Growth by Sector

From the descriptive statistics analysis displayed in the table below, the Internet sector shows the highest mean with 5,2% of the observations followed by the Software sector accounting for 32,9% of the total observations. The Internet sector median is higher than the mean which implies the existence of extreme lower values that are farther from the mean than the extreme higher values. The asset growth variable accounts for 1185 observations, which shows a decrease of 114 observations comparing to the R&D ratio variable. With the Computer Hardware exception, all the sectors show a higher standard deviation compared to the mean, those results can be the consequence of the outliers' existence.

Table 4: Asset Growth Statistics by Sector

Asset Growth				
Sector	mean	sd	p50	N
Computer Hardware	0,51	0,47	0,46	103
Computer Service	0,53	0,63	0,45	217
Internet	0,64	0,90	0,71	62
Semiconductors	0,34	0,49	0,31	246
Software	0,63	0,64	0,57	390
Telecommunication and Equipment	0,41	0,65	0,38	167
Total	0,51	0,62	0,47	1185

*** p<0.01, ** p<0.05, * p<0.1

4.5.1.3) Return on Assets by Sector

The return on assets variable shows the highest number of observations (2092) compared to the previous two. From the table below, it is possible to analyze that the standard deviation values are higher than the media values. The Computer Service, the Internet, the Semiconductors and the Software sector showed a lower mean compared to the median values. The Software sector present the highest mean and accounts for 32,5% of the total number of observations. The Computer Service sector displays the lowest mean and the highest standard deviation.

Table 5: Return on Assets Statistics by Sector

ROA				
Sector	mean	sd	p50	N
Computer Hardware	7,91	10,39	6,80	183
Computer Service	4,46	23,06	6,29	395
Internet	6,50	18,54	7,46	132
Semiconductors	6,87	13,27	8,47	406
Software	7,00	17,05	8,47	680
Telecommunication and Equipment	6,50	12,18	5,71	296
Total	6,47	16,78	7,22	2092

*** p<0.01, ** p<0.05, * p<0.1

4.5.2) Research and Development ratio and Return on Assets by Country

Considering the fact that this study includes companies all over the world, it is imperative to have a descriptive statistical analysis by country. The main propose of the following table is basically to evaluate the total number of observations by each country and to perceive any inconsistent value to determinate if it is pertinent to perform any kind of analysis by country. In a first approach, it is relevant to point out that in 34 countries, the United States accounts for 33,7% of the Return on Assets total observations and 50,6% of the R&D ratio observations. Secondly, there are 16 countries with no R&D ratio observation. With this results, it is essential to perform deeper analyzes. Consequently, it will be conducted an analysis between the United States technology companies and the rest of the World.

Table 6: R&D ratio and Return on Assets Statistics by Country

Market	Return on Assets				R&D ratio			
	Mean	sd	p50	N	Mean	sd	p50	N
Australia	19,75	16,88	21,12	21	0	0	0	0
Belgium	9,38	13,45	5,94	43	0,23	0,03	0,25	9
Brazil	15,23	3,16	15,14	7	0,07	0,02	0,07	8
Canada	14,15	17,12	11,81	65	0,12	0,04	0,10	64
Chile	8,25	0,55	8,32	6	0	0	0	0
Cyprus	4,83	1,99	3,92	7	0	0	0	0
Denmark	30,04	4,60	30,42	7	0,07	0,01	0,07	7
Finland	11,03	8,01	11,4	40	0,22	0,10	0,21	37
France	4,84	8,07	5,24	172	0,13	0,06	0,12	92
Germany	5,10	14,77	6,86	207	0,15	0,10	0,13	143
Greece	2,54	7,66	3,28	19	0,06	0,01	0,06	3
Hong Kong	-2,53	11,69	-2,88	12	0	0	0	0
Hungary	-2,56	8,26	0,39	25	0	0	0	0
India	17,24	6,34	17,22	50	0	0	0	0
Ireland	-3,72	5,93	-3,94	10	0,08	0	0,08	2
Israel	-25,18	22,83	-30,46	4	0,06	0,01	0,06	3
Italy	0,64	8,27	3,71	44	0	0	0	0
Japan	9,71	10,63	6,92	63	0	0	0	0
Malta	3,34	22,77	2,14	20	0	0	0	0
Marocco	5,41	2,20	6,48	8	0	0	0	0
Netherlands	-3,39	36,22	5,44	151	0,11	0,04	0,10	56
New Zealand	-42,92	53,80	-50,02	9	0,09	0,03	0,08	6
Norway	2,64	11,90	2,86	14	0,05	0	0,05	1
Poland	7	2,98	7,49	10	0	0	0	0
Portugal	1,68	8,38	2,05	29	0,05	0	0,05	1
Singapore	38,21	17,83	36,81	10	0	0	0	0
South Korea	18,34	11,85	20,66	11	0	0	0	0
Spain	3,38	8,60	5,42	38	0,08	0,01	0,08	4
Sweden	26,45	0	26,45	1	0	0	0	0
Switzerland	7,83	7,13	7,70	70	0,13	0,06	0,12	48
Taiwan	6,87	0,84	7,02	8	0	0	0	0
Thailand	8,43	9,54	5,53	30	0	0	0	0
United Kingdom	7,61	11,83	7,91	177	0,23	0,15	0,19	158
United States	7,74	13,41	8,91	704	0,11	0,06	0,10	657
Total	6,47	16,78	7,22	2092	0,14	0,09	0,11	1299

*** p<0.01, ** p<0.05, * p<0.1

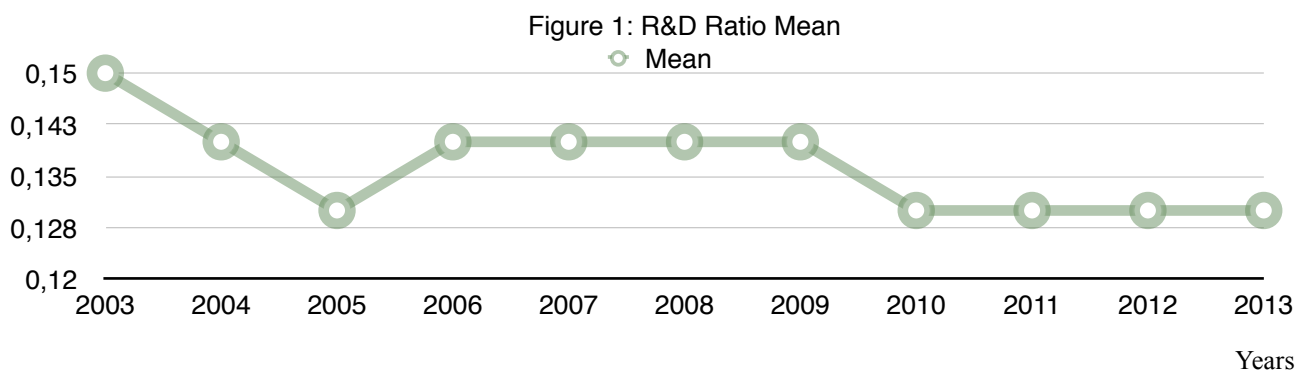
4.5.3) Research and Development ratio and Return on Assets by Years

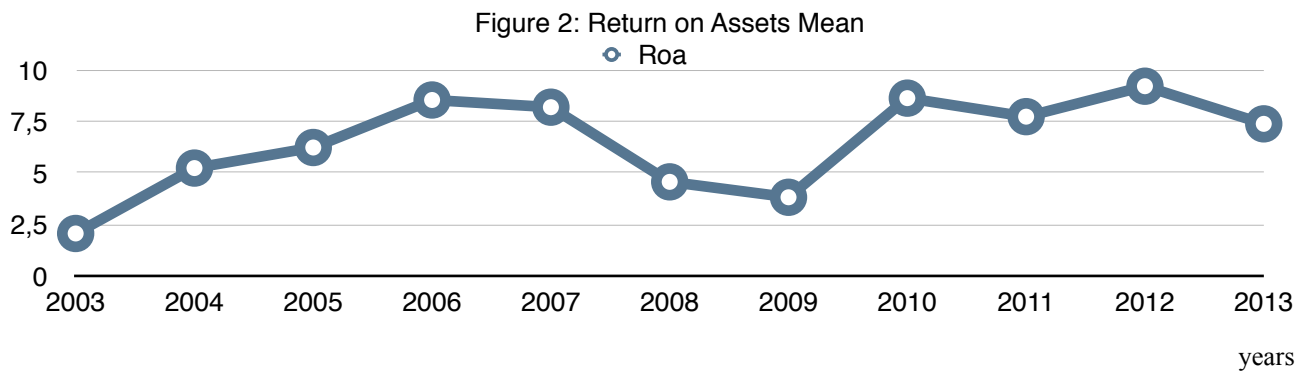
The table 7 shows the last phase of the descriptive statistical analysis by studying the R&D ratio variable and the Return on Assets in each year from this study time period. The table displays scattered values in the return of assets mean between 2003 and 2013 with not influencing in the R&D ratio variable. Both figures displays both variables mean through time suggesting that there is no relation between them.

Table 7: R&D ratio and Return on Assets Statistics by Years

Year	ROA			R&D ratio		
	Mean	sd	p50	Mean	sd	p50
2003	2,05	18,90	4,23	0,15	0,11	0,12
2004	5,23	22,08	6,94	0,14	0,09	0,12
2005	6,23	19,80	8,32	0,13	0,09	0,11
2006	8,54	16,58	7,83	0,14	0,09	0,12
2007	8,19	16,26	8,40	0,14	0,10	0,11
2008	4,56	21,12	7,39	0,14	0,09	0,11
2009	3,81	16,96	5,41	0,14	0,08	0,11
2010	8,63	11,13	8,12	0,13	0,08	0,11
2011	7,73	11,91	7,85	0,13	0,08	0,10
2012	9,21	10,25	8,13	0,13	0,09	0,10
2013	7,38	10,46	7,24	0,13	0,09	0,10
Total	6,47	16,78	7,22	0,14	0,09	0,11

*** p<0.01, ** p<0.05, * p<0.1





4.5.4) Sample Segmentation Main Conclusions

After conducting this first analysis there are some conclusions to make, when studying the R&D ratio variable by sector, it was pointed out the lack of observations from the Computer Services sector comparing with the fact that this sector accounts for 19% of all the technology companies. Therefore, this absence of data will have a deep influence in the overall study. In order to get accurate results, it was decided to reject this sector. Consequently, from the 346 valid technology companies it will be ignored 72 of them, which makes a total of **274 valid companies**. There are some outliers in those 274 companies, which will be eliminated for the next analysis by using the command *winsorize* in the *Stata* software. When studying the R&D Ratio and the Return on Assets variables for each country, it was perceived the importance of making a comparison between the United States companies against the rest of the World companies. In the last descriptive statistical analysis, it was noticed that there was no relation between the R&D ratio and the Return on Assets when studying each by year.

5) Results

5.1) Linear Regression Model

After performing a descriptive statistical analysis to the sample, it is time to conduct a linear regression to the 274 valid technology companies from the five sectors. From this point forward, the R&D ratio variable will be used as lagged variable. Considering the results that were obtained in the previous analysis, it was decided to conduct three different analyses.

5.1.1) Research and Development Ratio and the Asset Growth by Sector

In order to understand how the investment in R&D has affected the companies asset growth, it was conducted a linear regression to study both variables. The table below displays the results between the two variables for all the technology companies. It is certain that there is a positive effect from the R&D investment into the asset growth between the second period and the last one, shown by L2, L3, L4 and L5. It is possible to verify the existence of statistical significance at the 1% level in the two highest results, L4 and L5. The highest value is displayed by the fourth lagged variable, 1,47, suggesting that the asset growth will increase by 1,47 when the L4 increases by one.

Table 8: R&D Ratio and the Asset Growth of all Technology Companies

Variables	Asset Growth					
L1 R&D ratio	-0,54					
	0,50					
L2 R&D ratio		0,11				
		0,44				
L3 R&D ratio			0,66*			
			0,40			
L4 R&D ratio				1,47***		
				0,36		
L5 R&D ratio					1,22***	
					0,32	
Constant	0,56***	0,48***	0,40***	0,27***	0,29***	
	0,07	0,07	0,06	0,07	0,06	
Observations	754	753	747	737	636	
R-squared	0,01	0,00	0,01	0,06	0,05	

*** p<0.01, ** p<0.05, * p<0.1

The table below summarizes the most important conclusion of each sector (appendix 1.1) by displaying the intervals where there is a positive effect between the R&D ratio and the asset growth. The table also shows the highest result of each sector so it is possible to perceive when the R&D ratio has stronger effect in the asset growth.

Table 9: R&D Ratio and the Asset Growth positive effect by Sector

Asset Growth	Positive effect of the R&D	Highest positive variable
All Sectors	L2 → L5	L4
Telecommunications and equipment	L1 → L5	L5
Computer hardware	L2 → L5	L4
Internet	L1 → L3	L2
Semiconductors	L2 → L5	L5
Software	L2 → L5	L4

When comparing each sector, it is evident that the Internet is the only sector with a negative effect in the last two lagged variables. It is relevant to refer that the Internet sector displays only 15 observations, accounting for 2% of the total observations, suggesting a possible absence of accuracy. All the other sectors displayed highest results between the last two periods, L4 and L5.

5.1.2) Research and Development Ratio and the Return on Assets by Sector

To measure the relation between the investment in R&D and the return on assets, it was conducted a linear regression. After performing the first analysis to the 1196 observations (appendix 1.2), it was concluded that there was a lack of statistical significance level in all the five results that suggested a possible lack of accuracy. It was also noticed a negative influence between both variables in the first two results. So, in order to achieve accurate conclusions, it was decided to conduct the study by adding a new restriction, the entire negative return on assets negative values would be ignored. With this new restriction the total of observations decreased 13,6%, from 1196 to 1034.

Table 10: R&D Ratio and the Return on Assets of all Technology Companies

Variables	Return on Assets				
L1 R&D ratio	12,18***				
	4,19				
L2 R&D ratio		11,02***			
		4,17			
L3 R&D ratio			11,44***		
			4,11		
L4 R&D ratio				8,10**	
				4,04	
L5 R&D ratio					3,82
					4,73
Constant	10,04***	10,21***	9,96***	10,26***	10,78***
	0,74	0,77	0,79	0,83	0,89
Observations	1034	934	825	717	607
R-squared	0,02	0,02	0,02	0,01	0,00

*** p<0.01, ** p<0.05, * p<0.1

The table above shows the relation between both variables with the restriction. By adding this restriction there is a statistical significance level increase as also a result with positive effect between the variables. As in the previous analysis, the table below shows the performance of the relation between both variables for the five sectors. To achieve the table 11 results, it was essential to perform a linear regression analysis by each sector. The main goal of this investigation is to find out when the investment in R&D has higher effect in the return on assets of the technology companies. Like in the last regression, the Internet sector shows some unusual results compared to the others four sectors.

Table 11: R&D Ratio and the Return on Assets positive effect by sector

Return on Assets by sector	Positive effect of the R&D	Highest positive variable
All Sectors	L1 → L5	L1
Telecommunications and Equipment	L1 → L4	L1
Computer Hardware	L1 → L5	L3
Internet	L1, L4 → L5	L5
Semiconductors	L1 → L3	L2
Software	L1 → L5	L4

5.1.3) Research and Development Ratio, Return on Assets and Return on Equity by Sector in Different Markets

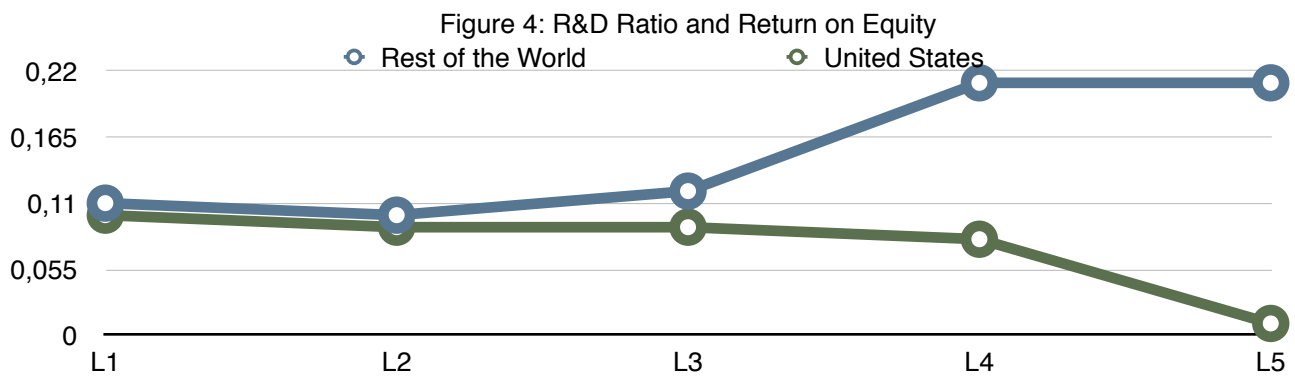
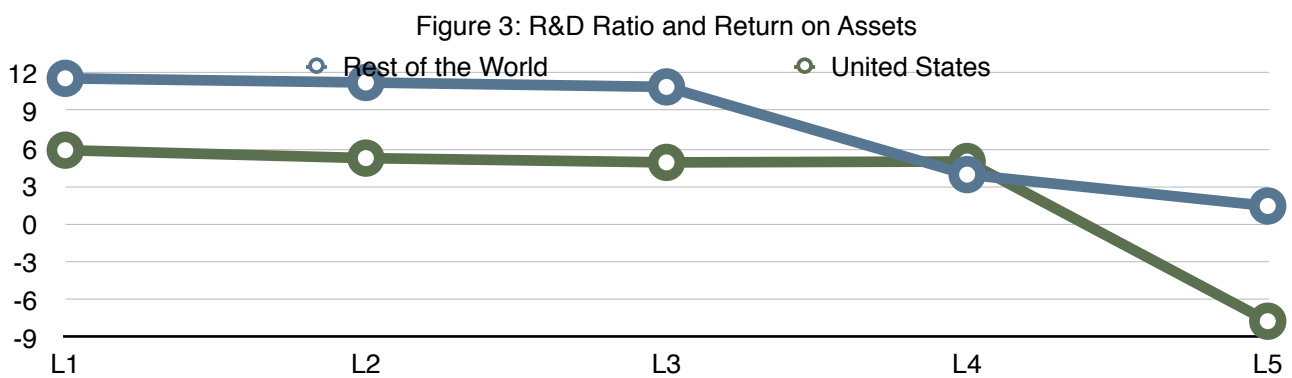
Like in the previous analysis, the return on assets restriction is also included in this linear regression. It is also important to refer the use of the return on equity as a dependent variable. By interpreting the table below, it is possible to analyze the relation of those three variables by having a differentiation of the technology companies from the rest of the World and against those from the United States. Regarding the higher number of observations of the U.S. compared to the rest of the World, the general relation between the R&D ratio with the return on assets and the relation between the R&D ratio with the return on equity displays lower results from the U.S. companies. The displayed figures present a more perceptive way to interpret the results where it is possible to perceive the highest results in the rest of the World results with just one exception showed by the relation between the R&D ratio and the return on Assets displayed by L4. It is also relevant to mention the presence of a highest statistical significance level showed by the three first results from the relation between the R&D ratio and the return on assets.

Table12: R&D Ratio, Return on Assets and Return on Equity of all Technology Companies from the ROFW and the U.S.

Variables	Rest of the World					United States				
L1 R&D ratio	11,58**					5,88				
	4,46					6,79				
L1 ROE	0,11***	0,10***	0,12***	0,21***	0,21***	0,10***	0,09***	0,09***	0,08***	0,01***
	0,03	0,03	0,02	0,05	0,05	0,02	0,02	0,02	0,02	0,02
L2 R&D ratio		11,25**					5,25			
		4,86					5,94			
L3 R&D ratio			10,90**					4,91		
			4,17					6,66		
L4 R&D ratio				3,94					4,98	
				3,92					7,02	
L5 R&D ratio					1,45					-7,69
					4,93					8,00
Constant	8,06***	8,41***	7,63***	7,24***	7,78***	8,99***	9,11***	9,03***	8,98***	10,34***
	1,24	1,22	1,08	1,10	1,22	0,94	0,89	0,93	0,97	1,07
Observations	453	423	382	338	286	480	436	384	334	285
R-squared	0,20	0,17	0,27	0,22	0,20	0,13	0,11	0,10	0,10	0,10

*** p<0.01, ** p<0.05, * p<0.1

The results obtained shows two different relations that are worth to mention. When comparing the relation between both figures below, it is perceived that the U.S. results present a similar behavior between the R&D ratio relation with the return on assets and the return on equity. In both cases, the results are very uniform until L4 with a strong decrease to L5. In the contrary, the rest of the World results displayed an opposite behavior. While the relation between the R&D ratio with the return on assets decreases between the period, the R&D ratio relation with the return on equity increases through the same period.



Regarding the linear regression by sector, the table below summarizes the main results obtained from each sector (appendix 1.3). As result of the low observation number displayed by the Internet sector from the rest of the World, it was impossible to perform a linear regression in order to achieve any conclusion. Both Telecommunication and Equipment sector as also Semiconductors sector from the U.S. show a negative influence from the R&D investment into the return on assets. By performing an analysis to each sector, it is suggested a better performance in the outset. The low number of observations in some sectors, may be the reason for some scattered values that are shown in the appendix.

Table 13: R&D Ratio, Return on Assets and Return on Equity positive effect by sector from the ROTW and the U.S.

	Positive effect of the R&D	Highest positive results
Rest of the World - All Sectors	L1 → L5	L1
U.S. - All Sectors	L1 → L4	L1
ROTW - Telecommunications and Equipment	L1 → L4	L1
U.S. - Telecommunications and Equipment	None	None
ROTW- Computer Hardware	L2 → L3, L5	L2
U.S. - Computer Hardware	L1 → L5	L5
ROTW - Internet	-	-
U.S. - Internet	L1 → L5	L3
ROTW - Semiconductors	L1 → L3	L1
U.S. - Semiconductors	None	None
ROTW - Software	L1 → L3	L2
U.S. - Software	L1 → L4	L1

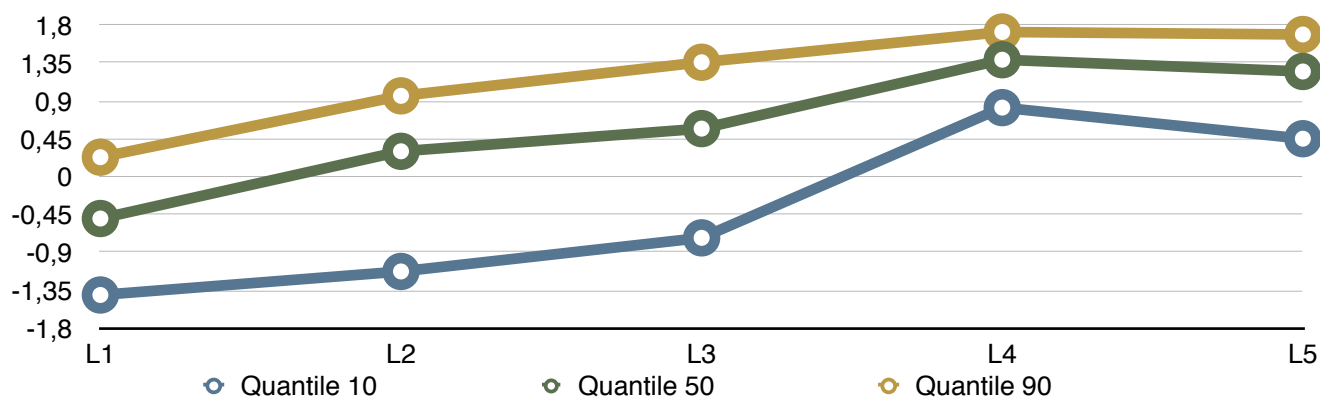
5.2) Quantile Regression

In order to study the relation between the R&D investment and the companies growth depending on the company's profitability, it will be conducted a quantile regression by following the same steps as in the linear regression.

5.2.1) Research and Development Ratio and the Asset Growth by Sector

The following figure shows the relation between the R&D ratio and the asset growth of all the technology companies with 754 observations (appendix 2.1). As it was mentioned before, each quantile accounts for different companies profitability. According to the results that are displayed in the figure below, companies with higher profitability have shown a better performance when investing in R&D comparing to those with lower profitability. Companies with low profitability have shown a negative relation between both variable in the first three periods.

Figure 5: R&D Ratio and the Asset Growth from all Technology Companies



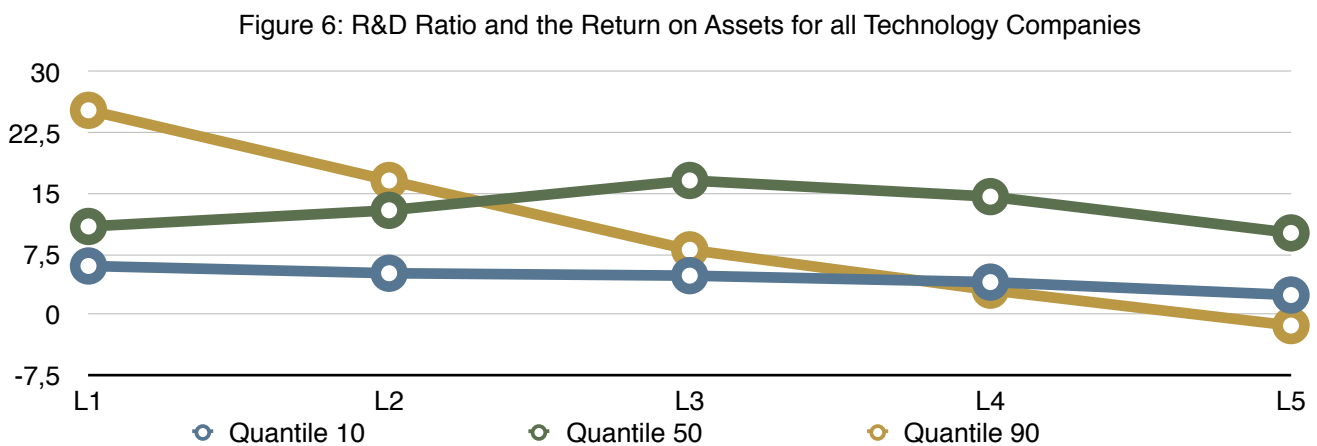
The table below summarizes the results obtained from each sector analysis. In general, the higher results are also achieved in a longer period of time. Companies of the Internet sector with low and high profitability and companies of the Telecommunication and Equipment sector with high profitability registered a best performance in the nearest period of time when investing in R&D. According to the results, it is more likely that companies with low profitability show lower performances from the R&D investment.

Table 14: R&D Ratio and the Asset Growth positive effect by sector

	Positive effect of the R&D 10Q	Highest positive variable 10Q	Positive effect of the R&D 50Q	Highest positive variable 50Q	Positive effect of the R&D 90Q	Highest positive variable 90Q
All Sectors	L4 → L5	L4	L2 → L5	L4	L1 → L5	L4
Telecommunications and Equipment	L5	L5	L1 → L5	L5	L1 → L5	L1
Computer Hardware	L4 → L5	L4	L1 → L5	L4	L2 → L5	L4
Internet	L1 → L3, L5	L1	L3 → L5	L4	L1 → L3	L1
Semiconductors	L4 → L5	L5	L2 → L5	L4	L1 → L5	L5
Software	L2 → L5	L4	L2 → L5	L4	L3 → L5	L4

5.2.2) Research and Development Ratio and the Return on Assets by Sector

By analyzing the figure below (appendix 2.2), it is possible to perceive that in the first period of time, companies with higher profitability shown higher performances when investing in R&D, but It was also possible to verify that companies that shown average profitability displayed higher performance of R&D investments in a long period. According to the results, there are 1034 observations in this analysis where there is a positive relation between the R&D ratio and the return on assets.



The table below summarizes the results that were obtained by performing the quantile regression analysis. It is evident that there is a general positive effect when companies invest in R&D but, by comparing all the sectors, it is possible to notice a different behavior of the Internet sector. The low number of observations in the Internet sector is the main reason for those scattered results, because in a small sample a few observations can have influential in all the others. It is also possible to analyze that companies with high profitability from the Computer Hardware sector present the best performance from R&D investment (appendix).

Table 15: R&D Ratio and the Return on Assets positive effect by sectors

	Positive effect of the R&D 10Q	Highest positive variable 10Q	Positive effect of the R&D 50Q	Highest positive variable 50Q	Positive effect of the R&D 90Q	Highest positive variable 90Q
All Sectors	L1 → L5	L1	L1 → L5	L3	L1 → L4	L1
Telecommunications and Equipment	L1 → L5	L1	L1 → L4	L3	L1 → L5	L1
Computer Hardware	L3 → L5	L4	L1 → L5	L5	L1 → L5	L2
Internet	L1 → L5	L5	L1, L4 → L5	L1	L5	L5
Semiconductors	L1 → L5	L4	L2 → L5	L3	L1 → L3	L2
Software	L1 → L5	L2	L1 → L5	L4	L1 → L5	L2

5.2.3) Research and Development Ratio, Return on Assets and Return on Equity by Sector in Different Markets

The last part of this analysis was conducted by performing a quantile regression to study the technology companies of the United States, with 480 observations, and of the rest of the World, accounting for 453 total observations, separately (appendix2.3). The first figure shows the technology companies of the rest of the World analysis and the second one displays the technology U.S. companies. It is notorious that companies with average profitability of the rest of the World show better results when investing in R&D, never the less, there is a general positive effect from the R&D investment in the three quantiles. By analyzing the United States figure, it is possible to see a positive effect in companies with high profitability and a poor effect in the other two quantiles.

Figure 7: R&D Ratio, Return on Assets and Return on Equity of all Technology Companies from the ROTW

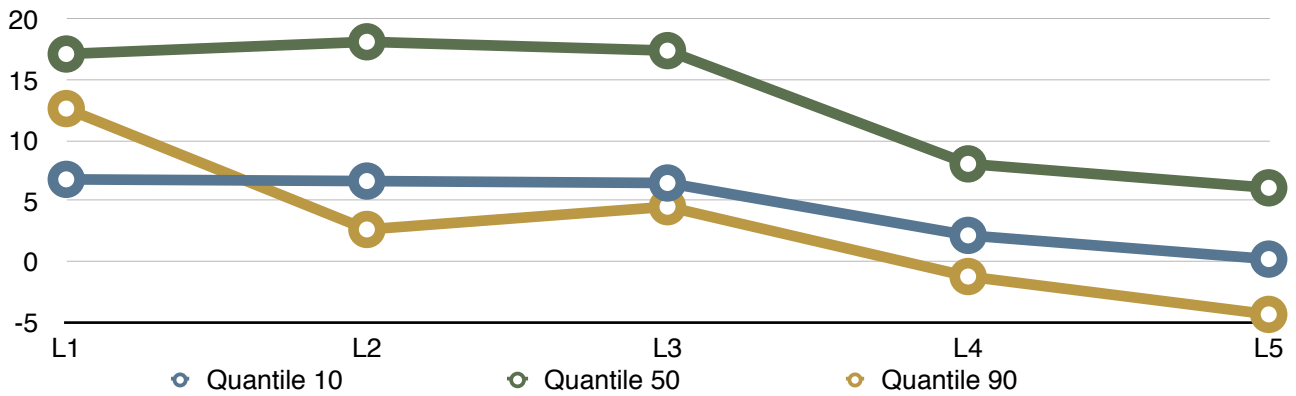
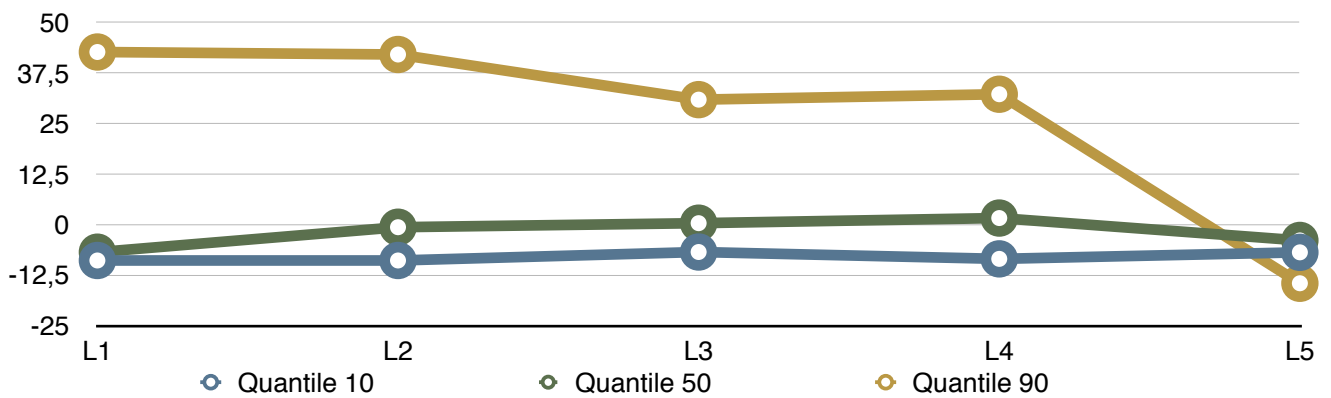


Figure 8: R&D Ratio, Return on Assets and Return on Equity of all Technology Companies in the U.S.



The table below summarizes the analysis to each sector from the United States and the rest of the World separately. Once more, there is no data available to get any conclusions of the Internet sector of the rest of the World. From the results that are displayed in the appendix, each sector shows a different behavior of the R&D investment effect. Clearly, United States companies have shown higher effects as also shown the lowest results. The table below shows the positive effect of the R&D in each sector and when these effects are higher.

Table 16: R&D Ratio, Return on Assets and Return on Equity positive effect by sector from the ROTW and the U.S.

Outside and inside the U.S.	Positive effect of the R&D 10Q	Highest positive variable 10Q	Positive effect of the R&D 50Q	Highest positive variable 50Q	Positive effect of the R&D 90Q	Highest positive variable 90Q
ROTW - All Sectors	L1 → L5	L1	L1 → L5	L2	L1 → L3	L1
U.S. - All Sectors	none	none	L2 → L4	L4	L1 → L4	L1
ROTW - Telecommunications and Equipment	L1 → L5	L1	L1 → L5	L2	L1 → L2	L1
U.S. - Telecommunications and Equipment	L3 → L5	L5	none	none	none	none
ROTW - Computer Hardware	none	none	L3, L5	L5	L1 → L3, L5	L2
U.S. - Computer Hardware	L2 → L5	L5	L1 → L5	L1	L1 → L5	L3
ROTW - Internet	-	-	-	-	-	-
U.S. - Internet	L1 → L5	L5	L1 → L3, L5	L2	L3 → L5	L5
ROTW - Semiconductors	L1 → L4	L1	L1 → L5	L2	L1 → L2	L1
U.S. - Semiconductors	L4 → L5	L4	none	none	L1 → L2	L1
ROTW - Software	L1 → L5	L5	L1 → L5	L2	none	none
U.S. - Software	none	none	L4	L4	L1 → L4	L1

6) Conclusions

This last chapter is going to summarize all the conclusions that were reached on the present study. It was conducted a deep analysis to the technology industry by focusing in each sector. Therefore, there are several conclusions to display. In order to be easier to explain and understand, in each part it will be shown a table to summarize the conclusions. The results that were obtained show a relation between the R&D investment and the technology companies' growth. Despite the several studies where the authors did not found any support to conclude a link between the R&D investment and the companies' growth, like it was mention in the literature review, this analysis will support all the other studies where it was found a relation between the R&D investment and the companies' growth.

6.1) Relation between R&D with the asset growth, the return on assets and the return on equity.



























By analyzing each sector individually, it was possible to conclude that, depending on the sector, investment in R&D will have higher or lower effect in the companies' growth. We have used three different dependent variables to evaluate the R&D investment and consequently there are differences between them. A common conclusion that can be drawn from the relation between the R&D investment, the asset growth and the return on assets is the continued presence of the computer hardware sector as the sector with the highest results. When the analysis is directed to the relation between the R&D and the return on equity, the computer hardware sector have shown higher results in the ROTW than in the U.S, the internet sector have shown highest results in the U.S. market and the telecommunication and equipment sector accounted for the lowest scores in the ROFW. From the relation between the R&D and the asset growth, the internet sector has shown the lowest results. Through the relation between the R&D and the return on assets, the semiconductors sector displayed the lowest results. From the R&D effect into return on assets, the telecommunication and equipment sector and the internet sector have shown the lowest results in the U.S. and the ROTW markets correspondingly.

To conclude, the results suggest that the computer hardware sector is the sector where managers should invest more in R&D in order to obtained more profit. The table 17 shows the main conclusions that were taken from the linear regression.




By performing the quantile model, it was analyzed the same variables but for three different groups: companies with low, average and high profitability. When analyzing the R&D, asset

growth and return on assets, in general, internet companies with low profitability displayed higher performances when investing in R&D. For the same variables, Computer hardware companies with average and higher profitability show stronger effects when compared to all the other sectors. By performing the analysis on the relation between R&D and the return on equity, the conclusions are completely different. In the ROFW market, the software sector shows the best results in all three different profitability groups and the telecommunication and equipment sector shows the lowest results also in all three groups. When analyzing the U.S. market, the low and high profitability companies displayed the highest results in the telecommunication and equipment sector. The Internet companies with average profitability show stronger performances. The lowest results in the U.S. market were shown in all three groups by the computer hardware sector. To summarize the results that were obtained by performing the quantile regression, the table 18 displays all the conclusions from this model.

Table 17: Linear Regressions main conclusions

	Sector where there is the highest R&D investment effect	Sector where there is the lowest R&D investment effect	Sector where there is the highest statistical significance level
Asset Growth			 
ROA by sector			 
ROA from the ROFW			
ROA from the U.S.			
ROA from the ROFW VS the U.S.	 INSIDE U.S.	 INSIDE U.S.	 INSIDE U.S.
ROE from the ROFW			
ROE from the U.S.			
ROE from the ROFW VS the U.S.	 INSIDE U.S.	 INSIDE U.S.	 INSIDE U.S.

Icons Reading:

-  Telecommunication and Equipment sector
-  Computer Hardware sector
-  Internet sector



-  Semiconductors Sector
-  Software Sector

Table 18: Quantile Regressions main conclusions

	Asset Growth	ROA by sector	Sectors from the ROFW	Sectors from the U.S.	Sectors from the ROFW VS the U.S.
Sector with the highest R&D effect 10Q (ROA)					from the U.S.
Sector with the lowest R&D effect 10Q (ROA)					from the ROFW
Higher statistical significance 10Q (ROA)					from the U.S.
Sector with the highest R&D effect 50Q (ROA)					from the U.S.
Sector with the lowest R&D effect 50Q (ROA)					from the ROFW
Higher statistical significance 50Q (ROA)					from the U.S.
Sector with the highest R&D effect 90Q (ROA)					from the U.S.
Sector with the lowest R&D effect 90Q (ROA)					from the U.S.
Higher statistical significance 90Q (ROA)					from the U.S.
Sector with the highest R&D effect of all (ROA)	50Q	90Q	90Q	90Q	90Q from the U.S.
Sector with the lowest R&D effect of all (ROA)	90Q	90Q	50Q	90Q	90Q from the U.S.
Sector with the highest R&D effect 10Q (ROE)	-	-			from the ROFW
Sector with the lowest R&D effect 10Q (ROE)	-	-			from the U.S.
Higher statistical significance 10Q (ROE)	-	-			ALL EQUAL
Sector with the highest R&D effect 50Q (ROE)	-	-			from the U.S.
Sector with the lowest R&D effect 50Q (ROE)	-	-			from the U.S.
Higher statistical significance 50Q (ROE)	-	-			ALL EQUAL
Sector with the highest R&D effect 90Q (ROE)	-	-			from the ROFW
Sector with the lowest R&D effect 90Q (ROE)	-	-			from the U.S.
Higher statistical significance 90Q (ROE)	-	-			from the ROFW
Sector with the highest R&D effect of all (ROE)	-	-	90Q	50Q	50Q from the U.S.
Sector with the lowest R&D effect of all (ROE)	-	-	10Q	50Q	50Q from the U.S.

6.2) Regressions Performances

This study was conducted by using the linear regression model and the quantile regression model. The linear regression model was used to study the independent variable, R&D ratio, and the mean of the distribution of each financial variable. The quantile regression model approach allowed us to examine the behavior of the return on assets, the return on equity and the asset growth beyond its average by using three quantiles. There are plenty literature on regression analysis such as Myers (1990), Kutner, Nachtsheim and Neter (2004) and Young, Shaffer and Guess (2008). During this study, we have always displayed tables with the statistical significance or the R-square. The R-square is a statistical measure of how close the data is to the fitted regression line. It is a statistical measure of how well the regression line approximates the real data points and it is also known as the coefficient of determination, or the coefficient of multiple determinations for multiple regression.

To perform a comparison between models, it is important to compare not only the results but also the R-square. The three tables below summarize the comparison between both models. Each table shows for each result the best model. The first table displays the relation between the R&D ratio and the asset growth. Let's see how can they be compared. By analyzing each model for the computer hardware sector we can conclude that the linear regression model shows a higher result compared to the quantile regression 10 quantile but a lower R-square, which means that the linear regression result from the relation between the R&D and the asset growth is higher compared to the 10th quantile of the quantile regression but it shows a lower approximation to the real data points having for that lower accuracy. In some cases there are no statistical significance level that are displayed by "none" and when the R-square is equal in both models we have displayed as "equal".

To conclude, each model has its own advantages and disadvantages, for the purpose of this study both models were suitable to analyze the information. By comparing one model to another we can say that both models complement each other, giving a good overlook to the R&D performance in the technology industry.

Table 19: Models Comparison between the R&D Ratio and the Asset Growth

	All sectors	Telecommuni- cation and Equipment	Computer Hardware	Internet	Semiconduct ors	Software
Higher R&D effect between LR and 10Q	LR	LR	LR	QR	LR	QR
Higher Statistical between LR and 10Q	QR	none	QR	QR	QR	LR
Higher R&D effect between LR and 50Q	LR	LR	QR	QR	LR	LR
Higher Statistical between LR and 50Q	QR	QR	QR	LR	QR	QR
Higher R&D effect between LR and 90Q	LR	QR	LR	QR	QR	LR
Higher Statistical between LR and 90Q	QR	none	LR	QR	QR	LR

Table 20: Models Comparison between the R&D Ratio and the Return on Assets

	All sectors	Telecommuni- cation and Equipment	Computer Hardware	Internet	Semiconduct ors	Software
Higher R&D effect between LR and 10Q	LR	LR	LR	QR	QR	LR
Higher Statistical between LR and 10Q	LR	QR	LR	QR	none	QR
Higher R&D effect between LR and 50Q	QR	QR	LR	QR	LR	QR
Higher Statistical between LR and 50Q	QR	QR	LR	none	none	QR
Higher R&D effect between LR and 90Q	QR	QR	QR	LR	QR	QR
Higher Statistical between LR and 90Q	LR	LR	LR	QR	QR	LR

Table 21: Models Comparison between the R&D Ratio, the Return on Assets and the Return on Equity from the ROFW and the U.S.

	All sectors OUT US	All sectors IN US	Telec. and equip. OUT US	Telec. and equip. IN US	Comp. Hard. OUT US	Comp. Hard. IN US	Internet OUT US	Internet IN US	Semic. OUT US	Semic. IN US	Software OUT US	Software IN US
Higher R&D effect between LR and 10Q (ROA)	LR	LR	LR	QR	LR	LR	-	LR	LR	QR	QR	LR
Higher Statistical between LR and 10Q (ROA)	LR	none	QR	QR	QR	QR	-	QR	LR	LR	QR	LR
Higher R&D effect between LR and 50Q (ROA)	QR	LR	QR	QR	LR	LR	-	LR	QR	LR	QR	LR
Higher Statistical between LR and 50Q (ROA)	QR	none	QR	none	none	QR	-	none	QR	QR	QR	EQUAL
Higher R&D effect between LR and 90Q (ROA)	LR	QR	LR	LR	QR	QR	-	QR	LR	LR	LR	QR
Higher Statistical between LR and 90Q (ROA)	LR	QR	none	QR	QR	LR	-	QR	LR	EQUAL	none	QR
Higher R&D effect between LR and 10Q (ROE)	LR	QR	LR	LR	LR	QR	-	LR	LR	QR	LR	LR
Higher Statistical between LR and 10Q (ROE)	EQUAL	EQUAL	QR	LR	QR	QR	-	QR	LR	EQUAL	QR	QR
Higher R&D effect between LR and 50Q (ROE)	QR	QR	LR	LR	QR	LR	-	QR	LR	QR	QR	LR
Higher Statistical between LR and 50Q (ROE)	EQUAL	EQUAL	QR	QR	QR	LR	-	QR	QR	EQUAL	QR	QR
Higher R&D effect between LR and 90Q (ROE)	QR	LR	QR	QR	QR	LR	-	LR	QR	QR	QR	QR
Higher Statistical between LR and 90Q (ROE)	LR	LR	LR	LR	QR	LR	-	LR	LR	LR	LR	LR

6.3) Implications and Main Limitations

This study extends the existing literature about the research and development of companies' growth. Technological development has contributed to increase the competition intensity, therefore the products are being replaced faster and faster for better ones shrinking products life cycle. Believing that product lifetimes are shrinking in their industries, many firms have implemented new programs to accelerate the development of new products (e.g., Fraker 1984, Dumaine 1989, Patterson 1993). Due to the R&D increasing importance, this study will contribute to future analysis on the subject. In fact, reducing the development time for new products and getting products to market faster has become an extensively discussed topic in the academic and business press (e.g., Rosenau 1988, Dumaine 1989, Patterson 1993).

This study was conducted with some known limitations:

1) The absence of any previous research regarding R&D effect into technology sectors. There are some studies where the R&D investments are analyzed but like it was shown in the literature review all of them did not focus into one specific industry.

2) The lack of data available from *Datastream* software. The low number of observations caused scattered results in some sectors as also a low accuracy showed by the R-square.

3) Only three variables were used to study the R&D, the assets growth, the return on assets and the return on equity. If this analysis was developed with more variables such as earnings per share the research output could be different.

6.4) Next steps

This research was performed to understand the R&D effect into the technology industry. To achieve the main goal it was required the usage of two different regression models, a linear regression and a quantile regression. To future studies, it would be recommended the following:

1) Apply the same study to other industries.

2) If it would be possible, collect the companies data from a better database or directly from the companies financial statements.

3) Apply different models to study a possible relation between them.

To conclude, there are more aspects that can be study to increase this subject knowledge.

We are here and now. Further than that, all knowledge is moonshine.

H.L. Mencken

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1) Linear Regression Model

1.1) R&D ratio and Asset Growth by Sector

1.1.1) Telecommunication and Equipment Sector

Variables	Asset Growth				
L1 R&D ratio	0,04				
	1,12				
L2 R&D ratio		0,20			
		1,13			
L3 R&D ratio			0,44		
			1,10		
L4 R&D ratio				1,30	
				0,96	
L5 R&D ratio					1,34
					0,96
Constant	0,49***	0,47***	0,43**	0,29*	0,25
	0,17	0,16	0,16	0,15	0,15
Observations	114	115	116	116	102
R-squared	0,00	0,00	0,00	0,04	0,06

*** p<0.01, ** p<0.05, * p<0.1

1.1.2) Computer Hardware Sector

Variables	Asset Growth				
L1 R&D ratio	-2,01				
	4,88				
L2 R&D ratio		3,54			
		3,19			
L3 R&D ratio			6,17**		
			2,19		
L4 R&D ratio				8,03***	
				2,30	
L5 R&D ratio					6,55**
					2,30
Constant	0,85*	0,36	0,10	-0,11	0,01
	0,41	0,26	0,18	0,18	0,19
Observations	60	60	60	59	51
R-squared	0,01	0,04	0,15	0,36	0,29

*** p<0.01, ** p<0.05, * p<0.1

1.1.3) Regression in the Internet

Variables	Asset Growth					
L1 R&D ratio	0,59					
	6,79					
L2 R&D ratio		1,57				
		7,36				
L3 R&D ratio			0,86			
			4,93			
L4 R&D ratio				-0,95		
				13,16		
L5 R&D ratio					-0,81	
					8,44	
Constant	0,80**	0,64	0,72	0,89	0,75	
	0,27	0,38	0,53	1,34	0,74	
Observations	15	15	13	11	11	
R-squared	0,00	0,01	0,00	0,00	0,00	0,00

*** p<0.01, ** p<0.05, * p<0.1

1.1.4) Semiconductors Sector

Variables	Asset Growth					
L1 R&D ratio	-0,08					
	0,75					
L2 R&D ratio		0,45				
		0,60				
L3 R&D ratio			1,02**			
			0,44			
L4 R&D ratio				1,50***		
				0,35		
L5 R&D ratio					1,58***	
					0,44	
Constant	0,35***	0,27**	0,17*	0,10	0,08	
	0,12	0,10	0,09	0,09	0,09	
Observations	241	241	241	241	207	
R-squared	0,00	0,01	0,05	0,11	0,13	

*** p<0.01, ** p<0.05, * p<0.1

1.1.5) Software Sector

Variables	Asset Growth				
L1 R&D ratio	-1,30				
	0,78				
L2 R&D ratio		0,19			
		0,97			
L3 R&D ratio			0,89		
			0,89		
L4 R&D ratio				1,84**	
				0,76	
L5 R&D ratio					1,08**
					0,49
Constant	0,78***	0,57***	0,46***	0,31**	0,40***
	0,12	0,14	0,14	0,14	0,11
Observations	282	283	280	277	234
R-squared	0,03	0,00	0,02	0,10	0,04

*** p<0.01, ** p<0.05, * p<0.1

1.2) R&D ratio and ROA

1.2.1) All sectors without the restriction

Variables	Return on Assets				
L1 R&D ratio	-9,05				
	12,28				
L2 R&D ratio		-3,68			
		10,21			
L3 R&D ratio			3,87		
			6,20		
L4 R&D ratio				5,26	
				5,37	
L5 R&D ratio					1,91
					6,32
Constant	9,50***	9,10***	8,17***	7,91***	8,22***
	1,42	1,29	0,98	0,97	1,04
Observations	1196	1071	945	823	701
R-squared	0,00	0,00	0,00	0,00	0,00

*** p<0.01, ** p<0.05, * p<0.1

1.2.2) Telecommunication and Equipment Sector

Variables	Return on Assets				
L1 R&D ratio	22,06*				
	11,94				
L2 R&D ratio		13,46			
		13,41			
L3 R&D ratio			14,25		
			11,48		
L4 R&D ratio				3,50	
				10,58	
L5 R&D ratio					-1,85
					15,78
Constant	8,43***	9,43***	8,74***	9,45***	9,66***
	2,14	2,32	2,09	2,19	2,47
Observations	157	143	128	113	97
R-squared	0,06	0,02	0,03	0,00	0,00

*** p<0.01, ** p<0.05, * p<0.1

1.2.3) Computer Hardware Sector

Variables	Return on Assets				
L1 R&D ratio	80,34**				
	31,87				
L2 R&D ratio		113,92			
		70,36			
L3 R&D ratio			117,85*		
			62879		
L4 R&D ratio				84,08*	
				45,09	
L5 R&D ratio					82,12**
					34397
Constant	5,77**	3,20	2,30	4,50	3,79
	2,27	4,51	4,26	3,30	2,79
Observations	87	77	65	56	48
R-squared	0,06	0, 14	0, 19	0, 14	0, 18

*** p<0.01, ** p<0.05, * p<0.1

1.2.4) Internet Sector

Variables	Return on Assets					
L1 R&D ratio	25,23					
	86,38					
L2 R&D ratio		-27,92				
		85,84				
L3 R&D ratio			-19,33			
			92,91			
L4 R&D ratio				31,64		
				67,82		
L5 R&D ratio					51,20	
					62715	
Constant	12,40**	15,51**	14,02	10,39	9,31	
	4415	5654	6686	5230	5085	
Observations	26	23	21	19	15	
R-squared	0,01	0,01	0,01	0,02	0,06	

*** p<0.01, ** p<0.05, * p<0.1

1.2.5) Semiconductors Sector

Variables	Return on Assets					
L1 R&D ratio	4,36					
	5,16					
L2 R&D ratio		6,38				
		5,17				
L3 R&D ratio			4,79			
			4,94			
L4 R&D ratio				-0,24		
				4,78		
L5 R&D ratio					-1,98	
					4,96	
Constant	11,56***	11,46***	11,61***	12,43***	12,75***	
	1,02	1,13	1,28	1,41	1,51	
Observations	296	264	234	205	176	
R-squared	0,00	0,01	0,00	0,00	0,00	

*** p<0.01, ** p<0.05, * p<0.1

1.2.6) Software

Variables	Return on Assets				
L1 R&D ratio	16,57**				
	6,42				
L2 R&D ratio		15,63**			
		7,25			
L3 R&D ratio			15,73*		
			7,97		
L4 R&D ratio				17,04*	
				9,08	
L5 R&D ratio					11,20
					10,19
Constant	8,71***	8,79***	8,75***	8,72***	9,51***
	1,33	1,43	1,58	1,77	1,83
Observations	404	370	326	280	234
R-squared	0,03	0,03	0,03	0,04	0,02

*** p<0.01, ** p<0.05, * p<0.1

1.3) R&D ratio, ROA and ROE by Sector in Different Markets

1.3.1) Sectors from the ROTW

1.3.1.1) Telecommunication and Equipment Sector

Variables	Return on Assets				
L1 R&D ratio	19,16				
	12,30				
L1 ROE	0,15***	0,07	0,07	0,08	0,11
	0,04	0,07	0,07	0,06	0,08
L2 R&D ratio		14,46			
		19,15			
L3 R&D ratio			16,06		
			16,26		
L4 R&D ratio				2,08	
				13,53	
L5 R&D ratio					-6,21
					18,22
Constant	5,80*	8,18**	7,05**	9,11**	9,33**
	2,87	3,77	3,14	3,34	3,46
Observations	77	72	65	61	52
R-squared	0,27	0,08	0,11	0,04	0,07

*** p<0.01, ** p<0.05, * p<0.1

1.3.1.2) Computer Hardware Sector

Variables	Return on Assets					
L1 R&D ratio	-50,18					
	106,17					
L1 ROE	0,10*	0,08*	0,09**	0,51***	0,51***	
	0,03	0,03	0,03	0,02	0,06	
L2 R&D ratio		136,20				
		159,27				
L3 R&D ratio			47,58			
			94,63			
L4 R&D ratio				-10,18		
				21,33		
L5 R&D ratio						28,81
						23,44
Constant	17,96**	488	6913	2035	-1290	
	4,00	8,71	3,49	2,54	0,98	
Observations	24	24	22	19	16	
R-squared	0,42	0,49	0,61	0,88	0,80	

*** p<0.01, ** p<0.05, * p<0.1

1.3.1.3) Semiconductors Sector

Variables	Return on Assets					
L1 R&D ratio	11,07*					
	5,22					
L1 ROE	0,18**	0,15**	0,13*	0,11	0,10	
	0,06	0,07	0,07	0,08	0,08	
L2 R&D ratio		10,89*				
		5,28				
L3 R&D ratio			5,69			
			5,50			
L4 R&D ratio				-0,04		
				5,81		
L5 R&D ratio						-0,99
						4,36
Constant	7,49***	7,95***	9,24***	10,93***	11,90***	
	1,71	1,92	2,11	2,52	2,55	
Observations	99	89	81	71	62	
R-squared	0,14	0,11	0,08	0,04	0,03	

*** p<0.01, ** p<0.05, * p<0.1

1.3.1.4) Software Sector

Variables	Return on Assets				
L1 R&D ratio	11,48				
	9,54				
L1 ROE	0,08	0,08	0,31***	0,39***	0,39***
	0,10	0,11	0,09	0,07	0,07
L2 R&D ratio		11,95			
		10,63			
L3 R&D ratio			0,07		
			8,11		
L4 R&D ratio				-1,07	
				8,12	
L5 R&D ratio					-4,68
					8,50
Constant	8,36***	8,30***	5,76***	4,16***	4,71***
	2,09	2,18	1,62	0,97	1,15
Observations	220	203	179	155	130
R-squared	0,10	0,11	0,50	0,58	0,59

*** p<0.01, ** p<0.05, * p<0.1

1.3.2) Sectors from the U.S.

1.3.2.1) Telecommunication and Equipment Sector

Variables	Return on Assets				
L1 R&D ratio	-38,76				
	30,20				
L1 ROE	0,24**	0,26**	0,27**	0,22***	0,24***
	0,08	0,08	0,08	0,06	0,06
L2 R&D ratio		-20,84			
		24,85			
L3 R&D ratio			-22,89		
			24,37		
L4 R&D ratio				-18,60	
				13,50	
L5 R&D ratio					-6,28
					17,75
Constant	11,06***	8,92***	8,33***	7,99***	6,67**
	2,93	2,18	2,06	1,58	2,20
Observations	62	58	51	44	38
R-squared	0,37	0,35	0,37	0,39	0,44

*** p<0.01, ** p<0.05, * p<0.1

1.3.2.2) Computer Hardware Sector

Variables	Return on Assets				
L1 R&D ratio	74,87**				
	27,36				
L1 ROE	0,03	0,02	0,00	0,03***	0,04**
	0,02	0,02	0,02	0,01	0,01
L2 R&D ratio		79,29**			
		31,21			
L3 R&D ratio			99,19**		
			27,94		
L4 R&D ratio				84,03**	
				25,65	
L5 R&D ratio					101,44***
					12,04
Constant	3,74*	3,57	1,77	2,44	0,39
	2,00	2,67	2,51	2,78	1,63
Observations	55	47	40	35	30
R-squared	0,24	0,24	0,31	0,27	0,31

*** p<0.01, ** p<0.05, * p<0.1

1.3.2.3) Internet Sector

Variables	Return on Assets				
L1 R&D ratio	60,46				
	195,03				
L1 ROE	0,31	0,31	0,30	0,30	0,14
	0,41	0,24	0,17	0,28	0,40
L2 R&D ratio		75,42			
		22,81			
L3 R&D ratio			128,74		
			35,05		
L4 R&D ratio				55,24	
				150,58	
L5 R&D ratio					98,41
					179,54
Constant	2,73	1,71	-1,49	4,12	3,86
	18,08	2,75	2,17	7,97	8,13
Observations	15	15	15	14	12
R-squared	0,01	0,12	0,22	0,19	0,18

*** p<0.01, ** p<0.05, * p<0.1

1.3.2.4) Semiconductors Sector

Variables	Return on Assets				
L1 R&D ratio	-8,57				
	9,20				
L1 ROE	0,11***	0,11***	0,10***	0,09***	0,09***
	0,02	0,02	0,01	0,01	0,01
L2 R&D ratio		-5,39			
		10,59			
L3 R&D ratio			-6,04		
			11,03		
L4 R&D ratio				-15,36	
				10,31	
L5 R&D ratio					-21,08*
					10,22
Constant	11,72***	11,40***	11,47***	12,66***	13,21***
	1,29	1,43	1,52	1,59	1,61
Observations	179	160	139	121	104
R-squared	0,16	0,13	0,13	0,14	0,14

*** p<0.01, ** p<0.05, * p<0.1

1.3.2.5) Software Sector

Variables	Return on Assets				
L1 R&D ratio	20,35**				
	8,97				
L1 ROE	0,10**	0,08*	0,06	0,05	0,05
	0,04	0,04	0,05	0,05	0,04
L2 R&D ratio		9,49			
		7,02			
L3 R&D ratio			6,71		
			9,56		
L4 R&D ratio				10,94	
				10,38	
L5 R&D ratio					-15,82
					11,61
Constant	6,20***	7,58***	7,81***	7,40***	10,41***
	1,45	1,37	1,49	1,60	1,79
Observations	156	143	127	110	93
R-squared	0,13	0,09	0,07	0,07	0,10

*** p<0.01, ** p<0.05, * p<0.1

2) Quantile Regression Model

2.1) R&D ratio and Asset Growth

2.1.1) All Sectors

Asset Growth															
	Quantile 10					Quantile 50					Quantile 90				
L1 R&D ratio	-1,41***					-0,50**					0,23				
	0,27					0,24					0,58				
L2 R&D ratio		-1,13***					0,03					0,96*			
		0,27					0,26					0,50			
L3 R&D ratio			-0,73**					0,57*					1,36**		
			0,31					0,26					0,45		
L4 R&D ratio				0,82*					1,39**					1,72**	
				0,33					0,27					0,41	
L5 R&D ratio					0,45					1,25**					1,69**
					0,34					0,27					0,54
Constant	0,03	0,01	-0,05	-0,26***	-0,21***	0,52**	0,46**	0,39**	0,26**	0,27*	1,14**	1,04**	0,99**	0,90**	0,87**
	0,04	0,05	0,06	0,06	0,06	0,04	0,04	0,05	0,05	0,05	0,09	0,08	0,07	0,07	0,08
Observ.	754	753	747	737	636	754	753	747	737	636	754	753	747	737	636

*** p<0.01, ** p<0.05, * p<0.1

2.1.2) Telecommunication and Equipment Sector

Asset Growth															
	Quantile 10					Quantile 50					Quantile 90				
L1 R&D ratio	-0.99					0.03					3.09				
	1.03					0.51					2.70				
L2 R&D ratio		-0.67					0.26					0.71			
		1.24					0.51					3.04			
L3 R&D ratio			-1.03					0.63					1.47		
			1.17					0.49					2.87		
L4 R&D ratio				-0.74					0.92*					2.57	
				1.05					0.49					3.07	
L5 R&D ratio					0.28					1.27*					1.71
					1.14					0.59					3.10
Constant	-0.13	-0.17	-0.16	-0.19	-0.37*	0.45**	0.41**	0.35**	0.30**	0.24*	0.95	1.18*	1.00*	0.89	0.93
	0.22	0.25	0.22	0.23	0.21	0.09	0.09	0.08	0.09	0.11	0.60	0.54	0.56	0.62	0.61
Observ.	114	115	116	116	102	114	115	116	116	102	114	115	116	116	102

*** p<0.01, ** p<0.05, * p<0.1

2.1.3) Computer Hardware Sector

Asset Growth															
	Quantile 10					Quantile 50					Quantile 90				
L1 R&D ratio	-6.48***					5.26*					-1.38				
	2.00					3.06					5.76				
L2 R&D ratio		-6.25***					7.20**				3.12				
		1.38					1.92				7.39				
L3 R&D ratio			-6.39***					8.00**				6.53			
			1.05					1.08				5.67			
L4 R&D ratio				3.58*					8.50**					12.0**	
				1.49					0.98					1.80	
L5 R&D ratio					2.05					7.54**					7.99*
					1.53					1.19					4.02
Constant	0.71**	0.70**	0.67**	-0.24	-0.09	0.19	0.03	-0.04	-0.07	-0.04	1.38*	0.94	0.62	-0.08	0.28
	0.15	0.11	0.13	0.21	0.20	0.27	0.18	0.11	0.10	0.13	0.55	0.66	0.53	0.21	0.44
Observ.	60	60	60	59	51	60	60	60	59	51	60	60	60	59	51

*** p<0.01, ** p<0.05, * p<0.1

2.1.4) Internet Sector

Asset Growth															
	Quantile 10					Quantile 50					Quantile 90				
L1 R&D ratio	4.40**					-2.83					12.47***				
	0.15					8.97					3.26				
L2 R&D ratio		2.92**					-3.10					2.62			
		0.58					7.16					5.05			
L3 R&D ratio			2.65**					3.34					0.52		
			0.30					6.04					6.05		
L4 R&D ratio				-2.65**					7.80						-18.66**
				1.00					14.86						6.37
L5 R&D ratio					0.76					6.46					-25.84***
					0.63					8.28					3.38
Constant	-0.11***	-0.03	-0.03	0.45**	0.05	1.22*	0.60	0.76	0.40	0.05	1.22**	1.22**	1.22	3.48**	3.29**
	0.01	0.03	0.04	0.08	0.04	0.57	0.46	0.59	1.33	0.46	0.21	0.26	0.80	0.55	0.23
Observ.	13	15	13	11	11	13	15	13	11	11	13	15	13	11	11

*** p<0.01, ** p<0.05, * p<0.1

2.1.5) Semiconductors Sector

Asset Growth															
	Quantile 10					Quantile 50					Quantile 90				
L1 R&D ratio	-1.46 ***					-0.20					0.93				
	0.32					0.38					0.87				
L2 R&D ratio		-1.24 ***					0.64*					1.50*			
		0.36					0.33					0.69			
L3 R&D ratio			-1.05 ***					0.84*					1.71*		
			0.31					0.33					0.61		
L4 R&D ratio				0.44					0.98*					2.15*	
				0.34					0.40					0.65	
L5 R&D ratio					0.55					0.94*					2.190 ***
					0.37					0.36					638
Const ant	0.03	-0.03	-0.06	-0.31 ***	-0.34 ***	0.35* **	0.23* **	0.19* **	0.15* *	0.17* *	0.74* **	0.68* **	0.62* **	0.57* **	0.544 ***
	0.07	0.08	0.08	0.07	0.08	0.08	0.07	0.06	0.08	0.07	0.17	0.14	0.12	0.13	121
Obser v.	241	241	241	241	207	241	241	241	241	207	241	241	241	241	207

*** p<0.01, ** p<0.05, * p<0.1

2.1.6) Software Sector

Asset Growth															
	Quantile 10					Quantile 50					Quantile 90				
L1 R&D ratio	-0.90					-0.72*					-0.95				
	0.87					0.40					1.36				
L2 R&D ratio		0.20					0.16				-0.08				
		0.93					0.32				1.68				
L3 R&D ratio			0.89					0.69*				0.86			
			0.72					0.27				1.51			
L4 R&D ratio				2.30**					1.46**				0.96		
				0.67					0.37				1.21		
L5 R&D ratio					1.35					0.912***					0.90
					1.06					227					1.19
Constant	0.07	-0.01	-0.13	-0.39***	-0.23	0.67**	0.55**	0.47**	0.36**	0.42**	1.42**	1.31**	1.16**	1.11**	1.09**
	0.14	0.15	0.12	0.11	0.18	0.06	0.05	0.04	0.07	0.04	0.21	0.26	0.24	0.20	0.20
Observ.	282	283	280	277	234	282	283	280	277	234	282	283	280	277	234

*** p<0.01, ** p<0.05, * p<0.1

2.2) R&D ratio and ROA

2.2.1) All the Sectors without the restriction

Asset Growth															
	Quantile 10					Quantile 50					Quantile 90				
L1 R&D ratio	-23.26*					2.12					19.88***				
	12.75					3.13					6.48				
L2 R&D ratio		-18.55					7.36*					14.32*			
		12.00					2.90					7.62			
L3 R&D ratio			-11.46					11.23***					7.91		
			10.76					2.40					8.74		
L4 R&D ratio				-10.07					10.20***					5.28	
				9.43					2.13					9.30	
L5 R&D ratio					-6.19					7.62**					-2.21
					11.58					2.35					11.29
Constant	0.74	0.75	-0.35	-0.62	-1.19	8.27**	7.80**	7.13**	7.10**	7.37**	17.91***	18.66***	19.66***	20.31***	21.33***
	1.92	1.81	1.73	1.57	1.91	0.51	0.47	0.40	0.36	0.40	1.10	1.27	1.43	1.56	1.81
Observ.	1,196	1,071	945	823	701	1,196	1,071	945	823	701	1,196	1,071	945	823	701

*** p<0.01, ** p<0.05, * p<0.1

2.2.2) All the Sectors with the restriction

Asset Growth															
	Quantile 10					Quantile 50					Quantile 90				
L1 R&D ratio	6.01*					10.89***					25.33***				
	2.90					3.34					7.81				
L2 R&D ratio		5.10					12.86***					16.56**			
		3.59					3.01					8.30			
L3 R&D ratio			4.77					16.64***					7.98		
			3.76					2.98					8.16		
L4 R&D ratio				3.98					14.62***					3.02	
				2.98					2.94					9.06	
L5 R&D ratio					2.40					10.08***					-1.39
					3.51					3.49					12.66
Constant	2.67**	2.79**	2.79**	2.84**	2.97**	8.652***	8.34**	7.57**	7.57**	8.12**	18.12***	19.86***	21.14***	21.67***	22.65***
	0.44	0.54	0.58	0.48	0.54	514	0.47	0.48	0.48	0.57	1.21	1.36	1.33	1.49	2.00
Observ.	1,034	934	825	717	607	1,034	934	825	717	607	1,034	934	825	717	607

*** p<0.01, ** p<0.05, * p<0.1

2.2.3) Telecommunication and Equipment Sector

Asset Growth																
	Quantile 10					Quantile 50					Quantile 90					
L1 R&D ratio	10.10**					19.13*					32.18					
	4.85					9.94					40.34					
L2 R&D ratio		4.37					21.28**					14.38				
		5.45					10.40					32.80				
L3 R&D ratio			4.64					31.31***					9.34			
			6.89					7.63					25.05			
L4 R&D ratio				3.65					11.98*						-2.97	
				4.86					6.15						51.39	
L5 R&D ratio					4.00					-0.18						1.98
					3.14					7.32						61.74
Constant	1.52*	1.99*	1.89*	1.86*	1.54*	7.01*	6.61*	5.20*	5.84*	7.08*	18.65***	21.12***	20.36***	21.20**	21.15**	
	0.81	1.03	1.10	0.84	0.65	1.61	1.65	1.25	1.08	1.23	6.03	4.96	4.46	9.24	10.17	
Observ.	157	143	128	113	97	157	143	128	113	97	157	143	128	113	97	

*** p<0.01, ** p<0.05, * p<0.1

2.2.4) Computer Hardware Sector

Asset Growth															
	Quantile 10					Quantile 50					Quantile 90				
L1 R&D ratio	-20.69					45.75**					120.36				
	15.75					21.52					188.17				
L2 R&D ratio		-18.56					51.65**					233.72			
		18.54					23.50					222.59			
L3 R&D ratio			32.10					34.86					202.97		
			20.71					22.37					169.37		
L4 R&D ratio				35.37**					33.34					190.71	
				16.66					22.56					114.23	
L5 R&D ratio					6.60					55.51***					131.57
					19.85					19.45					101.59
Constant	6.25**	6.19**	1.86	0.66	3.34	6.25**	6.19**	6.19**	6.04**	4.04*	11.10	6.19	6.19	7.57	7.58
	1.64	1.89	2.14	1.89	2.19	2.09	2.27	2.20	2.24	2.02	17.81	20.09	15.90	10.72	9.89
Observ.	87	77	65	56	48	87	77	65	56	48	87	77	65	56	48

*** p<0.01, ** p<0.05, * p<0.1

2.2.5) Internet Sector

Asset Growth															
	Quantile 10					Quantile 50					Quantile 90				
L1 R&D ratio	27.30					67.91					-112.83				
	66.19					89.73					131.39				
L2 R&D ratio		38.08					-126.12					-102.01			
		22.89					90.15					126.96			
L3 R&D ratio			52.43 ^{***}					-132.57					-127.00 ^{**}		
			16.81					118.26					57.67		
L4 R&D ratio				71.76 ^{***}					43.79						-61.44
				8.63					91.58						85.55
L5 R&D ratio					81.76 ^{***}					45.95					39.17
					21.58					107.75					27.83
Constant	1.75	0.73	0.67	0.56	0.83	9.12	21.64 ^{***}	21.33 ^{***}	9.12	9.12	28.03 ^{***}	28.03 ^{***}	28.03 ^{***}	21.64 ^{***}	21.33 ^{***}
	3.95	0.81	0.55	0.87	2.03	5.45	5.40	6.93	5.44	6.47	4.47	8.39	1.76	2.43	1.70
Observ.	26	23	21	19	15	26	23	21	19	15	26	23	21	19	15

*** p<0.01, ** p<0.05, * p<0.1

2.2.6) Semiconductors Sector

Asset Growth															
	Quantile 10					Quantile 50					Quantile 90				
L1 R&D ratio	3.43					-3.12					19.11**				
	4.75					5.62					7.84				
L2 R&D ratio		4.04					3.62					23.65***			
		4.46					5.17					6.85			
L3 R&D ratio			3.58					6.87					2.39		
			4.63					5.89					12.27		
L4 R&D ratio				4.06					0.89					-7.63	
				5.00					5.23					16.38	
L5 R&D ratio					3.29					1215					-11.30
					5.16					5267					16.62
Constant	2.82**	2.81**	3.09**	2.79**	2.79**	11.41***	10.69***	9.85**	10.70***	10.672***	18.93***	18.84***	22.05***	24.14***	24.72***
	0.82	0.80	0.89	0.95	1.02	1.00	0.93	1.10	1.00	1027	1.68	1.53	2.51	3.04	3.13
Observ.	296	264	234	205	176	296	264	234	205	176	296	264	234	205	176

*** p<0.01, ** p<0.05, * p<0.1

2.2.7) Software Sector

Asset Growth															
	Quantile 10					Quantile 50					Quantile 90				
L1 R&D ratio	9.89*					17.72***					29.26**				
	3.91					5.37					13.32				
L2 R&D ratio		14.06**					16.82***					35.08**			
		5.84					4.76					13.93			
L3 R&D ratio			10.41*					17.88***					24.35		
			5.8					4.24					18.18		
L4 R&D ratio				12.58**					19.97***					25.37	
				4.91					5.14					27.60	
L5 R&D ratio					5.20					18.25***					0.91
					5.10					5.39					24.43
Constant	2.40**	1.98*	2.79**	2.84**	3.26**	7.05**	7.00**	6.60**	6.56**	6.82**	16.21***	14.29***	16.42***	16.07***	22.18***
	0.64	0.90	0.91	0.80	0.85	0.84	0.77	0.69	0.84	0.88	2.24	2.44	3.02	4.43	4.06
Observ.	404	370	326	280	234	404	370	326	280	234	404	370	326	280	234

*** p<0.01, ** p<0.05, * p<0.1

2.3) R&D ratio, ROA and ROE by Sector in Different Markets

2.3.1) Sectors from the ROTW

2.3.1.1) All Sectors

Asset Growth															
	Quantile 10					Quantile 50					Quantile 90				
L1 R&D ratio	6.77*					17.13***					12.62				
	2.95					3.34					14.03				
L1 ROE	0.10**	0.10**	0.1***	0.15**	0.16**	0.17**	0.15**	0.15**	0.26**	0.27**	0.17**	0.15**	0.18**	0.24	0.23
	0.01	0.00	0.01	0.02	0.02	0.01	0.01	0.01	0.02	0.02	0.05	0.06	0.04	0.16	0.14
L2 R&D ratio	6.63*					18.14***					2.63				
	2.99					3.05					15.72				
L3 R&D ratio			6.57*				17.41***						4.51		
			3.84				2.37						13.80		
L4 R&D ratio				2.14					8.05**					-1.29	
				3.78					2.60					14.81	
L5 R&D ratio					0.18					6.07**					-4.39
					3.79					2.26					13.01
Constant	2.00**	2.09**	2.12**	2.17**	2.16**	4.40**	4.43**	4.14**	4.06**	4.40**	15.65***	18.81***	16.55***	17.17***	19.09***
	0.59	0.60	0.75	0.78	0.77	0.65	0.59	0.47	0.57	0.50	2.63	2.91	2.58	3.68	3.28
Observ.	453	423	382	338	286	453	423	382	338	286	453	423	382	338	286

*** p<0.01, ** p<0.05, * p<0.1

2.3.1.2) Telecommunication and Equipment Sector

Asset Growth															
	Quantile 10					Quantile 50					Quantile 90				
L1 R&D ratio	8.75*					29.02***					21.00				
	4.92					8.12					38.97				
L1 ROE	0.04* *	0.04* *	0.04* *	0.04* **	0.03*	0.12* **	0.06*	0.03	0.08* *	0.10* *	0.16	0.08	0.08	0.02	0.19
	0.02	0.02	0.02	0.02	0.02	0.03	0.04	0.03	0.03	0.04	0.19	0.30	0.14	0.19	0.19
L2 R&D ratio		3.92					39.56***					1.64			
		5.87					7.36					85.86			
L3 R&D ratio			2.60					34.01***					-0.19		
			3.63					6.82					32.07		
L4 R&D ratio				2.51					15.14**					-12.71	
				3.39					6.14					41.11	
L5 R&D ratio					2.44					1.72					-17.40
					3.04					7.36					52.64
Constant	0.47	0.80	0.80	0.83	1.32	2.15	2.31	3.37* *	3.72* **	4.39* **	18.68***	22.61	22.98***	26.20***	24.43**
	1.29	1.35	1.15	1.15	0.97	1.82	1.50	1.42	1.34	1.50	6.67	13.97	5.44	9.64	11.23
Observ.	77	72	65	61	52	77	72	65	61	52	77	72	65	61	52

*** p<0.01, ** p<0.05, * p<0.1

2.3.1.3) Computer Hardware Sector

Asset Growth															
	Quantile 10					Quantile 50					Quantile 90				
L1 R&D ratio	-91.65***					-123.73					184.28				
	11.48					75.06					587.64				
L1 ROE	0.10**	0.10**	0.10**	0.34**	0.25**	0.10**	0.09**	0.09**	0.47**	0.61**	0.37**	0.02**	0.32**	0.63**	0.43**
	0.00	0.00	0.00	0.04	0.02	0.01	0.01	0.02	0.06	0.05	0.07	0.01	0.01	0.02	0.03
L2 R&D ratio		-19.96***					-68.57					308.84***			
		5.88					67.23					55.29			
L3 R&D ratio			-22.90***					8.10						102.17***	
			5.29					79.94						18.96	
L4 R&D ratio				-12.43					-0.89						-78.69***
				30.15					37.39						13.04
L5 R&D ratio					-6.68					28.67					59.60***
					6.72					19.06					11.81
Constant	11.83***	4.84**	4.81**	0.86	1.32*	22.62***	17.77**	6.53	2.02	-2.68	-3.36	5.85	3.79	11.36***	2.36
	1.30	0.75	0.69	3.12	0.71	6.76	6.78	7.14	3.27	1.83	51.20	7.90	2.70	1.92	2.09
Observ.	24	24	22	19	16	24	24	22	19	16	24	24	22	19	16

*** p<0.01, ** p<0.05, * p<0.1

2.3.1.4) Semiconductors Sector

Asset Growth															
	Quantile 10					Quantile 50					Quantile 90				
L1 R&D ratio	8.31					16.75***					10.38				
	10.41					4.92					32.77				
L1 ROE	0.17**	0.03	0.04	0.00	0.02	0.17**	0.15**	0.11**	0.10*	0.07	0.16	0.14	0.14	0.18	0.17
	0.05	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.06	0.05	0.57	0.49	0.48	0.40	0.42
L2 R&D ratio		0.90					19.87***					6.78			
		6.25					4.83					28.09			
L3 R&D ratio			3.63					18.67***					-0.01		
			7.33					4.73					47.18		
L4 R&D ratio				3.49					6.25					-13.02	
				6.54					6.45					59.17	
L5 R&D ratio					-3.23					5.30					-5.53
					3.48					5.94					39.15
Constant	0.96	3.29*	3.43*	3.13*	4.12**	4.76**	4.23**	4.49**	7.27**	8.40**	17.17	19.63	20.65	24.58	23.31
	2.35	1.60	1.68	1.57	1.53	1.30	1.30	1.26	1.86	1.81	13.59	12.13	14.96	17.06	14.06
Observ.	99	89	81	71	62	99	89	81	71	62	99	89	81	71	62

*** p<0.01, ** p<0.05, * p<0.1

2.3.1.5) Software

Asset Growth															
	Quantile 10					Quantile 50					Quantile 90				
L1 R&D ratio	10.21***					6.11					-2.37				
	3.35					4.00					21.15				
L1 ROE	0.17**	0.20**	0.20**	0.19**	0.20**	0.33**	0.31**	0.37**	0.39**	0.40**	0.17	0.23	0.48*	0.57**	0.56**
	0.01	0.01	0.03	0.04	0.05	0.01	0.01	0.01	0.02	0.02	0.18	0.18	0.19	0.12	0.21
L2 R&D ratio		10.69**					7.55*					-14.80			
		4.26					3.73					22.04			
L3 R&D ratio			10.28**					5.07*					-9.19		
			4.55					2.58					20.97		
L4 R&D ratio				7.94					2.75					-1.35	
				5.22					2.86					17.84	
L5 R&D ratio					14.76**					1.97					-4.94
					6423					4.16					28.47
Constant	1.19	0.81	0.79	1.43	0.40	3.73**	3.61**	3.12**	3.08**	2.97**	15.970***	16.28***	8.86*	5.50*	5.96
	0.74	0.79	0.90	0.96	1.33	0.70	0.64	0.46	0.55	823	3.70	3.84	4.02	3.23	5.47
Observ.	220	203	179	155	130	220	203	179	155	130	220	203	179	155	130

*** p<0.01, ** p<0.05, * p<0.1

2.3.2) Sectors from the U.S.

2.3.2.1) All Sectors

Asset Growth															
	Quantile 10					Quantile 50					Quantile 90				
L1 R&D ratio	-9.00					-6.94					42.69***				
	6.71					5.60					13.37				
L1 ROE	0.10**	0.10**	0.09**	0.07**	0.07**	0.11**	0.14**	0.14**	0.10**	0.08**	0.10*	0.09*	0.06	0.06	0.05
	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.04	0.01	0.04	0.05	0.05	0.05	0.06
L2 R&D ratio		-9.00					-0.75					42.07***			
		6.54					5.56					14.90			
L3 R&D ratio			-6.90					0.26					30.88*		
			6.92					5.30					16.32		
L4 R&D ratio				-8.60					1.52					32.22***	
				6.75					6.19					12.01	
L5 R&D ratio					-6.98					-4.03					-14.65
					7.65					7.47					14.37
Constant	3.88**	3.77**	3.39**	3.57**	3.38**	9.32**	8.07**	7.54**	8.14**	8.88**	12.38***	12.93***	14.34***	13.97***	19.00***
	0.90	0.92	0.94	0.93	1.01	0.73	0.75	0.70	0.83	0.96	1.98	2.18	2.19	1.91	2.08
Observ.	480	436	384	334	285	480	436	384	334	285	480	436	384	334	285

*** p<0.01, ** p<0.05, * p<0.1

2.3.2.2) Telecommunication and Equipment Sector

Asset Growth															
	Quantile 10					Quantile 50					Quantile 90				
L1 R&D ratio	-101.45*					-32.64					-17.16				
	55.18					26.14					93.34				
L1 ROE	0.10	0.09	0.17*	0.07	0.44**	0.23**	0.26**	0.22**	0.19**	0.22**	0.30	0.32	0.27	0.24**	0.25*
	0.12	0.07	0.09	0.09	0.07	0.06	0.05	0.06	0.04	0.07	0.18	0.24	0.18	0.07	0.10
L2 R&D ratio		-20.99					-16.84					-9.28			
		29.68					17.12					100.55			
L3 R&D ratio			19.32					-25.90					-55.34		
			40.97					24.07					103.19		
L4 R&D ratio				30.64					-13.62					-54.252**	
				42.44					17.38					13.80	
L5 R&D ratio					33.44					-16.32					-59.19**
					81.33					25.36					24.85
Constant	13.30**	6.16*	0.73	-0.43	-3.57	9.77**	7.93**	9.03**	8.21**	8.00**	13.79*	12.63	15.61	16.18***	16.23***
	6.19	3.15	4.55	4.13	7.08	2.96	1.93	2.48	1.84	2.73	7.99	10.24	9.98	1.58	1.97
Observ.	62	58	51	44	38	62	58	51	44	38	62	58	51	44	38

*** p<0.01, ** p<0.05, * p<0.1

2.3.2.3) Computer Hardware Sector

Asset Growth															
	Quantile 10					Quantile 50					Quantile 90				
L1 R&D ratio	-72.42***					73.35***					207.46**				
	19.96					21.05					81.48				
L1 ROE	0.09**	-0.02	0.02	0.04**	0.07**	0.00	-0.02**	-0.03*	-0.01	-0.00	0.01	0.02	-0.02	0.04	0.05*
	0.02	0.03	0.02	0.02	0.01	0.02	0.01	0.02	0.01	0.02	0.10	0.09	0.07	0.11	22
L2 R&D ratio		60.71*					68.55***					193.47***			
		34.15					13.78					66.20			
L3 R&D ratio			55.06**					69.71**					231.63***		
			24.18					28.06					68.36		
L4 R&D ratio				59.56***					71.97***					129.60	
				13.53					23.00					107.63	
L5 R&D ratio					73.34***					60.76**					133.16**
					11.32					26.35					51166
Constant	9.03**	0.83	0.76	-1.32	-3.94**	3.37*	3.76**	3.80	2.61	3.10	-1.10	0.75	-2.12	3.53	2343
	1.90	3.43	3.00	2.03	1.66	1.82	1.32	2.58	2.41	2.92	6.25	5.24	5.36	10.61	5272
Observ.	55	47	40	35	30	55	47	40	35	30	55	47	40	35	30

*** p<0.01, ** p<0.05, * p<0.1

2.3.2.4) Internet Sector

Asset Growth															
	Quantile 10					Quantile 50					Quantile 90				
L1 R&D ratio	25.95					59.99					-173.34*				
	56.82					186.58					80.39				
L1 ROE	0.26*	0.22**	0.16**	0.09	-0.02	0.68*	0.57*	0.47*	0.71**	0.62*	-0.41***	-0.52***	-0.09	0.45*	0.68**
	0.10	0.06	0.04	0.06	0.08	0.28	0.22	0.25	0.16	0.25	0.13	0.09	0.14	0.19	0.01
L2 R&D ratio		9.32					117.25					-82.53*			
		34.06					110.78					41.67			
L3 R&D ratio			57.79**					84.40						258.56***	
			24.24					104.78						63.75	
L4 R&D ratio				70.45***					-29.93						246.61***
				22.49					62.91						64.81
L5 R&D ratio					97.99**					15.27					356.50***
					33.40					83.94					4.08
Constant	-0.91	1.07	-0.74	-0.21	0.06	-3.94	-5.10	-1.76	2800	1.02	40.12***	35.26***	4.63	-0.90	-13.18***
	5.53	3.03	1.79	1.56	1.89	17.03	9.54	8.67	4.56	5.55	7.22	3.80	5.52	5.60	0.30
Observ.	15	15	15	14	12	15	15	15	14	12	15	15	15	14	12

*** p<0.01, ** p<0.05, * p<0.1

2.3.2.5) Semiconductors Sector

Asset Growth															
	Quantile 10					Quantile 50					Quantile 90				
L1 R&D ratio	-3.11					-23.29**					12.04				
	19.89					9.89					21.37				
L1 ROE	0.10**	0.10**	0.10**	0.10**	0.10**	0.11**	0.14**	0.13**	0.12**	0.08**	0.12*	0.12*	0.13*	0.09	0.10
	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.05	0.07	0.07	0.07	0.09
L2 R&D ratio		-1.97					-19.43**					10.58			
		15.99					9.54					29.21			
L3 R&D ratio			-1.31					-14.80					-10.90		
			14.29					9.08					33.32		
L4 R&D ratio				2.11					-19.71*					-23.13	
				19.47					10.66					37.47	
L5 R&D ratio					0.93					-26.52*					-71.73*
					11.23					14.77					39.11
Constant	3.53	3.32	3.17	2.70	2.55	12.53***	11.67***	11.18***	12.28***	13.42***	16.11***	16.80***	19.55***	21.70***	27.39***
	2.73	2.26	2.12	2.57	1.77	1.41	1.37	1.30	1.56	2.06	3.13	3.84	4.58	5.36	5.49
Observ.	179	160	139	121	104	179	160	139	121	104	179	160	139	121	104

*** p<0.01, ** p<0.05, * p<0.1

2.3.2.6) Software Sector

Asset Growth															
	Quantile 10					Quantile 50					Quantile 90				
L1 R&D ratio	-3.10					-1.18					77.52 ^{***}				
	9.90					9.00					22.09				
L1 ROE	0.06 ^{**}	0.07 ^{**}	0.07 ^{**}	0.05 [*]	0.05 ^{**}	0.08 ^{**}	0.07 ^{**}	0.07 ^{**}	0.01	0.05 ^{**}	0.12	0.11	0.05	0.05	0.04
	0.02	0.02	0.02	0.02	0.01	0.02	0.02	0.02	0.02	0.02	0.08	0.1	0.08	0.08	0.05
L2 R&D ratio		-3.70					-0.03					62.48 ^{**}			
		8.35					8.07					24.23			
L3 R&D ratio			-4.13					-9.89					44.90		
			8.44					6.72					33.79		
L4 R&D ratio				-8.11					0.61					38.34	
				10.11					8.02					26.70	
L5 R&D ratio					-10.32						-14.90 ^{**}				-59.30 ^{***}
					11.64						7.31				19.28
Constant	2.35	2.46 [*]	2.50 [*]	3.48 [*]	4.23 ^{**}	8.32 ^{**}	8.10 ^{**}	8.88 ^{**}	8.21 ^{**}	9.27 ^{**}	6.76 [*]	7.93 [*]	10.81 ^{**}	11.07 ^{***}	22.65 ^{***}
	1.46	1.35	1.29	1.52	1.59	1.28	1.23	1.03	1.14	1.02	3.62	4.24	4.16	3.77	2.92
Observ.	156	143	127	110	93	156	143	127	110	93	156	143	127	110	93

*** p<0.01, ** p<0.05, * p<0.1