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## Intellectual Capital's Leverage on Market Value

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## **Intellectual Capital's Leverage on Market Value**

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### **Executive summary**

The purpose of this thesis is to visualize whether there is a correlation between the intellectual capital and the market value among Swedish companies, listed on the Stockholm stock exchange. The purpose is furthermore to enlighten if there are factors that might alter the strength of this correlation. By using these results the aim is to further examine a possible indicator for leveraging the efficiency of intellectual capital.

In order to perform this investigation, intellectual capital and market value are quantified with, respectively, value added per employee and stock exchange value per employee. These measurements were gathered for 40 Swedish companies listed on the Stockholm stock exchange, divided into four industry sectors, *Industrials*, *Life science*, *Real estate and construction* and *IT consulting and services*, and tested statistically in order to find a linear pattern. The companies have also been divided by company size and age.

What this thesis visualizes is that there is a correlation between value added per employee and stock exchange value per employee, the stock exchange value can to a degree of 62 percent be predicted by value added per employee. This means, according to our approximation on the return on intellectual capital, that there also is a correlation between intellectual capital and market value. It further proves that there also are substantial differences between the different industry sectors, both regarding the correlation between intellectual capital and market value and regarding the leverage effect an increase in intellectual capital has on market value.

In order to provide an indicator for improving companies' intellectual capital, a statistical examination concerning the relationship between the IC Multiplier and value added is also performed. This examination shows that there is a strong correlation between the IC Multiplier and value added, value added can to a degree of 84 percent be predicted by the IC Multiplier, and that working with the ratio between structural and human capital is an excellent method for companies to increase their intellectual capital.

In conclusion it can be said that most companies in this investigation show very poor values regarding the IC Multiplier, leading to an erosion of the companies' human capital. In order to become more stable and lower the degree of risk, these companies must improve their IC Multiplier. What this thesis demonstrates is that an improvement of the IC Multiplier also will have an extensive effect on the company's market value.

### **Key words**

Intellectual capital, Value added per employee, Structural capital, Human capital, IC Multiplier

## *Preface*

*This thesis concludes our studies at the Lund School of Economics and Management, Lund University. Although the thesis has meant a lot of work, it has definitely been worth the effort. Intellectual capital is a very new and interesting topic and we believe its importance will grow substantially in the future and are pleased that we found an interest in the topic at its relatively early development stage.*

*We would like to commence by thanking those who have contributed to the completion of this thesis.*

*First, we would like to thank Professor Leif Edvinsson who, with his exceptional knowledge in the area of intellectual capital, has given us useful insights and guidance throughout the thesis.*

*We would also like to thank Harry Matilainen and the employees at Six Data AB, whose help has been an essential prerequisite for the existence of this thesis.*

*Lund, Spring of 2002*

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# 1 Introduction

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*In this chapter, we present the purpose of this thesis. Furthermore we provide the reader with a background and a problem discussion covering issues related to the study and the reasons why we chose to investigate this subject. A description of the hypotheses formulated has been included in the problem discussion. Lastly we present our view of the target audience and the disposition of this thesis.*

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*“Whereas at one time the decisive factor of production was the land, and later capital... today the decisive factor is increasingly man himself, that is, his knowledge.”*

Pope John Paul II (1991), *Centesimus Annus*.

## 1.1 Background

During the last few years, society, the economy and individual companies have slowly transformed. Many companies of today have realized that their prime assets no longer consist of real estate and machine parks. The focus point has instead shifted to incorporate customer loyalty, electronic infrastructure, innovation and last but not least: *the knowledge of the workforce*.

Knowledge has hence evolved into one of the economy's prime resource, more important than raw material and sometimes more important than money itself. Knowledge has become the central ingredient in what we produce, buy and sell ([www.intellectualcapital.org](http://www.intellectualcapital.org)). Knowledge, like other physical and financial corporate assets creates shareholder value and is generally expected to generate above-normal benefits (Lev, 2000). Information age companies do not hire people for their physical abilities but for the ability to exploit their knowledge. These companies do not hire a person. They hire that person's knowledge and skills. For many people in the West, the days of manual work on a production line or in a mine where just about anyone could do any job are long gone. Now, most jobs are knowledge jobs. ([www.intellectualcapital.org](http://www.intellectualcapital.org))

Stemming from this is the emergence of the intellectual capital (IC) discussion, accompanied by the drive to establish new methods that can be used to measure and report the value of the intangible assets, i.e. the intellectual capital. Internationally a number of firms, practitioners and consultants have begun experimenting with various ways of identifying, measuring and reporting IC within organizations. As a part of this trend, new breeds of internal and external accounting statements have emerged; these



include Sveiby's *Intangible Asset Monitor*, Skandia's *Navigator* and Kaplan & Norton's *Balanced Scorecard*. (Guthrie, 2001)

Many practitioners and researchers agree that IC is of major importance, but few are able to define and quantify it. One classical approach is the "market-minus-book", but this has, according to Feng Gu and Baruch Lev proven to be unsatisfactory. The reason for this is that this approach is circulatory. As Mr Gu and Mr Lev argue: "*One searches for measures of intangibles value in order to provide new information to managers and investors. What is the use of a measure that is derived from what investors already know?*" ". Estimating the value of intangible assets, through a different approach, is naturally something that seems of great importance. (Gu & Lev, 2001, p. 3)

Furthermore, the lack of means concerning the ability to make the IC visible leads to an inefficient basis for decisions for investors. A company with a large share of IC, which is not illustrated in the traditional accounting principles, and which has high future earnings potential, can easily be wrongfully valued. The consequences may be under capitalization and reduced ability for the company to perform its outermost. (Edvinsson & Malone, 1998)

Lately, many groups, comities and other associations have tried to establish standards for valuing IC. The AICPA (The American Institute of Certified Public Accountants) appointed the Jenkins committee in 1994, with the aim of investigating companies' external reports. This resulted in the Jenkins report. This report has been followed up by the American FASB (Financial Accounting Standards Board) and also addressed in other countries such as Denmark and Sweden. (Noll & Weygandt, 1997)

In conclusion, it is quite clear that IC could be of great importance both today and in the future, for whole industries as well as for the appraisal of individual companies. Presently, some businesses are valued at more than one hundred times their book value. The traditional accounting principles have lost much of its relevance especially concerning the valuation of consulting firms and high tech IT-businesses. With market values that highly exceed these companies' book values, one might ask oneself if the conventional balance sheet and income statement with the available measures are sufficient or if they have become outdated. We believe that the importance of IC and its measurement will grow substantially in the future and that this issue demands further enlightening.

## 1.2 Problem discussion

In the knowledge economy that has risen, most companies base their business on knowledge, compared to formerly, in which physical assets were the prime resources. In fact, researchers claim that in today's economy, all companies are knowledge companies (Eneroth, 2002). The knowledge exists in the employees who convert it into value depending of their capabilities and the support offered by the company. The focus point should, according to many researchers, shift from cost control to value addition. In order to manage and understand the value creation within companies we thus need more modern management methods and new measuring tools (Pulic, 2000).

However, as previously mentioned, IC still does not have one accepted definition and therefore not one commonly accepted measurement approach. To complete this thesis we have therefore made a vital assumption regarding the measurement of intellectual capital. We use *Value added per employee* as an *approximation* of the return of intellectual capital. This approximation can consequently be considered as the fundamental assumption of the thesis on which the hypotheses is based and dependent on. The measure and its relevance will be further discussed in *chapter 4*.

Nowadays, a company's market value, measured in this thesis through stock exchange value, relies not only on its financial value but also on the company's ability to communicate its intellectual capital. Do companies manage to do this equally well and does the financial market acknowledge this? In today's economy where the majority of a company's value lays in its IC this question can be formulated as follows - Is there a linear pattern between the value of companies IC and their market value? This leads us to the first hypothesis.

*Hypothesis 1: There is a linear pattern between companies' value added per employee and their stock exchange value per employee when comparing all the selected companies.*

If this hypothesis is correct and there is an identifiable pattern, we believe that it is probably not strongly correlated. Is it possible to find variables that make this correlation stronger? Alternatively, if the linear pattern is not identifiable, is it possible to find variables that make the pattern visible?

With the end of the "IT-boom" in the year 2000, numerous companies lost a great deal of their stock exchange value. Of course, many of these companies were heavily over-valued, but possibly a part of their prior value may be explained with an above average ability in communicating IC value to the public. Do companies in some industry sectors communicate their true worth better than others? Consequently the question asked is:

- Is the linear pattern between IC and market value easier to determine when companies within the same industry sector are compared?

*Hypothesis 2: There is a linear pattern between companies' value added per employee and their stock exchange value per employee when comparing companies by industry sector.*

If this hypothesis proves to be correct, what might lie behind this correlation? Possibly, it is not just the fact that the companies are situated in the same industry sector, but rather the characteristics of that particular company. In trying to determine this, some further questions might be asked.

- Does size matter? Does the original correlation become more substantial if we divide the examined companies according to size?
- Does company age have any effect on the original correlation? By this, we mean that the sought pattern becomes more legible over time. As companies settle in a more steady state, so does the development of their market value, thus making the relationship between intellectual capital and market value more even.

From the questions above, two additional hypotheses can be defined.

*Hypothesis 3: There is a linear pattern between companies' value added per employee and their stock exchange value per employee when comparing companies divided by company size.*

*Hypothesis 4: There is a linear pattern between companies' value added per employee and their stock exchange value per employee value when comparing companies divided by company age.*

In the last three hypotheses we will in addition elaborate and compare these results with the results obtained in hypothesis 1, i.e. if the results are stronger correlated than in the first hypothesis. In the chosen industry sectors, many changes have occurred during the last decade. Therefore, it might also be interesting to test the stated hypotheses over a period of years, to examine whether the strength of the believed correlation has changed. This comparison will consequently be made over a period of five years, from 1996 to 2000.

If the hypotheses defined above prove to be correct, it would be interesting to find a way for companies to improve their value added and thereby their stock exchange value. One way to accomplish this is to work with the ratio between structural and human capital, e.g. the IC Multiplier. On this note another hypothesis can be defined.

*Hypothesis 5: There is a linear pattern between companies' IC Multiplier and their value added per employee.*

The calculations, results and analysis of hypothesis 1 to 4 will be presented in *chapter 5*, while *chapter 6* serves the same purpose for hypothesis 5.

## **Purpose**

The purpose of this thesis is to visualize whether there is a correlation between value added per employee, as an approximate measurement of intellectual capital, and stock exchange value per employee among Swedish companies, listed on the Stockholm stock exchange. The purpose is furthermore to enlighten if dividing the companies by industry sectors, size and age might alter the strength of this correlation. By using these results the aim is to further examine a possible indicator, IC Multiplier, for leveraging the efficiency of intellectual capital.

### **1.4 Target audience**

The target audience for this thesis is students and faculty members of Lund School of Economics and Management, but also others, such as analysts and investors that have an interest within the field of intellectual capital and related subjects. With this target audience, some previous knowledge concerning business and economics, as well as academic research methods, is presumed. However we have included some defined key words regarding intellectual capital, which may help the reader. The key words are presented in *Appendix 12*.

This field of study is relatively new, which is why some concepts and definitions still will be explained in more detail. This thesis can, for the proposed target audience, serve the purpose of being merely interesting reading. Our hopes, expectations and ambitions are, however, that the thoughts and analysis that we put forward will contribute to the debate and enhance the understanding regarding intellectual capital, its significance as well as its complications.

### **1.5 Disposition**

The thesis will be disposed according to *figure 1.1*. The results and analyzes of the hypotheses defined in the problem discussion will be presented in *chapter 5* and *6*. More

precisely as the figure indicates; hypothesis 1-4 in *chapter 5-Empirical results and analysis* and hypothesis 5 in *chapter 6-Leveraging human capital*.

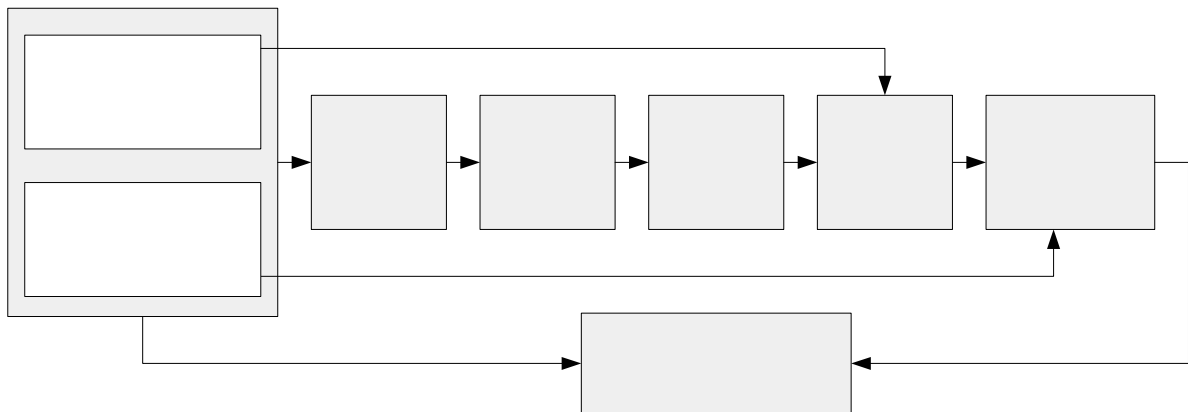


FIGURE 1.1 THE DISPOSITION OF THE THESIS

In the introductory chapter, we present the purpose of this thesis. Furthermore we provide the reader a background and a problem discussion covering issues related to the study and the reasons concerning why we chose to investigate this subject. A description of how the hypotheses were formulated has been included in the problem discussion. This is followed by our view of the target audience and the disposition of this thesis.

## Introduction

The second chapter serves as a guideline, for the reader; in order to explain and visualize how we have handled the data and what different methodological approaches we have used to complete this thesis. We begin by explaining how the thesis initially started out. We then turn to our empirical and theoretical framework. This is followed by a description of the collection of both primary and secondary data and finally criticism of the sources that have been used.

## Hypotheses 1-4

In the theoretical chapter, we present the theories that we have used as a point of departure. The chapter begins with a discussion concerning intellectual capital as a concept, an historical overview of past research and a presentation of common definitions. We then continue with a review of the measurement of intellectual capital and describe various approaches towards this.

## Hypothesis 5

In the fourth chapter, we aim to further explain our empirical research method, by explaining what we are trying to find, how we intend to find it, and most importantly how to statistically prove our findings. We will also explain and compare the chosen measure with previously described measurement approaches and methods.

The fifth chapter contains a presentation of the study's actual results. We begin by statistically describing the empirical observations followed by an initial approach to the material. Thereafter the data is analyzed and presented through regression analyzes to

prove or discard if there is a linear pattern between value added per employee and stock exchange value per employee. The empirical observations are presented according to the order of hypotheses stated in chapter 1 and 4, i.e. all companies, industry sectors, company size and company age. We end the chapter by presenting the regression lines and putting them into a context.

In the next chapter we relate our findings to the IC Multiplier. We first present and analyze the degree of structural and human capital of the selected companies. Furthermore we present the regression plots concerning VA/e and IC Multiplier, presented in the same order as in the previous chapter. Lastly we relate the results to the market value and the meaning of these findings.

In the seventh and final chapter we present the insights that have emerged among the authors during the work of this thesis. We first present the conclusions that have been drawn from the results and analysis of the five hypotheses. Thereafter the contribution of the study is discussed; in this part we also include some short interviews that have been made to place the results of this thesis in a practical context. We then provide the reader with some suggestions for future research and finish with some hints for the practitioner.

## 2 Method

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*This chapter serves as a guideline for the reader in order to explain and visualize how we have managed the data and what different methodological approaches we have used to complete this thesis. We begin by explaining how this thesis initially started out. We then turn to our empirical and theoretical framework. This is followed by a description of the collection process of both primary and secondary data and finally criticism of the sources that have been used.*

---

### 2.1 Introduction

In this chapter we focus on enlightening and explaining how the study has been conducted, why it has been conducted in this manner and the advantages and disadvantages of this approach. That is how this approach has influenced the result and contribution of the study. We have done it in this manner to provide the reader with possibilities to form an opinion on whether the content and results of the study are relevant to the stated purpose.

We will not present methods for conducting scientific research. Rather the focus will be on the study itself and the methods we have used to fulfill the purpose of the study.

### 2.2 Initial approach

A guest lecture and subsequent discussions with Professor Leif Edvinsson initiated this thesis. During the lecture and the subsequent discussions, an interest concerning intellectual capital evolved among the group members. The group members' prior knowledge of this concept was however fairly limited. Our first priority was therefore to increase our knowledge of the concept and related theory.

To increase our understanding of this relatively new topic we collected and read various books that have been published on IC. We also identified and researched some of the academics and practitioners that are most renowned in the IC community, e.g. Nick Bontis, Leif Edvinsson, Baruch Lev and Karl Erik Sveiby. In addition, we collected the most recent academic reports that have been written within and around this area.

Parallel to the research and theory investigation mentioned above, a great deal of the initial effort was aimed at obtaining the necessary data for the defined hypotheses. The only database in Sweden, to our knowledge, that provides this kind of data is Six Trust.

However, obtaining the financial data became a problem. The cost for the service was calculated to be around 10 000 SEK. Therefore, we tried to obtain the data in various other arrangements, e.g. using an application of Six Trust at Sydsvenska Dagbladet, and installing an application of Six Trust at Lund School of Economics and Management. To our disappointment however, these arrangements did not work out. After numerous discussions with Six AB they agreed, to our surprise, to do the service free of charge. This was a breakthrough for the investigation and an essential prerequisite for the existence of this thesis.

## 2.3 Empirical framework

To fulfill the purpose of this thesis we have chosen a quantitative research method. We wanted to investigate if there is a linear pattern between the value of intellectual capital and market value, and also between the IC Multiplier and the value of intellectual capital. This is why a qualitative approach would not have been possible. We have according to the chosen method formulated hypotheses. This makes the research area relatively narrow and it means that statistical measurements have been central to the presentation and analysis of the empirical data. We have at the end of the work with this thesis conducted some minor telephone interviews with various analysts and journalists. This is although merely an action taken to put our results and analysis in a practical context, thus obtaining some feedback and discussion topics on the contribution of this thesis. This does not, however, mean that we also have a qualitative research approach.

Our research approach is, as mentioned earlier, based on hypotheses, which in the study have been defined in the problem discussion. A vital element in this phase is the process of translating concepts into measures, i.e. *operationalization* or *operational definitions* (Bryman, 1989). The study's main concept, intellectual capital, has been approximately translated for measuring as *value added per employee*. The measure, its comparisons to other measures and its relevance as a measurement of IC, will be further discussed in *Chapter 3* and *Chapter 4*. The operational definition of market value has, in order to be measured, been translated as stock exchange value.

The quantitative data consists of financial information of 40 companies listed on the Stockholm stock exchange over a five-year period. The selection is limited by only including Swedish registered companies since Six Trust can only provide data from these companies. Because of this, the selection excludes for example the industrial company ABB that is registered in Switzerland.

We began the empirical process by defining four different industry sectors that would be of interest from an IC perspective. The four sectors chosen were: *Industrials*, *Life science*,



*Real estate and construction* and *IT consulting and services*. We have not conducted an in-depth analysis of the various industry sectors, nor have we taken part of such a study. This somewhat limits our ability to draw context specific conclusions from the analysis of those sectors. We though draw conclusions from general characteristics that are included in our knowledge, as the ones presented below. However, many conclusions can be drawn from the statistical observations.

These sectors were selected to provide a broad spectrum of companies with different surroundings, conditions and possibilities. Industrials are focused on products, Life science on research and development, IT consulting and services on man-hours and Real estate and construction are focused on a combination of services and “products”. The goal of the selection of sectors was to have an adequate blend of different companies, e.g. knowledge/less knowledge intensive companies, technical/non-technical companies, etc. The sectors were chosen based on our thoughts going into this thesis. We believed there would be a sustainable difference between the chosen sectors, with industrials and IT consulting and services as the extremes.

Within these sectors, we chose the 10 largest corporations, sorted by revenue. We could have made the selection based on for instance number of employees or randomly but we consider revenue to be the most appropriate characteristic for a selection as this one. Also, since we were only able to get data from Six Trust on one occasion, selecting the companies randomly would have increased the risk of more fallen data with more companies not being listed during the entire five year period. We believe that the results from the analysis could be misleading if the companies were sorted after number of employees since this figure is a central component of the chosen approximate measure, value added per employee.

Regarding hypothesis 3 and 4, company size and company age, we divided the selected companies into different segments. The company size is based on revenue. The companies were divided into three groups: *Large companies*, *Medium sized companies* and *Small companies*, see *Appendix 8*.

To be able to conduct regression analyzes on company age, the companies were divided into three groups based on the date and year that they were registered as a company. The selection was easy since there were three groups emerging with quite clear distinction. The result of this was: *Old companies* (1897 to 1918), *Medium aged companies* (1935 to 1972) and *Young companies* (1981 to 1999), see *Appendix 9*.

## 2.4 Theoretical framework

Since the theory of intellectual capital in itself is relatively new, we considered it important to firstly acquire a thorough understanding of this area. The theoretical chapter begins with an explanation of the contexts that IC originates from, i.e. the knowledge economy, knowledge economics, and the gap between market and book value.

The concept of intellectual capital can be somewhat difficult to grasp. In order to clear the picture we present some of the various definitions that are used by researchers and practitioners. The discussion regarding the definitions will also contain descriptions of the components of intellectual capital. We further explain how the research and practice of IC has evolved over its short existence and why it is important. This first part, a general overview of the concept of IC, could be regarded as the background theory in this thesis. Although this presentation of theory will not be of vital importance for the empirical results and the analysis, we believe it is important to fully understand the concept and context of IC to be able to grasp the findings and context of this study. If the reader has extended prior knowledge of the IC concept, this part of the theory could perhaps be disregarded.

The second part of the theoretical framework focuses on the measurement of intellectual capital. The main reason for discussing measurement of IC is that we, in this study, strive to quantify intellectual capital, i.e. measure it, and then compare it with market value in search for a correlation.

We begin this part of the theory with a presentation of the importance and the complexity concerning the measurement and reporting of intellectual capital. We then turn to different models and perspectives on how to measure intellectual capital. Today a multitude of measuring models are available. The models are presented in accordance to the various categories of measurement that exist today. We will in *chapter 4, Empirical research*, further discuss the measure that we have chosen. Hereafter, a comparison of previous measures and the chosen measures strengths and weaknesses is discussed. This part is what could be regarded as the most crucial point of the theoretical framework, see *figure 2.1*

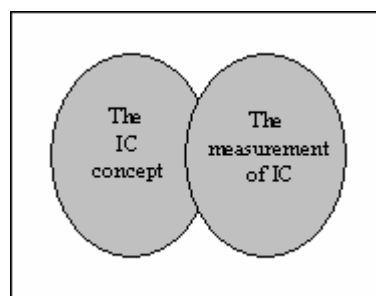


FIGURE 2.1 THEORETICAL FRAMEWORK

## 2.5 Data collection

### 2.5.1 Primary data

The primary data of this thesis consists of financial data from 40 companies listed on the Stockholm stock exchange, with figures collected over the last five years (1996-2000). Initially we extracted the revenue of all the companies that existed within a chosen industry sector. These figures were gathered using the Stockholm stock exchange's homepage ([www.stockhomborsen.se](http://www.stockhomborsen.se)). We then selected the ten largest companies within each sector based on their revenue, see *Appendix 1*.

In order to assemble the measure value added per employee we have used Six Trust. The following financial data were needed to generate the measure: operating profit after depreciation, depreciation according to plan, total salaries including social fees, total salaries excluding social fees and total number of employees at year-end. The definition of value added per employee is derived from *Konsultguiden 2001*. *Konsultguiden* was one of the first in Sweden to emphasize value added per employee as an important measure. The figures extracted for us from Six Trust can be viewed in *Appendix 2*.

The *stock exchange value* is calculated by multiplying the single stock price by the number of shares. However, the stock exchange value was provided without required calculation on our part. Total number of employees at year-end is used in this calculation as well.

### 2.5.2 Statistical Methods

We have used the spreadsheet program MS Excel to calculate the figures into statistical observations. In order to find linear patterns between value added per employee and stock exchange value we have used regression analyzes as the main statistical method for presenting and analyzing the figures. All regressions were analyzed to see whether they were statistically significant.

In *chapter 4* we present a thorough description of how the statistical calculations were conducted. We further elaborate on how we tested the hypotheses so that conclusions consequently could be drawn from the empirical observations.

### 2.5.3 Secondary data

The secondary data mostly consists of scientific articles and books. The tools initially used for gathering this material were various databases on the Internet. The objective was to get a general understanding of IC and the IC community, and to identify the researchers and practitioners active in this field. Via homepages of institutions and researchers, we were able to assemble relevant scientific articles and references of books that would be of interest to the study.

Further research was conducted through different library databases to retrieve prior research material within this field. We have also used databases such as EBSCO to retrieve academic reports. Furthermore, journals such as the *Journal of Intellectual Capital* have been used in the search and are important elements of our research.

Via references in articles, books, and academic reports we have been able to gain further knowledge of which sources could be useful in our study. Unpublished masters' and bachelors' theses have also been an important source for other relevant articles and books. Although, this type of investigation within this area has, to the best of our knowledge, never been done before, we have looked at similar reports to gain an understanding of books and articles that could be of more specific relevance to our study.

## 2.6 Criticism of sources

There are a number of factors, concerning both primary and secondary data, which have influenced this study. Our intention is to disclose these factors and describe how they have been managed.

### 2.6.1 Primary data

Regarding number of employees, it could be considered natural to use the average number of employees per year, which is also what is stated in the definition from *Konsultguiden*. As mentioned before, we however, use the total number of employees at year-end. The reason for this is that we have not been able to acquire figures from 1995, which means that calculations of average number of employees for 1996 would not have been possible. The difference between average number of employees per year and the total number of employees at year-end is in most cases insignificant. This is therefore not considered as something that has an impact on the results, but it should still be mentioned.

We have selected four sectors that could be interesting from an IC perspective. Initially we wanted to include a sector containing companies within the banking and financial services sector. Unfortunately this was not possible since Six Trust does not provide figures for these types of companies. We are however satisfied with the current selection and the limitation of not being able to choose this sector does not influence the contribution of this study. Real estate and construction was chosen as the alternative industry sector. The real estate portion of this industry sector, with its relatively low amount of employees, turned out to be considerably different from the other companies. This might cause a statistical disturbance. The handling of this is further explained in *Chapter 4, Empirical Research*.

Another issue that could have been a problem is the measure, value added per employee, which we used as an operational definition of intellectual capital. One consideration we had was that we were using an incorrect definition of value added per employee. We first came across the definition of value added per employee in *Konsultguiden*, and then investigated its validity by using *Kunskapsföretaget* by Karl-Erik Sveiby. We also had e-mail contact with Mr. Sveiby to ensure that we used the measure appropriately. Leif Edvinsson has also been an important element in this control process. The credibility and relevance of value added per employee, as a measure will be further discussed in *Chapter 4, Empirical Research*.

This study is being conducted during the spring of 2002. Because of this deadline, the latest figures available were for 2000, since very few of the selected companies' annual reports for 2001 have been disclosed. Naturally, it would have been better if the 2001 figures could have been included. The only solution to this problem would have been to wait for all the annual reports to be accounted for. This was never a possibility because of the aforementioned deadline.

### **2.6.1.1 Management of fallen data**

When handling a large quantity of data, as in this study, there is bound to be a number of fallen data. Our aim is to present the fallen data and how the management of these has been conducted. We will also discuss if the fallen data have had an impact on the result of the study.

The choice to arrange the companies into industry sectors means that some companies have been rejected, such as the telecom company Ericsson. Ericsson could be regarded as a company within industrials, but since it is mostly placed within the telecom sector, we have chosen not to include Ericsson in this study. This is also the case for many other companies.

For some of the companies that were included in our first selection Six Trust could only provide figures for two years. Most of these companies have therefore been removed and the next company in line replaced it. Our initial plan was to only include companies with three to five years of observed data. With the exception of two companies: Perbio science AB and QMed AB, this has been accomplished. These two companies were founded recently which limited the data available for them. The Life science industry sector itself is rather young, so we were willing to accept limited data availability.

As mentioned before, as the data was gathered over a five-year period, there ought to be 200 observations. However, because of mergers, acquisitions and recent foundations of companies, the data for some years have fallen out. The number of fallen data adds up to 21 of the total 200. This has struck the industry sectors *Life science* and *IT consulting and services* harder than the other two sectors. The year that has been most affected is 1996. We have, as mentioned above, made the arrangements of removing, when possible, those companies with fewer years than three. No other actions have been taken to complement these fall outs and we regard the effect on the study's result as relatively small.

For some years, data of companies' total salaries excluded social fees. To complement this, we have used the percentage of social fees compared to salaries the year after and added this to the personnel costs of the missing year.

### **2.6.2 Secondary data**

Criticism of secondary data is usually not discussed in a study such as this one, but since intellectual capital is a relatively new phenomenon one has to be somewhat cautious with the available secondary data. The reason for this is that some researchers and practitioners are very subjectively involved in their area of interest. This becomes especially important when studying the numerous measuring models that exist today. Particularly since presently there is not *one* specific model that is accepted by the entire IC community.

We emphasize that it is important to view the secondary data critically and not accept everything as pure facts. We have thus strived for high credibility in our theoretical framework by using and internally discussing numerous independent researchers and theories that manage the same phenomenon within similar areas (Holme & Solvang, 1997). We consider the credibility important because it can be relatively easy to find sources that fit the writers' situation best or solely finding one source to the area of interest. In regards to measurement approaches and methods, we have made an effort to find as independent material as possible. To manage the problem mentioned above we have focused the search of secondary data to those that handle critical aspects of IC and its measurement as well as the less critical.

## **2.7 Method of analysis**

The analysis is structured in which we firstly analyze the results in a more detailed and statistical manner. This is mostly occurring when we present the various results, i.e. in the form of tables, plots and relevant indicators. This analysis is relevant since the aim is to prove the defined hypothesis and drawing statistical conclusions from deviations and similarities. The important aspect of this part of the analysis is for the reader to understand how the various hypotheses are proven or discarded, and if there are statistical explanations for the various results obtained. If a hypothesis is proven it is also important to understand the strength, of for example a correlation, and if this then strengthens the hypothesis.

The second part of the analysis is composed in a more comprehensive perspective, in which we aim at analyzing above the statistical level, seeking answers beyond statistical explanations. This part of the analysis could be regarded as more interesting reading to most people, since the first part is very statistical. However, as we base the second part of the analysis on the first one, we provide the reader with a short summary of the results obtained at various stages of the thesis. Thus, if the statistical evidence for the results is not considered interesting reading, it could be enough to merely reading the second part. However, to grasp the whole essence and context of the study we naturally emphasize that it is important to read the entire thesis.

In some parts of the thesis, such as the analysis of the regression lines and in the IC Multiplier chapter, there is no actual distinction between the first and second part of the analysis, i.e. the statistical and the comprehensive analysis. We consider these two parts being closely linked and that a dividing would lead to a poorer understanding for the reader. This is the reason for keeping the two levels of the analysis together.

## 3 Theory

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*In the third chapter, we present the theories that we have used as a point of departure. The chapter begins with a discussion concerning intellectual capital as a concept, an historical overview of past research and a presentation of common definitions. We then continue with a review of the measurement of intellectual capital and describe various approaches towards this.*

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### 3.1 Introduction

In this chapter, many conceptions will be presented. As been mentioned in the methodology chapter, all theories are not directly important for the results and analysis. However, we emphasize that it indirectly is important to understand the various conceptions in order to fully grasp the results and analysis. This does not only concern the reader but the theory chapter has also been a prerequisite for our own understanding of the context of this thesis.

### 3.2 The gap between market value and book value

According to Ante Pulic of the Austrian Intellectual Capital Research Center there are two essential elements that have changed the activity of the modern business world. *The introduction of knowledge into products and services has given labor an entirely different position.* (Pulic, 2000)

First, *the introduction of knowledge into products and services* has resulted in quality being more important than quantity. Before, prices fell due to increased quantities of products on the markets, today it falls with increased knowledge possessed by the actors on the markets. Secondly, *labor has an entirely different position*, because of the first element. Previously the majority of labor was simple and routine, nowadays the majority of labor is tied to knowledge and the ability of the employees to transform knowledge into profitable actions.

These two elements are according to Mr. Pulic, the reason more and more companies are sensing a gap between the modern approach of value creation and the old way of monitoring operations. He argues that traditional companies based their business on physical assets and modern companies base their business on knowledge. (Pulic, 2000)



Baruch Lev of Stern University also emphasizes knowledge as a keyword and argues further that in developed economies, e.g. the U.S., Japan and the Scandinavian countries, most of the productive resources of businesses are based on intangible, or knowledge assets. Mr. Lev recognizes the vast value-creation capabilities of knowledge assets and argues that this originates from their unique attributes, i.e. *non-scarcity*, *increasing returns* and *network effects*. The attribute non-scarcity means that knowledge assets can be deployed simultaneously in multiple tasks, contrary to physical assets. This also means that the more knowledge is shared the more highly it is valued. While physical assets are subject to decreasing returns of scale, knowledge assets are subject to increasing returns. Because knowledge assets are cumulative, meaning that the more intensive it is used, the larger the benefits (e.g. second generation software programs are cheaper to develop and yield larger benefits because of the R&D done on the first generation). Networks effects means that knowledge assets successfully implemented often contribute to value by positive feedback, i.e. an early market lead can rapidly lead to a domination of that particular market, due to the expansion of users and affiliated companies. (Lev, 2000)

The discussion above leads us to the conclusion that previously, traditional companies could more easily be valued by their physical assets, but in the knowledge economy, this is no longer true because of the increasing domination of knowledge assets within the companies. In a study conducted by The Brookings Institution it is demonstrated that in 1962 62 percent of a company's value was represented by its physical capital. 30 years later, this percentage had declined to 38 percent. Other studies also support these results. Mr. Lev has for instance found that in 1929, 70 percent of American investments went into tangible goods and 30 percent into intangible goods. By 1990 this sample was reversed, and the dominant investments are in intangibles, e.g. R&D, education, etc. (Edvinsson, 2002)

The discussion above highlights a critical question when it comes to comparing the company value represented on the balance sheet and the value that the world attributes to it, i.e. the book value and the market value discussed by for instance James Tobin, who we will return to later on. The investments in intangibles have had its implications on stock prices. Market and book values were more or less equivalent in the 1970s. During the 1990s companies such as Microsoft, Coca Cola, Intel and many more illustrated that the market value can exceed the book value more than ten times. The *average* market-to-book ratio is now greater than three, and for IT and technology stocks it can go as high as 50 or more. (Edvinsson, 2002)

This gap between market value and book value is a very simplified suggestion, provided by many researchers, of what in reality constitutes the concept of IC (Burnaby et al, 2002). We will, nevertheless, penetrate the concept of IC deeper in order to get a more thorough understanding of the subject.

### 3.3 Definition of intellectual capital

As we pointed out previously, the definition of IC is far from obvious. The opinions regarding which components that should be included differ to large extent depending on the researcher. We will here describe the most common definitions and make an effort to clarify what we, and others, mean when IC is the topic of conversation.

The most straightforward definition of IC may well be, as stated earlier, the gap between market value and book value. This is however a somewhat too one-dimensional perspective which do not tell the whole truth about this complex concept. According to Feng Gu and Baruch Lev, there have been attempts to estimate the value of intangible assets by using the difference between the market value and the book value of companies. This has, according to Mr. Gu and Mr. Lev, however proven to be inadequate since this approach is based on two incorrect assumptions. The first assumption is that the financial markets are efficient, i.e. there exist no mispricing. The second incorrect assumption is that the assets on the balance sheet reflect their current values. (Gu & Lev, 2001)

Leif Edvinsson elaborates on the definition and defines IC as: *“a combination of human capital – the brains, skills, insights and potential of those in an organization – and structural capital – things like the capital wrapped up in customers, processes, databases, brands and IT systems. It is the ability to transform knowledge and intangible assets into wealth creating resources, by multiplying human capital with structural capital”*. (Edvinsson, 2002, p. 24)

Skandia was a pioneer in the area of defining, measuring and working with IC. They provided one of the initial classification schemes and their definition of IC was *“the possession of knowledge, applied experience, organizational technology, customer relationships and professional skills”* which later on has been simplified to human capital plus structural capital equals intellectual capital. (Edvinsson & Malone, 1997, p. 65)

#### **Human Capital + Structural Capital = Intellectual Capital**

This definition of IC is one of the most widespread and practical. The Organization for Economic Co-operation and Development (OECD) also agreed on this definition and stated in 1999 that IC is the economic value of two categories of intangible assets of a company: organizational (structural) capital and human capital. (Guthrie, 2001)

The definition has since its creation been further enhanced. Hubert St Onge, Charles Armstrong, Gordon Petrash and Leif Edvinsson have developed one model regarding IC management jointly. The model, or *“Value Platform”* (figure 3.1) as it is called, can best

be described as a development of the model used by Skandia but distinguishes Customer Capital from the previous two components. (Dzinkowski, 2001)

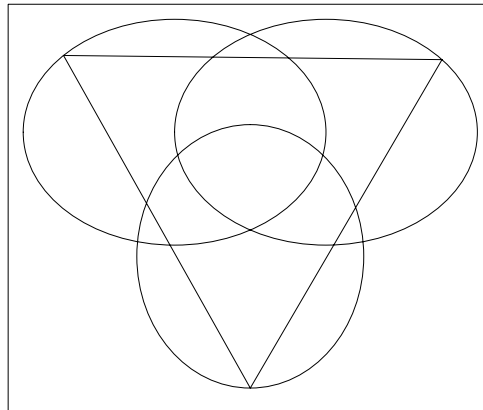


FIGURE 3.1 THE VALUE PLATFORM (EDVINSSON & MALONE, 1997)

Their theory further is that it is not enough to merely include the three components individually. Instead they have to be grouped so that they enhance each other. The value does not arise from the separate components of intellectual capital, it takes place in the interplay between them and they are all equally important for this value creation. (Edvinsson & Malone, 1997)

The Skandia Market Value Scheme also thoroughly illustrates the structure of the components of IC, shown in figure 3.2. *Intellectual capital* is divided into *Human capital* and *Structural capital*. *Structural capital* is then divided into *Customer capital* and *Organizational capital* and *Organizational capital* in turn, is divided into *Innovation capital* and *Process capital*, etc.

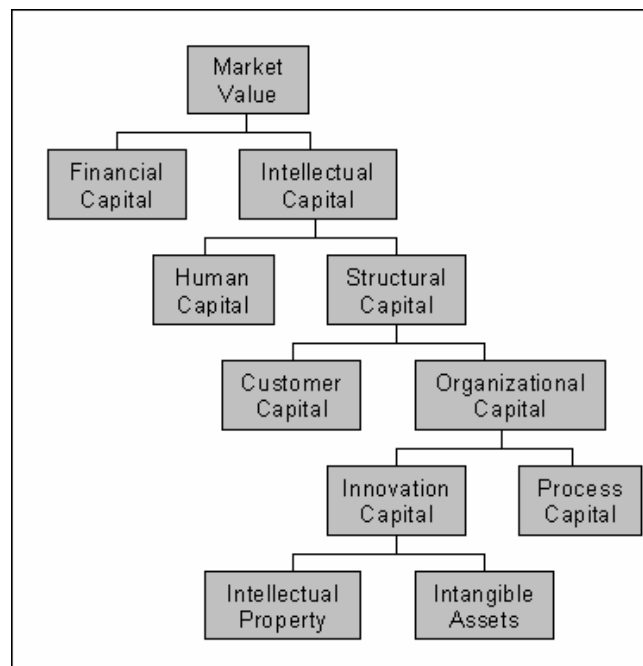


FIGURE 3.2 THE SKANDIA MARKET VALUE SCHEME (EDVINSSON &amp; MALONE, 1997)

Together with *Financial capital*, these components illustrate an organization's market value. This statement also suggests that IC has the value matching the gap between market value and financial capital, i.e. book value. (Edvinsson & Malone, 1997)

Annie Brooking suggested that intellectual capital was a function of four major asset types: market assets, intellectual property assets, human-centered assets, and infrastructure assets. Timothy Draper, founder of venture capital company Draper Fisher Jurvetson, provided one of the broadest classification schemes arguing that the major components of intellectual capital consisted of six categories. These were human capital, structural capital, customer capital, organizational capital, innovation capital and process capital. (Williams, 2000)

Consistent with much of the recent literature on intellectual capital such as Edvinsson's, we have, in order to slightly simplify the concept, categorized it into three major components. These components are described as follows:

### **3.3.1 Human (individual) capital**

Human capital refers to know-how, capabilities, skills and expertise of the human members of the organization. Some of the key functions tied to human capital management are drawn from the traditional practices of human resource and knowledge management. This includes for instance identifying needed competences among the employees, knowledge enhancing routines, etc. (Dzinkowski, 2000) The tacit knowledge of the employees can be transformed into explicit knowledge, which leads to the conversion of human capital into structural capital which thereby becomes property of the company. This conversion will be analyzed and discussed in *chapter 6 Leveraging human capital*. The human capital is therefore of vital importance because it is the source of innovation and strategic renewal. (Åberg, 2001)

### **3.3.2 Structural (organizational) capital**

Structural capital includes the capabilities developed inside the organization. These capabilities may include patents, trademarks, organizational efficiency, improved innovative capabilities, customer directory, and databases. While it is impossible to prescribe an all-encompassing framework for managing the structural capital of the firm, analyses like Porter's Value Chain Analysis can help identify the elements of organizational processes and activities and link them to the creation of value by the firm.

(Dzinkowski, 2000) Structural capital can best be described as all that remains of intangible assets when the employees go home for the day (Edvinsson & Malone, 1997).

### 3.3.3 Customer (relationship) capital

Of the three categories, customer capital is the most obviously valuable. This is what actually pays the bills. Due to this fact, customer capital is the easiest to track with measurement of market share, customer retention and defection rates and per-customer profitability. (Stewart, 1999) Customer capital also includes connections outside the organization such as customer loyalty, goodwill and supplier relations (Dzinkowski, 2000). Since it is in fact the customer capital that gives rise to the profit of the organization, it is the reason why there is an extensive management literature describing how to put a monetary value on, for example customer loyalty (Stewart, 1999).

## 3.4 Historical Development

The objective of illustrating the historical development of IC is to bring the reader up to date on where the theory and research stand today and how it has evolved over its relatively short existence. We believe that by giving a historical perspective on IC, we can provide the reader an understanding of the context within which IC came to be viewed as the essential business element that it is today.

According to James Guthrie and Richard Petty, the development could be viewed in two stages. The *First stage* includes the “battle“ of acceptance of IC as a topic worthy of for example a boardroom discussion and serious academic investigations. This “battle” has been won. Testaments to this are numerous conferences on IC, service offerings from various consulting firms and the amount of books, articles and journals centered on the subject. First-stage work is mainly focused on raising consciousness and creating mass awareness of the relevance of IC. A great deal of first-stage publications have been concerned with what is happening in various organizations.

In the *Second stage*, researchers have begun to investigate ideas related to the influence on micro-level, i.e. more organization-specific, and conceptualizations of the value of IC on the behavior on financial (as for example this study) and labor markets. It is important to emphasize that the distinction between first and second stage not necessarily has to be chronological. First-stage investigations are more concerned with questions such as “why, what and where”. Second-stage investigations on the other hand focus on “how” questions and deal primarily with the process of measuring and managing the intellectual

capital that has already been identified within for instance a firm. The research challenge now is to secure the second stage of development. (Guthrie & Petty, 2000)

According to Guthrie and Petty, it is clear that the IC research and theory have been guided by practice, i.e. from the desire of practitioners. The development of IC reports can, for instance, be traced back to the will of individuals and organizations to better understand what creates value within an organization and thereby managing the value creation objects better (Guthrie & Petty, 2000).

John Kenneth Galbraith first mentioned the term intellectual capital in published form in 1969. His idea was that intellectual capital meant more than “just intellect as pure intellect “. Rather, he felt that the term incorporated a degree of “intelligent action”. In that sense, IC is not a static intangible asset but an ideological process. (Bontis, 1998) It is however, as will be presented, not until the early 1990s that the term gained ground, mostly due to the new business conditions that have emerged.

During the early 1980s, the general notion of intangible value developed, often labeled “goodwill”. In the mid 1980s, the “information age” or knowledge economy developed for instance with an increased general emphasize towards information technology. Discussed earlier, the gap between market and book value widened noticeably for many companies. This initiated early attempts in the late 1980s for consultants to develop statements/accounts that measure the intangible assets.

In the year 1990 Skandia appointed Leif Edvinsson as the world’s first director of IC. This was the first time the role of managing intellectual capital was elevated to a formal status. At about the same time Kaplan and Norton introduced *The Balanced Scorecard* and Skandia introduced the *Navigator*, which both emphasize that not only financial but also non-financial perspectives should be included when measuring and evaluating an organization. Celemi’s Tango simulation tool, which was the first widely marketed product to enable executive education on the importance of intangibles, is launched. A supplement to Skandia’s annual report was produced which focused on presenting an evaluation of the company’s stock of intellectual capital. Pioneers of the IC movement, Kaplan and Norton, Edvinsson and Malone, Sveiby etc. published best-selling books on the topic.

The progression made during the mid 1990s belongs to the first stage of the IC development. The ongoing activities of today belong to the second stage. In the late 1990s, IC becomes a popular topic with researchers and academic conferences, which initiates an increasing number of large-scale research projects (e.g. Meritum). At this point, the OECD convened an international symposium on intellectual capital. (Guthrie & Petty, 2000)

In the past years we have seen more and more companies in Sweden (ABB, Sydkraft etc.) and Denmark (Carl Bro Gruppen, Coloplast, Opticon and Dator A/S etc.) follow in the footsteps of pioneers such as Skandia and trying to include their IC in the reporting.

### 3.5 The importance of intellectual capital

So, why are we discussing the topic IC and why is it important? The rise of a knowledge economy is identified by the OECD as an explanation of the increased prominence of IC as a business and research topic. Mr. Guthrie has the same opinion and points out four arguments which emphasizes the importance of IC:

- The revolution in information technology and the information society
- The rising importance of knowledge and the knowledge-based economy
- The changing patterns of interpersonal activities and the network society
- The emergence of innovation and creativity as the principal determinant of competitiveness (Guthrie, 2001)

Furthermore, Petty and Guthrie highlight that the genesis of the modern organization and the rise of an information or knowledge economy, created what is mentioned as new knowledge-based intangibles, i.e. organizational structures and processes, know-how, intellectual and problem-solving capacity. They stress that this is not new in the way that it did not exist within organizations and in the economy before. However, its importance has increased as a consequence of a business world defined by global competition, the need for constant strategic adaptation, ever-increasing customer demands and an explosion of service-based industries. This is a world where the relative importance of intangible assets is increasing and tangible assets, such as factories and land, are decreasing (Guthrie & Petty, 2000). Edvinsson supports this and stress that: *“We now live in the intangible economy. Knowledge economics is the new reality. Minds matter”* (Edvinsson, 2002, p. 34).

Fortune magazine rate IC as the next “great idea”, the third in a row of concepts changing the way companies are managed, with the two previous being TQM (quality assurance in all levels and parts of a company) and Reengineering (revaluation of old structures) (Arnberg, 1999). The growth of the importance of IC has also shown itself in a more concrete manner. Both the U.S. stock inspection and the Swedish Bokföringsnämnden recommend a supplement to the annual report, which should disclose the company’s IC. The Danish government has taken this one step further. A new law has been proposed which constitutes that companies are obliged to communicate the company’s intellectual capital. On the other hand, both the measurement and the disclosure of IC have been criticized, something we will return to later on (Forsberg, 2001). However, as Leif

Edvinsson argues, the fact remains that most value added in companies today comes from intangible or knowledge assets. Another argument is that the whole point of intellectual capital is that it is universal, i.e. it does not apply merely to one company. Unlike reengineering and TQM, intellectual capital is not a management technique that a company can choose to apply. The essence of IC is that it is more fundamental than that. Intellectual capital can be applied too all companies, communities and societies. (Edvinsson, 2002)

### **3.6 The complexity of measuring intellectual capital**

As we have discussed earlier, the economy is becoming more knowledge intensive and the intangible assets are starting to dominate many companies' business operations. This makes the performance measurement somewhat different from before. The standard accounting model has previously provided the framework for a company's performance measurement system. The accounting model of today, however, was developed for entities that depended mainly on tangible assets to create value. In the modern economy a great deal of the value created can be derived from intangible assets, which leads us to the conclusion that it is necessary to develop non-financial as well as financial measures that can live up to these new conditions. As stated by Burnaby et al, it is hard to manage what you do not measure. The companies that fail to measure and value their IC risk facing inefficiency, ineffectiveness and loss of profit. Therefore, it is important for companies to develop measures, which could provide support in the valuation and evaluation of the use of IC to meet strategic objectives. (Burnaby et al, 2002)

According to Ante Pulic, the present accounting and measurement system is tied to capital employed and financial capital flows, and therefore still missing relevant information on the performance of intangible resources. He argues furthermore that traditionally a company would measure its input on how much material, how many employees with a certain level of education and how much time is needed to complete a task. Thus, opposed to this, Mr. Pulic emphasizes that new measuring systems should focus on value creation, value creators and value creating activities. (Pulic, 2000)

This is supported by a study conducted by Baruch Lev and Paul Zarowin. The usefulness of the traditional financial reports and its measurement, i.e. reported earnings, cash flows and book values has according to Mr. Lev and Mr. Zarowin declined over the last 20 years. This decline originates in the change that the companies of today are going through, i.e. innovation, changed competition because of deregulation, etc. This change is not, however, adequately reflected by the current reporting system, which further enhances the need for new measuring systems. (Lev & Zarowin, 1999)



The result of the dialog among researchers is a number of new measurement approaches, which aim at synthesizing the financial and non-financial generating aspects of companies into one external report.

Nick Bontis of McMaster University suggests that in order to comprehend the importance of measuring IC it is necessary to understand the concept of “Tobin’s q”, stemming from the accounting and finance literature. This concept returns somewhat to the previous discussion concerning the difference of market and book value. However, this ratio measures the relationship between a company’s book value and its *replacement value*, i.e. the cost of replacing its assets. In the end, the ratio will have a value of 1,00. Nevertheless, the ratio differs much between different industries, e.g. software and steel industries. In the software industry, where IC is abundant, companies will be likely to have a ratio of 7,00, whereas in the steel industry the companies are more likely to have a ratio close to 1,00, due to large capital assets. By measuring IC we can more easily understand why companies are valued differently and in turn we can value companies in a more correct manner according to the IC that a company “posses”. (Bontis, 1999)

In an international Symposium hosted by the OECD in 1999, two issues were discussed that are relevant to disclose when discussing the measurement of IC. The first concerned the assessment of what motivates companies to measure their IC. The motives were as follows:

- to assist with competitive benchmarking exercises
- to create a consciousness within the organization that IC (and human resources in particular) does matter
- to provide structured information to capital and labor markets that may enhance perceptions of the company

The second issue discussed was the determination of the potential effects that the measurement and reporting of IC are expected to have. The effects determined were:

- improved employee morale
- an higher value being attributed to a company’s IC by senior corporate officers than previously
- lower staff turnover
- an improved understanding of what specific factors are crucial to continued growth and development (Guthrie, 2001)

Much has been written about the need to measure and report on a company’s IC and attempts have also been made to present the IC together with financial statements. Although, the arguments above seem like a strong case for the measurement and reporting of IC, criticisms have been brought forth. The measurement and reporting have been

criticized in that it reduces knowledge into numbers and furthermore that it has been a bit naive. It needs to be more complex and integrated into the company's accounting so that it is easier to see the relationship between intellectual and financial capital. (Forsberg, 2001)

Many measurement approaches have, as mentioned, been developed to capture the IC within companies, but few have made steps towards showing a link to organizational success. The main reason for this is that measuring knowledge assets, human capital in particular, is difficult. There now seems to be two schools emerging within the IC community. One that emphasize that there probably never will be an answer to this dilemma and another that believe that over time there will be a pool of metrics available which could and should be applied to companies regardless of industry.

According to the critical school, one should be skeptical when someone claims to have developed a calculation or magical formula for IC. Bontis for instance stress that IC never will be measured in the traditional dollar values. *"At best we will see a slow proliferation of customized metrics that will be disclosed in traditional financial statements as addendums."* (Bontis, 1999, p. 293)

The other school states that it is important, and plausible, that the IC community collectively develops an applicable and accessible framework of measures and that this convergence is already beginning to take place. There are already measures of human capital that have emerged thus demonstrating that this convergence is taking place, e.g. training as percent of payroll, percentage of employees trained, number of employee suggestions. Another important aspect that this group emphasizes is that the capital markets so far have rewarded those companies that successfully leverage their intellectual capital. (Bart, 2001)

### 3.7 Measurements methods available

The research regarding the measuring and visualization of IC and the intangible assets of companies and organizations have, during the last decades, resulted in various methods, models and theories concerning this area of study.

These methods can be classified into four categories of measurement approaches, as illustrated in *figure 3.3*. (Sveiby, 2001)<sup>1</sup> They are: *component-by-component and non-monetary*, *component-by-component and monetary*, *organizational level and non-monetary* and *organizational level and monetary*.

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<sup>1</sup> <http://www.sveiby.com/articles/IntangibleMethods.htm>

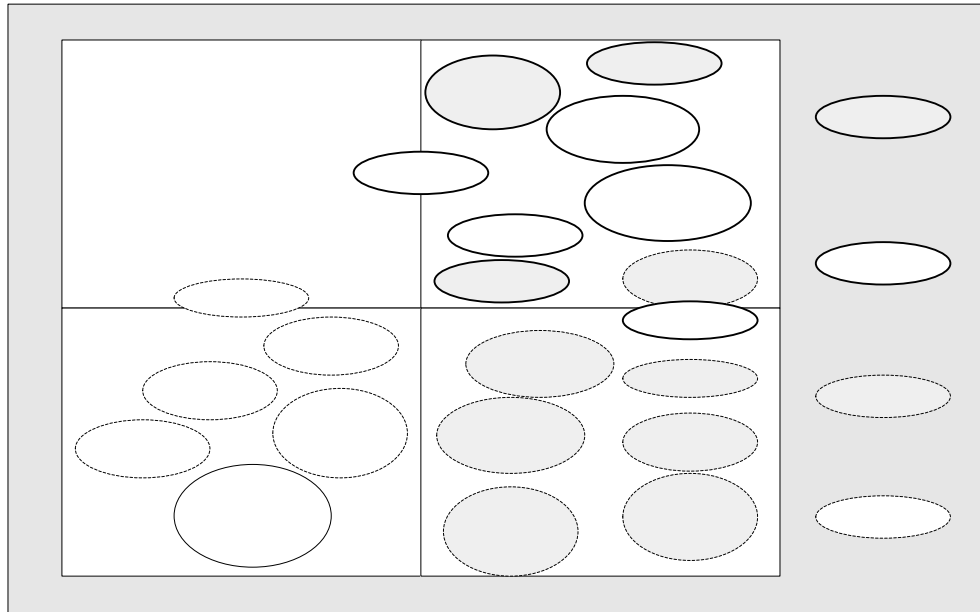


FIGURE 3.3 INTANGIBLE ASSETS MEASURING MODEL (SVEIBY, 2001)

The component-by-component methods include measuring the indicators that are appropriate for each component used within the organization. The indicators are company specific, i.e. it might not be possible to apply the same indicators at numerous companies.

Methods used at the organization level measure the value of intellectual capital without reference to individual components. Instead, they focus on the organization as a whole. (Luthy, 1998) In the next paragraphs, we will outline the differences and similarities between the various approaches and further describe some of the most established.

### 3.7.1 Monetary valuation methods

The methods on the right in *figure 3.3* consist of monetary valuation methods, such as ROA (Return on Assets), MCM (Market Capitalization Methods) and DIC (Direct Intellectual Capital methods). These can be very useful for financial valuation of companies and overall stock market valuations. They can also, with advantage, be used when illustrating the financial value of IC and the intangible assets or when comparing companies within the same industry. One of their most appreciated advantages is that they, with the exception of DIC, are based on the conventional accounting standards, which means that they are easily communicated and understood. (Sveiby, 2001)<sup>2</sup>

<sup>2</sup> <http://www.sveiby.com/articles/IntangibleMethods.htm>

Components Identified

Organisation Level Only

Balanced Scorecard

IC-in

Scandi Navigator

Human Inte

### 3.7.1.1 Market Capitalization Methods (MCM)

Market Capitalization Methods determine the intellectual capital and intangible assets by calculating the difference between a company's market capitalization and its stockholders' equity. These methods are the most superficial and criticized but also easiest to use and communicate throughout an organization and to its external stakeholders. (Sveiby, 2001)<sup>3</sup>

Nobel prize winner economist James Tobin developed a measure to help investment decisions; *Tobin's q* (Luthy, 1998). The stock market value of the company is divided by the replacement cost of its assets. The outcome (q) and variations of it can be used for measuring how effective the intellectual capital is utilized. (Sveiby, 2001)<sup>4</sup> The theory is that if q is greater than 1 and greater than the market average, then the company also has the ability to make above average profits. The reason for this profit is that the company has intellectual capital that gives an advantage compared to its competitors. (Luthy, 1998)

The *Market-to-book value* measurement presumes that the value of a company (tangible assets + intangible assets) is equal to the market value. This means that the gap between the book value and the market value gives an approximation of the intellectual capital of the company. However, this way of measuring the value of intellectual capital has limitations, as previously mentioned, proposed by for instance Baruch Lev. The market value of a company is not necessarily related to the value of its tangible and intangible assets. When investment analyses are made, they focus on future potential earnings instead of historical, which is one of the reasons why the gap may be unjust. (Luthy, 1998)

### 3.7.1.2 Return On Assets methods (ROA)

The ROA methods are somewhat more complex and time-consuming than MCM but on the other hand, according to the majority of researchers, gives a more adequate and thorough analysis.

In the *Human Resource Costing & Accounting (HRCA)*, concealed costs originating from human resources are calculated. The intellectual capital is measured by calculating the contribution of human assets divided by capitalized salary expenses.

*Economic Value Added (EVA)* is calculated by adjusting the profit with expenses regarding intangible assets. Changes in EVA indicate if the utilization of the intellectual capital is effective. (Sveiby, 2001)<sup>5</sup>

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<sup>3</sup> <http://www.sveiby.com/articles/IntangibleMethods.htm>

<sup>4</sup> <http://www.sveiby.com/articles/IntangibleMethods.htm>

<sup>5</sup> <http://www.sveiby.com/articles/IntangibleMethods.htm>

The *Value Added Intellectual Coefficient (VAIC)* provides information about the value creation efficiency of tangible and intangible assets. It measures how much value is created by use of the intellectual capital and whether intellectual capital or the structural capital employed is the crucial source for profits above market average. (Pulic, 2000)

### 3.7.1.3 Direct Intellectual Capital methods (DIC)

A DIC method estimates the monetary value of intellectual capital and intangible assets by identifying its various components. Once these components are identified, they can be directly evaluated, either individually or aggregated. By dividing the above-average earnings by the company's average cost of capital, an estimate of the value of its intellectual capital or intangible assets is possible. (Sveiby, 2001)<sup>6</sup>

Monetary methods at component level include Intellectual Asset Valuation, The Value Explorer, Citation Weighted Patents, Technology Broker, and Total Value Creation (TVC).

### 3.7.2 Non-monetary valuation methods

The Scorecard methods are more complex and offer deeper analyzes. The indicators are context related and the same indicator can often not be used in two separate organizations. This makes generalizations difficult. IC and intangible assets are not easy concepts to define. The analysis does not, like the ROA and MCM methods, result in easily communicated ratios. Instead, tons of data is generated which can be hard and time consuming to understand and analyze. This makes it even harder for managers and financial markets that have not worked with these kinds of perspectives before to analyze the information. (Sveiby, 2001)<sup>7</sup>

Non-monetary methods, such as the Scorecard methods, are more detailed and can create a better understanding of the current and future status of the organization and the business operations than the more superficial monetary methods. The methods are often used by managers or consultants within the organization and can be applied at any level of the organization and thus resulting in more accurate result than the financial measures applied from the outside. (Sveiby, 2001)<sup>8</sup>

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<sup>6</sup> <http://www.sveiby.com/articles/IntangibleMethods.htm>

<sup>7</sup> <http://www.sveiby.com/articles/IntangibleMethods.htm>

<sup>8</sup> <http://www.sveiby.com/articles/IntangibleMethods.htm>

### 3.7.2.1 Score Card methods (SC)

When using the score card methods, a wide variety of components concerning the intellectual capital or intangible assets are identified. Indicators and indexes are then generated and visualized as a scorecard or graph. These methods are somewhat related to the DIC methods, with the exception that they pay no attention to the monetary value of the assets (Sveiby, 2001)<sup>9</sup>. Examples of Scorecard methods are the *Skandia Navigator* and the *Intangible Assets Monitor*.

**The Skandia Navigator** is a perspective or “tool” that ties together and visualizes the five areas of focus in IC. It also shows how they interact with each other as well as relate them to each other in time. The “tool” serves the function of both acting as an organizer and as a guide to its users. The process concerning the construction of the Navigator started in the beginning of the 1990s by Leif Edvinsson and a team of experts within the Swedish insurance company Skandia. (Edvinsson & Malone, 1997)

The Skandia Navigator consists, as illustrated in *figure 3.4*, of five areas of focus. The financial focus is the balance sheet and represents the past. The Customer focus and Process focus is where the company is today and the ground that the house is resting on, Renewal & Development focus is the company’s capabilities for the future. What connects the four components is the Human focus, which ironically also is the part of the company that goes home every day. We will here shortly describe the five areas of focus in order to try to deepen the understanding of this “tool”.

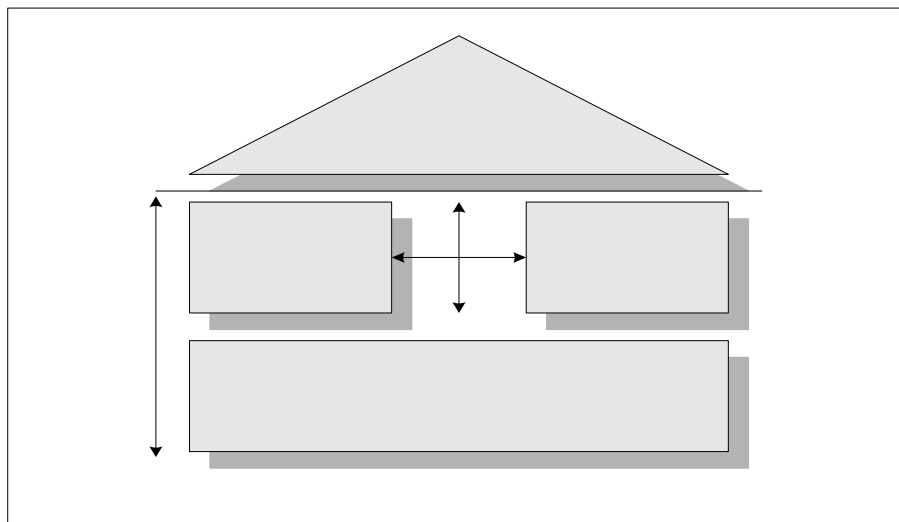


FIGURE 3.4 THE SKANDIA NAVIGATOR (EDVINSSON & MALONE, 1997)

All companies of today depend on value creation in order to make a profit. This process is illustrated as the *Financial focus* but can be followed through the Navigator. Starting

<sup>9</sup> <http://www.sveiby.com/articles/IntangibleMethods.htm>

from the foundation created by the Renewal & Development focus, passing through the Process and Customer focus and then eventually generating financial benefits to the enterprise. A few of the indicators suggested by Edvinsson and Malone are: Total assets, Revenues/total assets, Market value, Value added per employee and R&D investment.

The *Customer focus* encompasses the customers and most importantly the relationships with the customers. These relationships have changed radically during the last decade. The value of a company's customers is defined as the present value of all customer relations. The measurements that could be used are: Market share, Number of customers, Customers lost, Satisfied customer index and Average time from customer contact to sales response.

The *Process focus* contains issues regarding the technology as a tool for supporting the value creation. This includes IT systems, networks, archives and general working processes. Badly chosen technology or technology applied incorrectly, could cause the organization to stall, and should therefore not be overlooked. The Process focus can be measured by using the following indicators: Administrative expense/managed assets, Contracts filed without error, Administrative expense/employee and IT capacity.

The *Renewal and Development focus* lies at the opposite end from the financial focus. That is, while financial focus is a reflection of the past, renewal and development focus looks into the future and tries to ascertain how the organization best can prepare itself for upcoming business opportunities. Measurements for this are: Renewal expense/customer, R&D expense/administrative expense, Share of employees under the age of 40, R&D resources/total resources.

*Human focus* is intentionally put in the center of the Navigator due to the fact that it interacts with all the other areas in a very vivid manner. The labor force is split into a number of categories so that interesting indices can be created from these subpopulations. *Office goers* are distinguished from *telecommuters*, *road warriors* and *corporate gypsies* and the specifics of each are thoroughly scrutinized. The following indicators are some of those suggested for measuring the Human focus: Leadership index, Motivation index, Employee turnover and Number of female managers. (Edvinsson & Malone, 1997)

***The Intangible Assets Monitor*** is a model for measuring and visualizing IC (Sveiby, 1997). It is a method for measuring intangible assets and a presentation format, which displays a number of relevant indicators for measuring intangible assets quite uncomplicated. The choice of indicators depends on the strategy of the company. The format is particularly relevant for companies with large intangible assets, such as consulting firms, but can easily be used by a wide variety of companies and organizations (Sveiby, 2001). There are, according to Sveiby, two main purposes for using the Intangible Assets Monitor. First, the presentation of the company to customers, credit

institutions or shareholders in order for them to build an understanding of the overall quality of the company, and second - a means for management to analyze the company so that correctional actions may be conducted before it is too late (Sveiby, 1997).

The monitor's intangible assets can be divided into three categories – *External structure*, *Internal structure* and *Competence*.

*External structure* contains customers, suppliers and other external stakeholders. In most private companies, the most important ones will be the customers. Public sector organizations will use other stakeholders, such as community members. However, many companies have so valuable alliances with their suppliers that they must be included too. Indicators of the external structures are for example: Organic growth, Profitability per customer, Satisfied customer index, Proportion of big customers, Devoted customers ratio and Frequency of repeat orders. (Sveiby, 2001)<sup>10</sup>

The main activity of employees who work in general management administration, accounting, personnel, reception, filing, etc is to maintain the *Internal Structure* of the company. Sveiby defines these employees as support staff. Indicators of the internal structure are Investments in the internal structure, investment in information systems, sales of new products/services, new processes implemented, proportion of support staff, values and attitude measurements and support staff turnover. (Sveiby, 2001)<sup>11</sup>

Concerning *Competence*, there is a distinction between the people who plan, produce, process or present the products/solutions client asks for, and the members of the company's support functions, i.e. those who work in accounting, administration, reception, etc. The latter are part of the internal structure and should not be accounted for under this heading. Nowadays, it is however often a problem identifying the boundaries of the organization and see where the competence of the organization ends and where the competence of its supplier begins. (Sveiby, 2001)<sup>12</sup> Indicators of competence are: level of education, Training and education costs, Proportion of professionals, Leverage effect, Value added per employee, Value added per professional, Profit per employee and Profit per professional (Sveiby, 2001)<sup>13</sup>.

We have so far discussed methods that measure the value of intellectual capital. However, there are also complementary methods for measuring the ratio between the components of intellectual capital. One of these are the IC Multiplier, which will be discussed next.

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<sup>10</sup> <http://www.sveiby.com/articles/CompanyMonitor.html>

<sup>11</sup> <http://www.sveiby.com/articles/MeasureInternalStructure.html>

<sup>12</sup> <http://www.sveiby.com/articles/MeasureCompetence.html>

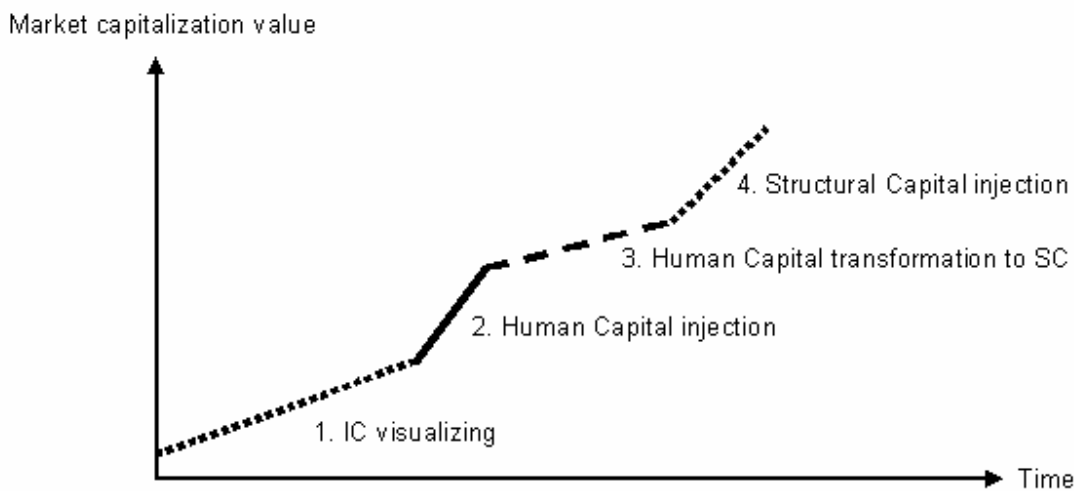
<sup>13</sup> <http://www.sveiby.com/articles/CompanyMonitor.html>



### 3.8 IC Multiplier

The intellectual capital consists, as previously mentioned, primarily of Human and Structural capital. These components interact with each other in order for the organization to create value.

In order for a company to be able to fully take advantage of its human capital, the necessary organizational structure needs to be provided. If the right structure is available, then this leverages the capacity and opportunities of the human capital (Daum, 2001). Because of this leverage effect, a high portion of structural capital becomes of vital importance. One way of increasing this leverage is by converting the human capital into structural capital. This increase is illustrated in *figure 3.5* below (Edvinsson, 2000).



*Figure 3.5 Market capitalizations over time (Edvinsson, 2000)*

The first step, *IC visualizing*, is to map and evaluate the existing intangible assets of the organization. This can be accomplished by using one of the scorecard methods, described in 3.6.2.1, *Score Card methods*.

The second step *Human Capital injection*, handles the increasing of the human capital within the organization, i.e. competence enhancing actions, recruiting of new personnel and knowledge management methods concerning knowledge sharing, etc. (Edvinsson, 2000)

The third step, *Human Capital transformation to SC*, focuses on the packaging of knowledge so that it can be shared rapidly and globally. This also contains a shift of leadership focus from human capital on to structural capital in order to visualize and stimulate this continuous flow. This transformation acts as a multiplier, *The IC Multiplier*, with sustained earnings potential for the organization. (Edvinsson, 2000)

The *IC Multiplier* provides an indication on how well the human capital of the organization uses the structural capital to leverage its potential. The ratio is calculated by looking at the relationship between structural capital and human capital, i.e.  $IC\ Multiplier = \text{Structural Capital} / \text{Human Capital}$ . (Åberg, 2001) This ratio shows that structural capital has to be larger than human capital. Otherwise you have not a multiplier but the opposite, which in turn will lead to an erosion of human capital. (Daum, 2001) A small degree of structural capital also means that a company is less enduring and that the risk increases, since the employees can leave the company whenever they wish. Some companies, e.g. IT consulting companies have degrees of human capital of up to 90 percent, which obviously involve a tremendous risk. (Edvinsson, 2002)

This process, in which human capital leverage with structural capital, thus creating the value of IC, can be measured by using value added per employee (Åberg, 2001).

The fourth step is *Structural Capital injection*. By acquiring structural capital externally, the organization gets a turbo effect on the already established IC multiplier since it now combines different types of structural capital and uses it in the value creation. (Edvinsson, 2000)

### 3.9 Theoretical summary

In this chapter, we have presented some of the many available theories that have been developed within the area of intellectual capital. IC is, as stated in *chapter 3.4*, defined as  $\text{Human Capital} + \text{Structural Capital} = \text{Intellectual Capital}$ . This definition is rather straightforward, easy to understand and established by the OECD. The main reasons why intellectual capital now has become important are:

- the revolution in information technology and the information society
- the rising importance of knowledge and the knowledge-based economy
- the changing patterns of interpersonal activities and the network society
- the emergence of innovation and creativity as the principal determinant of competitiveness
- explosion of service-based industries

Since intellectual capital nowadays has become more essential, a number of dissertations, theses and projects have focused on the measurement and reporting of IC. The main reasons and motives for measuring IC could be summarized as:

- to assist with competitive benchmarking exercises

- to create an consciousness within the organization that IC (and human resources in particular) does matter
- to provide structured information to financial and labor markets that may enhance perceptions of the company

A walkthrough of different measurement methods and approaches were found in *chapter 3.6*. Measuring can be done by using monetary measures as well as non-monetary measures and can be applied both at the organizational and on the component level. The general thought is, however, that the methods get more complex and needs further resources when used at the component level. Organizational methods, especially when using a monetary approach, are less complex to use and communicate, but can to some extent be considered slightly superficial and one-dimensional.

The *IC Multiplier*, described in *chapter 3.7*, provides an indication on how well the human capital of the organization uses the structural capital to leverage its potential. The ratio is calculated by looking at the relationship between structural capital and human capital. This leverage effect of the value creation is what later can be measured with for example value added per employee.

In the following chapter, we will proceed by thoroughly describing and explaining the empirical research. Included is a description and discussion of the chosen measure. In the discussion, we will also categorize it and compare it with some of the relevant measures described in *chapter 3.6*.

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## 4 Empirical Research

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*In this chapter, we aim to further explain the empirical research method. That is, what we are trying to find, how we intend to find it and most important how to statistically prove our findings. We also elaborate on the used measure and discuss it with the background of the previous descriptions of measurement approaches and methods.*

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### 4.1 Introduction

Although, briefly explained in the methodology chapter, a further clarification of some fundamental concepts might be helpful to additionally illustrate the research method. Since we are using statistical methods to prove or discard the defined hypotheses, it is of vital importance that the reader understands the idea behind the proving of the results. We will therefore provide the reader with a walkthrough of the indicators used in the statistical observations. This could be regarded as a methodological issue, however, the authors emphasize that this chapter should be placed close to the empirical results and analysis in order to maximize the understanding of these chapters.

We previously provided a background regarding measurement of IC and approaches of measuring it. With this in mind for the reader, we aim to discuss and explain the chosen measurement. We will in this context describe some comparisons with the other measures previously presented. We emphasize that the important reason for this comparison and the previous description is to understand the chosen measure's strength and weaknesses, i.e. what type of result we can obtain and how this differs if we would have used another measure.

### 4.2 Hypotheses

As previously mentioned this thesis seeks to prove the supposed relationship between intellectual capital and market value, and in addition between the return on intellectual capital and the IC Multiplier. This relation is sought with a completely quantitative method, and is based on the following five hypotheses:

*Hypothesis 1: There is a linear pattern between companies' value added per employee and their stock exchange value per employee when comparing all the selected companies.*

*Hypothesis 2: There is a linear pattern between companies' value added per employee and their stock exchange value per employee when comparing companies by industry sector.*

*Hypothesis 3: There is a linear pattern between companies' value added per employee and their stock exchange value per employee when comparing companies divided by company size.*

*Hypothesis 4: There is a linear pattern between companies' value added per employee and their stock exchange value per employee value when comparing companies divided by company age.*

*Hypothesis 5: There is a linear pattern between companies' IC Multiplier and their value added per employee.*

For all the hypotheses, the defined h0-hypothesis is:  $\beta = 0$ . Consequently, the h1-hypothesis is:  $\beta \neq 0$ .

### **4.3 Quantification of intellectual capital and market value**

In order to prove our chosen hypotheses, the first step was to find adequate measurements for quantifying a company's IC and market value. We chose Value added and Stock exchange value, both divided by the number of employees to be able to compare companies of different size.

Stock exchange value per employee (SEV/e) is rather self-explanatory for measuring market value. Value added per employee (VA/e), as an approximate measurement of a company's return of intellectual capital, might nevertheless need some additional explaining.

#### **4.3.1 Definition of value added per employee**

Value added is the additional value, which is created within the company. (Sveiby et al, 1990) By using value added per employee, one can get an impression of how much individual employees contribute to this value. (Sveiby, 1995)

The key figure value added is most straightforwardly explained as the difference between a company's revenue and the cost of goods or services sold, e.g. output-input. There are a number of different ways to calculate the key figure VA/e. We use the most established

definition, which is operating profit before depreciation and personnel costs<sup>14</sup> divided by number of employees<sup>15</sup> (Konsultguiden, 2001).

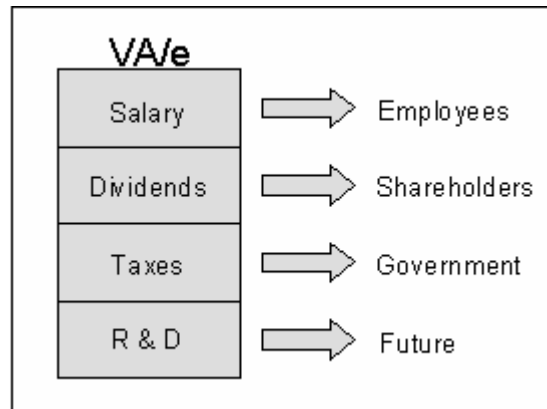


FIGURE 4.1 VALUE ADDED (SVENSKA MANAGEMENTGRUPPEN, 1982)

The value created in a company should fill a number of purposes. As presented in *figure 4.1*, the four stakeholders that the created value added is distributed between are: Salary, Dividends, Tax and R&D. The percent that each sector constitutes is dependent on numerous factors, such as the work force, the context of the industry sector, capital intensity, investment plans, etc. These factors differ of course depending on the company. The amount is, however, limited and has to cover all the expenses in order for the company's continued existence. If not, the company has to decide what costs to cut down on, which might lead the company into a negative trend. (Svenska managementgruppen, 1982)

#### 4.3.2 Value added per employee, categorized and compared

This method for quantifying intellectual capital can, when using Sveiby's categorization, as seen in *figure 3.3*, be classified as a *monetary* method, which measures at the *organizational level*. Furthermore, it can best be compared to some of the Return on Assets methods, mentioned earlier in chapter 3. Among the Return on Assets methods, VA/e has the most similarities with HRCA and EVA. The three methods all focus on the intangible assets and their contribution to a company's value and revenues. The methods are easy to apply from an external perspective, which allows for measuring organizations and companies without any prior knowledge of their business operations, organizational structure etc. HRCA and EVA are, however, not appropriate to use when comparing companies with different sizes since these methods are not used per employee.

<sup>14</sup> Personnel costs = total salaries + social fees

<sup>15</sup> VA/e = (operating profit + depreciation + personnel costs) / number of employees

Other optional methods and measures that we discussed when outlining this study were Tobin's q and Market-to-book value. These are similar to the *Return on Assets* methods in that way that they are uncomplicated to apply while working with an external perspective. While this external perspective was appropriate to us, since we wanted to do an overview study, these methods are not quite suitable. Tobin's q and Market-to-book value are on the one hand accepted methods for measuring intellectual capital but, according to most practitioners and researchers, they are limited, unspecific and do not provide the same profundity that can be attained using VA/e.

Finally, methods that could be of interest when conducting a study of intellectual capital among companies are *non-monetary, scorecard* methods such as the Skandia Navigator and the Intangible Assets Monitor. This type of methods demand however, a thorough investigation and knowledge of the companies studied, i.e. an in-depth internal investigation, which does not concur with the purpose of this thesis.

### **4.3.3 Why Value added per employee?**

#### **4.3.3.1 In general**

Measurements of efficiency illustrate how well the company succeeds in fulfilling the stakeholders' demands. Traditionally, the return on financial capital is accounted for, but companies also need to measure the return on the knowledge capital. Experiments with this purpose have been conducted, e.g. by using "social accounting", but this method turned out to be too complicated. The measures in the income statement are, however, nowadays used in lack of others. (Hult, 1998)

There are many methods of measuring the return on financial capital, which also has a link to companies accounting, but measures and methods of measuring the return on knowledge capital are few. Value added per employee is, however, among these methods the most frequently used. (Hult, 1998)

Although somewhat basic, value added represents a company's intellectual capital in the way that it describes the company's ability to create value from a limited input. In today's economy, this value creation is almost exclusively related to intellectual capital. This is one of the main reasons for the evolvement of the measure. (Wiarda & Luria, 1997)

Intellectual capital can, as described earlier, be divided into Organizational capital, Human capital and Customer capital<sup>16</sup>. It is the *interaction* among these components, i.e. in which human capital leverage with structural capital, that creates the value, or more precisely the return of intellectual capital. The return of this value creation, is then what can be approximately measured by using *value added per employee*, see figure 4.2. We stress the importance of understanding this paragraph and the figure below.

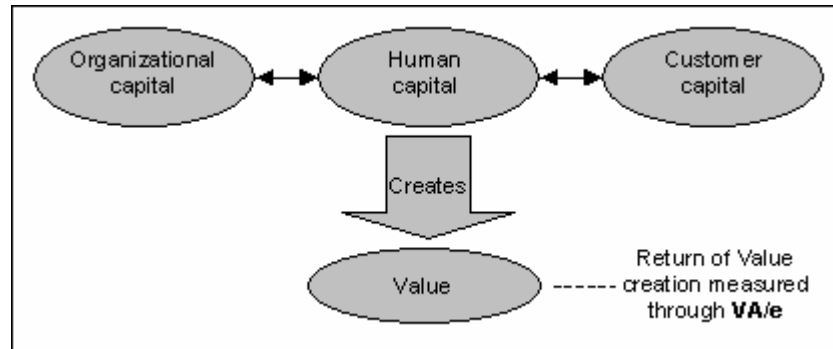


FIGURE 4.2 VA/E AS AN APPROXIMATE MEASUREMENT OF INTELLECTUAL CAPITAL

VA/e is closely tied to profit per employee. Some argue that this measure, profit per employee, becomes more relevant as the number of employees increases substantially. However, this argument does not always apply. This is more relevant when a strive is made to value the entire company, not merely its intellectual capital. (Jäghult, 1989) The usage of VA/e seems to have increased over the last years, for instance in the annual reports. A fairly recent study made in Sweden, regarding IT companies revealed that companies that disclose this measure in their financial statements have increased. One result of the study showed that nearly 60 percent of the IT consultants disclosed VA/e. This percentage was lower for software manufacturers but increased over the period with almost 100 percent, i.e. from 13 percent to 22 percent. (Eklund & Larsson, 2002)

Value added per employee is, after stated the above, an important key indicator since it measures labor productivity, a fundamental indicator of efficiency. The measure is also strongly correlated with profitability, but unlike profitability, it is not subject to vagaries of inconsistent accounting, such as *profit*, that can be manipulated through for instance various adjustments. (Wiarda & Luria, 1997) Value added per employee can also, as profitability, be manipulated. The sensitivity is, however, not as large since the total sum of salaries, social fees, etc. adds up to a relatively large amount compared to profitability per employee which seldom exceeds SEK 100 000. (Sveiby et al, 1990)

The indicator is furthermore, according to American Society for Quality, an excellent predictor of a company's technological and organizational sophistication and the variations of this measure are huge. It is also often used as a measure within other

<sup>16</sup> Structural capital = organizational capital + customer capital, see figure 3.2



measurement approaches, such as the Skandia Navigator and Intangible Assets Monitor. (Wiarda & Luria, 1997)

#### **4.3.3.2 Applied in this study**

Although value added might seem as a very basic and approximate measurement of IC, at least in comparison with other methods we have presented, it is very suitable for this study.

One of our intentions with this study is to examine whether the intellectual capital per employee differ when comparing companies within various industry sectors. This leads us to the conclusion that the HRCA and EVA are somewhat unsuitable, since those methods do not allow for a comparison between companies of different sizes. VA/e allows us to conduct the study from an external perspective on an organizational level, while it at the same time gives us an individual approach since we get an insight of how respective employee within the companies contribute to the value added. Furthermore, it makes it possible to compare different companies over a period of several years, which suites this study perfectly. (Hult 1998)

The criticism that could be brought forth is that the measure is superficial, at least compared to for instance the Skandia Navigator or the VAIC. This is also something that the authors have acknowledged and internally discussed. However, if the study had the purpose of merely investigating a few companies, naturally a more in-depth measurement approach would have been chosen. Since we, the authors, have chosen the current structure of the thesis, a more in-depth study of every company would have been too time consuming. A more in-depth study of the chosen companies' intellectual capital would perhaps give a somewhat different result, but this does not make our findings less interesting.

In conclusion, the principal arguments for the measure, value added per employee, are:

- accepted, approximate measure of the return of intellectual capital, in addition the measures usage is increasing
- based on existing, financial data
- offers profundity without being unspecific and limited
- easy to apply without having knowledge of a company, e.g. its business operations, organization structure
- able to measure the company on an organizational level and have an external perspective
- allows comparing companies of different size

- allows comparing companies over a period of several years
- an excellent predictor of a company's technological and organizational sophistication

To further strengthen and control this choice of measurement we have discussed it with Leif Edvinsson and Karl Erik Sveiby, who both thought it was a suitable measurement for our purpose.

## 4.4 Hypothesis test methods

When explaining which statistical methods that are being used to test our hypotheses some basic knowledge regarding these methods is presumed. The explanation will instead commence at the knowledge level the authors were at when initially approaching this thesis.

To better understand exactly what we intend to examine, a further breakdown of the hypotheses might be helpful. The relationship we are seeking is if there is a Y-variable, in our case stock exchange value per employee, which is dependent on an X-variable, value added per employee. Basically, does the value of Y depend on the value of X, i.e. does *market value* depend on *intellectual capital*? This dependency is easiest found using the simple linear regression model. This method seeks to find the linear equation which best fits the quantity of data. Since we are trying to find a linear pattern, assuming that the data fits a straight line, this equation is  $Y_t = \alpha + \beta X_t + u_t$ , where  $\alpha$  and  $\beta$  is the regression coefficients and  $u$  is the unobserved error term assumed to be a random variable. This error term is the difference between  $Y_t$  and the deterministic part  $\alpha + \beta X_t$  and is the combination of four different effects, omitted variables, non-linearities, measurement errors and unpredictable effects (Ramanathan, 1998). The effect of this error term on our investigation will be further explained for each sample in *chapter 5 - Empirical results and analysis*.

The simple linear regression model provides, besides merely the linear equation, a number of interesting results when testing hypotheses. These results will be explained below.

*Statistical significance(p)* - When testing a hypothesis the primary goal is consequently to examine whether it is statistically significant or not. That is, if the zero hypotheses can be discarded. In all our tests, we have chosen a 5 percent level of significance, hence trying to prove whether the  $H_0$ -hypothesis can be discarded with a 95 percent certainty. This means we are accepting a p-value less than 0,05 as statistically significant. This p value, of 5 percent, is based on common practice in academic research. (Andersson et al, 1994)

*Correlation (r)* – When performing a regression analysis, another important indicator is the correlation coefficient  $r$ . This is a standardized measurement showing the strength of the linear fit, thus allowing meaningful comparison of separate materials (Anderson et al, 1994).  $r$  therefore gives a value to how good a straight line describes the observed data.  $r$  is a value between 1 and  $-1$ , where the extremes imply the strongest correlation. This is illustrated below in *figure 4.3*.

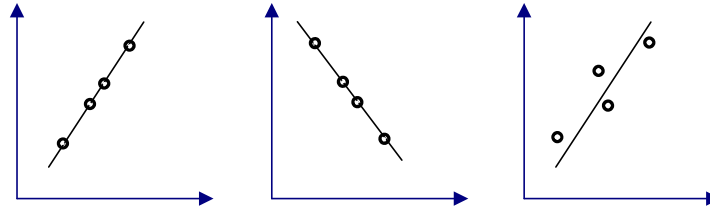


FIGURE 4.3 CORRELATION EXAMPLES (ANDERSSON ET AL, 1994)

Although  $r$  gives the correlation between the two variables, it does not say anything about the inclination of the line. This is instead given by the  $\alpha$  and  $\beta$  variables. Another limitation when analyzing the correlation is the significance of outliers. A value far away from the others has great effect on the correlation. (Andersson et al, 1994) The management of outliers is presented below.

*Determination coefficient ( $r^2$ )* – The determination coefficient is a measurement of the degree of determination. It indicates the proportion of common variability of two variables and is viewed together with the correlation coefficient. Multiplied by 100  $r^2$  provides a percentage for the forecast of the result (SEV/e), if the result of one variable is known (VA/e). (Ramanathan, 1998) An  $r^2$  value of for example 0,56 means that the y-value can be forecasted to a degree of 56 percent using the x-value.

When performing a simple linear regression, the  $r^2 = r * r$ . Nevertheless, we have used both these indicators in the subsequent presentations and analysis. The reason for this is because the correlation coefficient is the most established, but the determination coefficient it somewhat easier to understand. These two coefficients are also, for the most part, always presented together.

*Confidence interval* – Of great importance when analyzing this kind of data, especially regarding the analysis of regression lines, is the regression confidence interval. Meaning that an interval is presented within 95 percent of where the  $\alpha$  and  $\beta$ -values resides. The confidence interval is furthermore a method to discard of the  $h_0$ -hypothesis, if the  $\beta$ -interval includes 0, the  $h_0$ -hypothesis cannot be discarded.

*Outliers* – An outlier is most often a value that due to some sort of error has been misread. When performing a regression analysis the most common way to handle outliers is to exclude values with a residual larger than three times the population standard error. (Andersson et al, 1994) In this case, outliers are not caused by measurement errors, since possible outliers have been thoroughly controlled. Therefore, if nothing else is mentioned, outliers are not excluded in the analyzes. This non-exclusion of outliers thus might cause a disturbance, especially regarding some of the companies within the Real estate and construction sector, which have relatively few employees. Consequently, this is important to have in mind when viewing the results, although not a reason to discard them completely. To illustrate the effect of outliers some of the tests are also made without them. In those cases, where a removal of the outliers might be interesting, this is clearly stated.

## 5 Empirical results and analysis

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*In this chapter we present the actual results of the study. We begin by statistically describing the empirical observations followed by an initial approach to the material. Thereafter the data is analyzed and presented through regression analyzes to prove or discard if there is a linear pattern between value added per employee and stock exchange value per employee. The empirical observations are presented according to the order of hypotheses stated in chapter 1 and 4, i.e. all companies, industry sectors, company size and company age. We end the chapter by presenting the regression lines and putting them in a context.*

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### 5.1 Introduction

In this chapter, we first statistically describe the data as a starting point of the empirical results. After this, an initial breakdown of the statistical observations is made and thereafter we continue by describing and analyzing the data through regressions analyzes according to the defined hypotheses. We then turn to the regression lines to highlight the differences between industry sectors, companies of different size and companies of different age. In order for placing the  $\beta$ -values of the regression lines' in their proper context, we lastly discuss them compared to the P/e-ratio.

The analysis will, as mentioned previously, first be structured according to a more detailed manner, in which we discuss the various statistical tables, regression plots and regression lines. After this is completed, we analyze the results in a more comprehensive manner. We emphasize that the first detailed analysis will be focused on mainly analyzing the results statistically, while we in the more comprehensive part of the analysis, will pursue an analysis focused on what lies behind this statistical results. Therefore the descriptions and analyzes that are presented in connection with the various diagrams and tables exist mainly to prove or discard the hypotheses, and reflect over the result. This can according to us be very statistical, while the more comprehensive analysis is probably, to the reader more interesting reading.

We will throughout this chapter present data for all observed companies as well as divided according to industry sectors, company size and company age. All numbers in the entire statistical material are presented in thousands of Swedish Kronor (SEK). Worth mentioning is also the fact that when nothing else is pointed out, the statistical presentations consist of all available data, without yearly separations.

## 5.2 Description of the observed data

The intention is to first statistically describe the observed data to provide the reader with an image at first glance. The idea of this is to increase the reader's understanding of the statistical material, so that the subsequent observations, calculations and analysis will be less complicated to grasp. We emphasize that it is important for the reader to study the presented tables in order to fully understand the discussion below.

### 5.2.1 All selected companies

In *table 5.1* we have put together some statistical descriptions for the entire observed material, i.e. all selected companies and years. The *mean* value for the IC measure VA/e is set to 1 271 while the SEV/e is more than four times higher at 5 182. If we instead observe the *median*, a first observation can be made regarding the difference between VA/e and SEV/e. With this statistical description, the difference is less than three times greater for SEV/e. Notable is further that the difference between the mean and median value has been halved when observing VA/e. This indicates that the Mean value could be somewhat misleading, at least regarding VA/e.

	VA/e	SEV/e
Mean	1 271	5 182
Median	619	1 836
$\sigma$	1 736	8 109
Largest	8 467	60 643
Smallest	-349	136

TABLE 5.1 STATISTICAL DESCRIPTIONS FOR THE ENTIRE OBSERVED DATA

The *standard deviation* ( $\sigma$ ) visualizes that the spread around the mean of SEV/e is greater when comparing the two measures, i.e. in *table 5.1* by 1 736 for VA/e and 8 109 for SEV/e. Thus, this indicates, according to us, that the stock exchange value is more volatile than the value added, which however probably is not a surprise to most people.

This volatility is also illustrated when observing the *largest* and *smallest* observation for VA/e and SEV/e. The largest value of VA/e is 8 467 while the largest value accounted for in SEV/e is as high as 60 643, a difference of more than seven times. In contrast to the smallest amount of VA/e and SEV/e which has values of, respectively, -349 and 136.

Some reflections can be made regarding the chosen approximate measure VA/e. In order to get a better understanding of its values we have extracted the average salary cost per employee for all the selected companies. We emphasize that it is important for the reader to have *figure 4.1* in mind when taking part of this discussion. The average salary cost is

438 out of the 1 271. This would mean that the other 832 would be distributed to the shareholders (dividends), the government (taxes) and for the future investments (R&D). At a first glance this seems fairly reasonable but considering the median value of VA/e, which is half the amount of the mean value, there story is different. If this indicator would have been used instead the capital left after salary costs would equal only 179. The question one might ask is if the value added should be placed on a higher level, i.e. the median value shows indication of that the companies VA/e are very low since the salaries at this moment constitute a large part of the VA/e. This question will be further addressed later on when discussing the industry sectors' values.

### 5.2.2 Industry sectors

The observations discussed above can be illustrated more in detail by dividing the data into separate industry sectors. As can be viewed in *table 5.2*, the sector with the highest values in mean is Real estate and construction, both regarding VA/e and SEV/e at respectively 3 029 and 11 408. In contrast the sector with the lowest mean values is Industrials, with VA/e at 525 and SEV/e at 1 314. These trends also include the median values, for each measure.

	Industrials		Life science		Real estate and construction		IT consulting and services	
	VA/e	SEV/e	VA/e	SEV/e	VA/e	SEV/e	VA/e	SEV/e
Mean	525	1 314	706	4 260	3 029	11 408	611	3 198
Median	515	1 301	656	1 974	2 479	10 584	619	2 210
$\sigma$	147	731	265	6 003	2 591	12 199	203	2 893
Largest	1 089	3 842	1327	29 675	8 467	60 643	910	16 984
Smallest	232	237	256	333	358	136	-349	864

TABLE 5.2 STATISTICAL DESCRIPTIONS, BY INDUSTRY SECTOR

The *Standard deviation* ( $\sigma$ ), for SEV/e, as observed in the figure is highest for the sector Real estate and construction, more than double compared to the next sector in line; Life science. The sector Industrials demonstrates the smallest standard deviation. Regarding the standard deviation of VA/e, the three sectors Industrials, Life science and IT consulting and services are all approximately centered around 200. However, Real estate and construction once again show indicators of diversification compared with the other sectors since its standard deviation prove to be 2 591. We believe the main reason for this large standard deviation concerning VA/e is caused by the sector being divided into two sub-sectors. Real estate on the one hand, contains companies characterized of few employees and large amounts of financial capital. Construction on the other hand, include companies with much more employees and a smaller amount of financial capital compared to the Real estate sub sector. These factors naturally influence, to a large extent, the values of VA/e and SEV/e since they are calculated *per employee*.

The industry sector with the largest values of VA/e and SEV/e is Real estate and construction, with Life science having the second largest values. An interesting observation, concerning the smallest values observed, is that the sector IT consulting and services holds the *smallest* lowest VA/e of the four sectors, at -349. In contrast, this sector also holds the highest SEV/e at 864, in the *smallest* category. The figure belongs to Adcore AB, of the years 2000 for VA/e and 1998 for SEV/e. This great difference is with certainty caused by the IT-Boom, however the negative result of VA/e probably means that the loss for 2000 must be substantial in order to reach this low value of VA/e.

Another interesting observation in the smallest category section is within the Real estate and construction sector. When comparing VA/e and SEV/e the observation can be made that, the VA/e at 358 exceeds the SEV/e at 136. This result does not exist within any of the other sectors, i.e. the VA/e being larger than the SEV/e. The company that possesses these two values is PEAB AB. The VA/e per employee of this company is throughout the entire observed period larger than the SEV/e. Our view of in this matter is that PEAB AB have obtained a very low stock exchange value combined with a large amount of employees. The conclusion thus, could be that the company is undervalued.

The same discussion above, concerning VA/e and the average amount of total salary per employee (salary/e) could be applied here as well. Once again we therefore emphasize that the reader views *figure 4.1*. The average salary cost per employee compared to VA/e can be viewed in *table 5.3*. As can be seen in the table, the Real estate and construction sector demonstrate the largest difference of 2 626.

	Industrials	Life science	Real estate and construction	IT consulting and services
VA/e	525	706	3 029	611
Salary/e	364	450	403	537
Difference	161	256	2 626	74

TABLE 5.3 THE SALARY PER EMPLOYEE SHARE OUT OF VALUE ADDED PER EMPLOYEE

The reason for the great difference of Real estate and construction ought to be caused by the small number of employees in the Real estate companies. In contrast, the three other sectors demonstrate very low values of VA/e. The IT consulting and services sector for instance prove to have the smallest difference between VA/e and Salary/e, with a value of only 74. This is alarmingly low considering all the other “stakeholders” that are to take part of the value added after salary costs. However, as these companies’ value and business operations consists primarily of their employees, this figure could be adequate. What could be more alarming is the fact that the Life science sector only has 256 left for the other stakeholders after salaries. Considering the business that these companies are in, i.e. R&D, this figure could probably be considered more alarming than the one for IT consulting and services. Especially since the Life science companies’ value added should



nourish their R&D development, thus supporting new and innovative R&D that have future earnings potential.

What has been indicated throughout this description of the statistical material is clearly visualized in *figure 5.1*, in which we have put VA/e and SEV/e together for the observed companies and plotted them in scattered diagrams, divided by industry sector. The three sectors Industrials, Life science and IT consulting and services points of measure are scattered in the lower left corner. Most of the Real estate and construction plots are, on the other hand, scattered relatively evenly over the entire lower part of the diagram, with a few plots on the upper half.

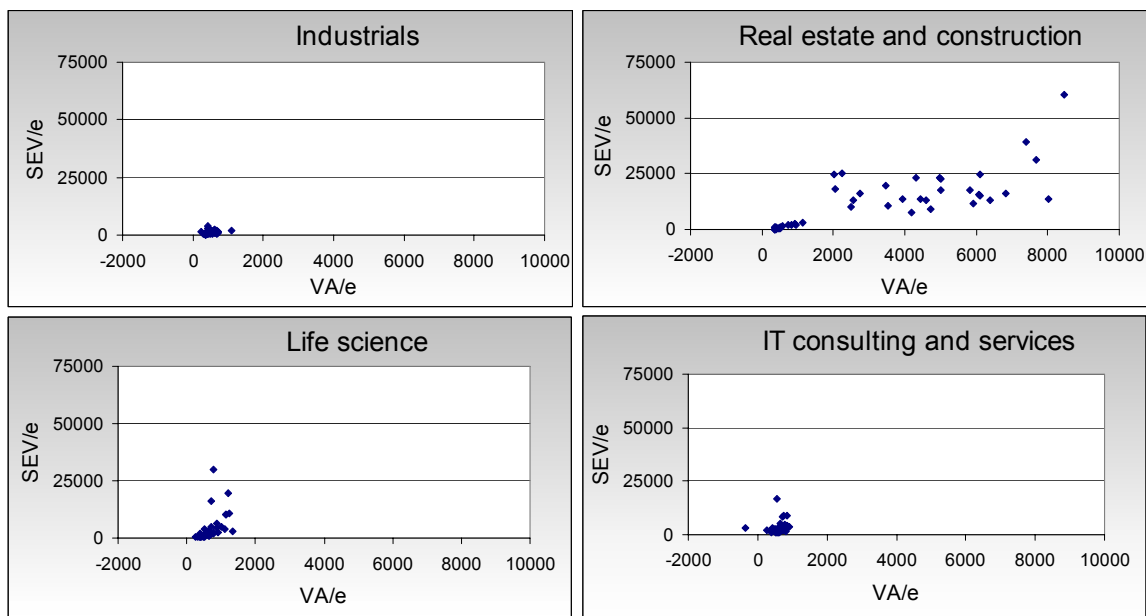


FIGURE 5.1 SCATTERED DIAGRAMS, BY INDUSTRY SECTORS

As discussed before, the Industrials points of measure, also the sector with the lowest standard deviation concerning both VA/e and SEV/e, are closely placed in the between the 0 and 2 000 mark. The Life science and IT consulting and services sectors are somewhat more scattered but still more closely correlated compared with the Real estate and construction.

### 5.2.3 Company size

In *table 5.4* the same descriptions of the statistical data, as in the two previous tables above, can be found regarding company size. The Large companies have the lowest *mean* values, while the Small companies demonstrate the highest mean values and the Medium sized companies in between the other two, both regarding VA/e and SEV/e. The same trends can be found regarding the *median* values. The Small companies have the largest *standard deviation*. The other two size segments have both much lower values, especially

the larger companies. This difference is also revealed when comparing the *largest* and *smallest* values. The reason for this deviation is because the Small companies contain mainly a mix of Real estate companies and IT consulting and services companies. These two sectors are extremes concerning both VA/e and SEV/e, i.e. IT consulting has low VA/e and SEV/e and the Real estate companies have very high values regarding VA/e as well as SEV/e.

	Large		Medium sized		Small	
	VA/e	SEV/e	VA/e	SEV/e	VA/e	SEV/e
Mean	560	1 673	1 306	5 044	2 011	9 108
Median	509	1 270	653	2 243	780	3 858
$\sigma$	216	2 079	1 752	6 829	2 275	11 070
Largest	1 327	10 884	7 684	31 436	8 467	60 643
Smallest	232	237	-349	136	256	333

TABLE 5.4 STATISTICAL DESCRIPTIONS, BY COMPANY SIZE

The same trends as was mentioned above can be found with reference to solely the *largest* values when comparing VA/e and SEV/e. However, the *smallest* values of VA/e and SEV/e show a different picture. The values of VA/e and SEV/e are relatively correlated regarding Large companies. The biggest difference is found within the Medium sized companies, in which the smallest value of VA/e is -349 and 136 for SEV/e.

As can be seen in *figure 5.2* below, the Large companies are plotted close together, which supports the descriptions concerning especially the standard deviation. As was described above the small companies are the most spread out sector, while the Medium sized are evenly spread out under the 25 000 SEV/e line. These findings are interesting since large companies are “generally” seen to have larger stock exchange values. However, as we use the measures *per employee* it becomes a different story, and the smaller companies have the highest values regarding mean, median, largest and standard deviation. This is as, mentioned previously, one of the strengths of the chosen measure. By using the measure *per employee* we can compare companies of different size. It also enlightens variations well. However, the measure has, as mentioned earlier, its limitations since small companies, as for instance some of the Real estate companies achieve very high values. Because of this, some caution has to be taken when interpreting this data.

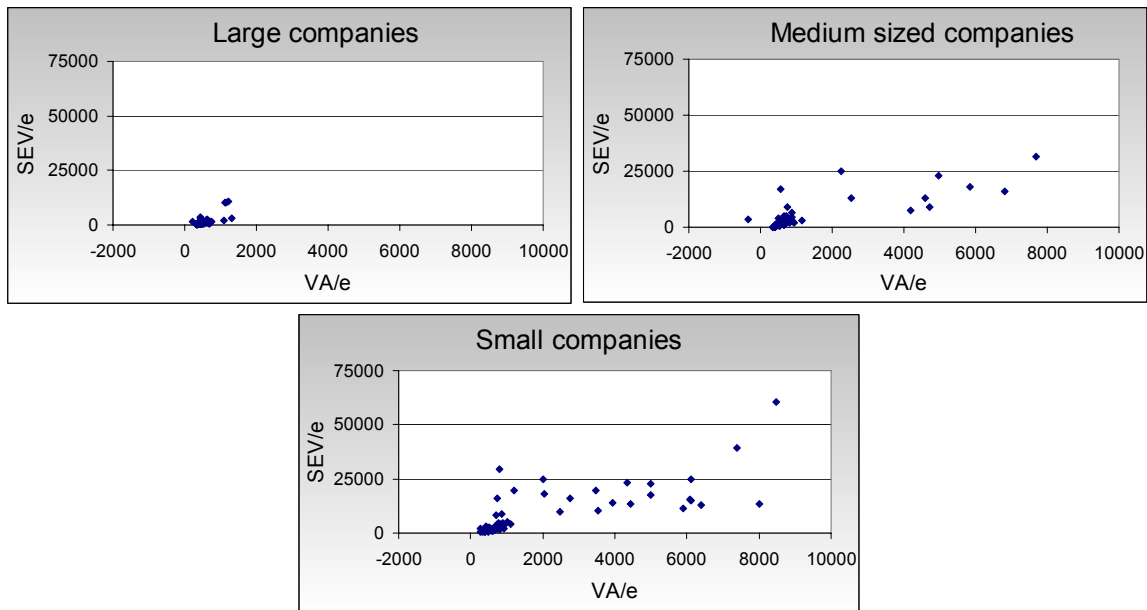


FIGURE 5.2 SCATTERED DIAGRAMS, BY COMPANY SIZE

### 5.2.4 Company age

In *table 5.5*, the same descriptions of the data, divided by company age can be viewed. The Old companies prove to have the lowest *mean* values, regarding both VA/e and SEV/e. The low values originate from the fact that the majority of these companies mainly consist of Industrials. The Young companies have the largest mean value for SEV/e at 5 423, though the Medium aged companies are not far off at 5 271. Concerning the mean Value of VA/e, the medium aged companies' holds the largest value. Regarding the *Median* values the Old companies as before holds the lowest values of VA/e and SEV/e. The Medium aged and Young companies median values, as for the mean values, are very much alike, i.e. 653 and 659 for VA/e and 2 102 and 2 070 for SEV/e. This cannot be explained by the composition of companies in these two age segments, instead this similarity could actually be caused by a coincidence. The Medium aged companies consist of all the four sectors while the Young companies consist mainly of IT consulting and services and Life science companies.

	Old		Medium aged		Young	
	VA/e	SEV/e	VA/e	SEV/e	VA/e	SEV/e
Mean	957	4 787	1 648	5 271	1 131	5 423
Median	587	1 399	653	2 102	659	2 070
$\sigma$	1 484	1 460	2 130	6 855	1 379	7 051
Largest	8 467	60 643	8 019	31 436	6 099	29 675
Smallest	312	237	232	136	-349	333

TABLE 5.5 STATISTICAL DESCRIPTIONS, BY COMPANY AGE

An interesting observation is the *standard deviation* for the Old companies. The deviation for VA/e proves to be higher than the SEV/e, something that has not occurred previously in the descriptions. The values for VA/e and SEV/e are also very similar at 1 484 and 1 460. The standard deviation for the two other age segments are fairly similar, though the Young companies have the largest values of SEV/e and the Medium aged companies have the largest values regarding VA/e. The Old companies have the *largest* values, both concerning VA/e and SEV/e at 8 476 and 60 643 respectively, which is interesting considering that these companies had the lowest standard deviation. The second largest value of SEV/e is merely half the value and belongs to the Medium aged companies. Regarding the *smallest* values, both the Old companies and the Medium aged companies have VA/e values that exceed the SEV/e values. The values for Old companies are Electrolux AB concerning VA/e and SKF AB concerning SEV/e. For the Medium aged companies these values belong to Scania AB regarding VA/e and PEAB AB regarding SEV/e.

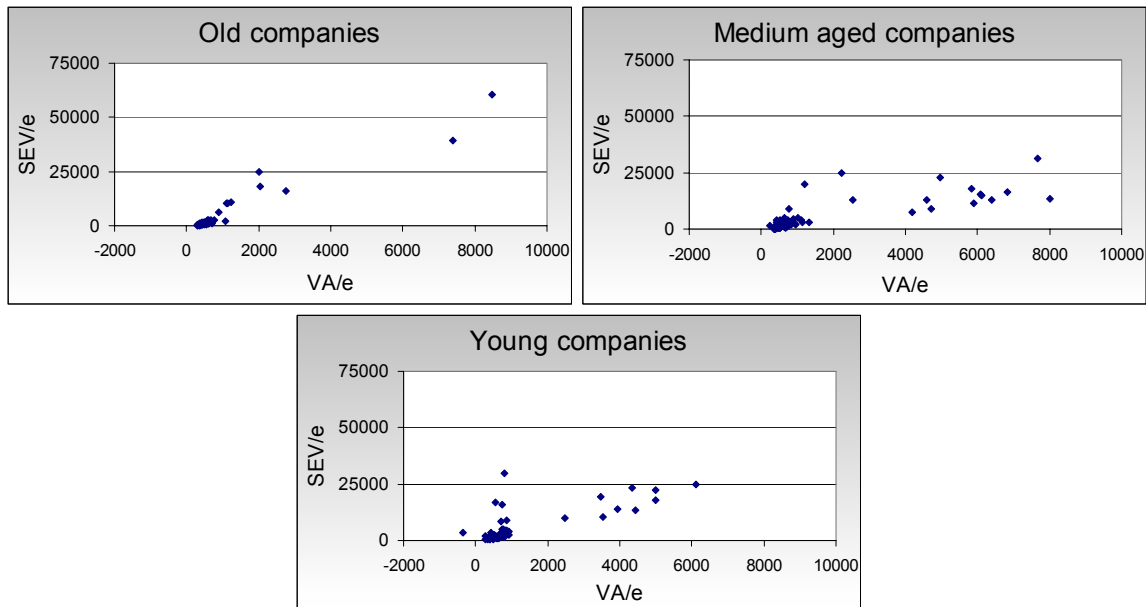


FIGURE 5.3 SCATTERED DIAGRAMS, BY COMPANY AGE

The points of measure for the companies divided according to company age are presented in scattered diagrams in *figure 5.3*. The Old companies are, with a few exceptions, stabilized between 0 and 2 000 regarding VA/e and just under the 25 000 line for SEV/e. Both the Medium aged and Young companies are more evenly scattered, mainly with a gathering to the right of the 0 mark as well as under and just above the 25 000 line.

### 5.3 Initial approach to the observed data

One simple way to examine whether there is a linear pattern between VA/e and SEV/e, is to see if the average SEV/e follows the average VA/e over time. We point out that these calculations are not statistically correct; rather these comparisons have been made as an initial approach to the data. If these observations would show a close correspondence it could be proof of the first hypothesis, i.e. there is a linear pattern between VA/e and SEV/e when comparing all the selected companies. When the term correspondence is used, we mean that when an increase in VA/e occurs, the parallel occurs with SEV/e, and naturally vice versa with a decline in VA/e.

As can be observed in *figure 5.4*, the average SEV/e is much more volatile over time compared to the average VA/e. Consider for example the values between 1996-1998 and 1998-2000. Although there are some years that correspond, for instance between 1997-1998 and 1998-1999, the initial impression is that it is difficult to observe a pattern.

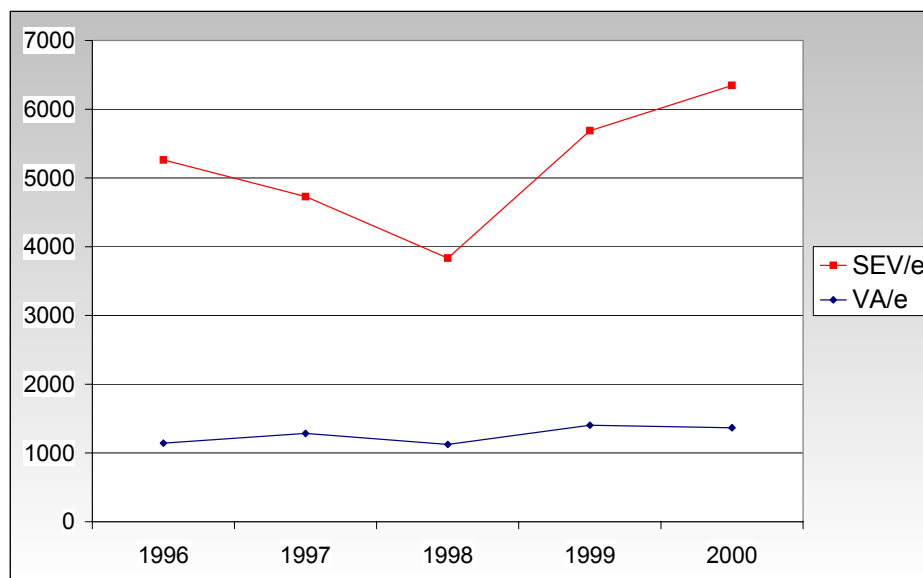


FIGURE 5.4 AVERAGE STOCK EXCHANGE VALUE AND VALUE ADDED PER EMPLOYEE FOR ALL COMPANIES

Is it possible to distinguish a pattern if we divide the data based on the established industry sectors? See *Appendix 3, figures A3.1 through A3.4*. As can be observed the industry sector with the highest correspondence between VA/e and SEV/e is Real estate and construction, where there is a correspondence between the measures from 1996-1999, but with a “dip” of VA/e from 1999-2000.

The sector that seems to have the least correspondence is Life science, which only corresponds two of the observed years. An interesting observation regarding Life science is the huge increase in SEV/e in 1999-2000. The SEV/e, of 3 100 in 1999 climbed to nearly 7 500 in 2000, in comparison the changes of VA/e is very small. The conclusion

that can be drawn from this is that the huge increase cannot be explained by the increase in VA/e. We will elaborate further on this increase of SEV/e when discussing and analyzing the Life science regression line.

Other interesting observations can be made concerning the IT consulting and services sector. The Average VA/e is very stable over time despite the differences in SEV/e, which moves from around 2 500 in the year 1998 to peak at over 5 000 in the year 1999. In the year 2000 this figure has decreased to around 2 700. A clear illustration of the IT-boom that existed during this short period. The average VA/e corresponds well in this period of decline. One of the reasons for this correspondence is most likely the increase and thereafter the reduction of customers for the IT companies during this turbulent period.

Regarding Industrials, the average VA/e show different trends compared with the other sectors. In this sector, the average VA/e is constantly increasing, from around 450 in the year 1996 to 600 in the year 2000. In contrast the SEV/e is much more volatile. In our opinion, it is not a surprise that the Industrials display this pattern concerning the increase in VA/e. As previously mentioned the companies within this sector regularly demonstrate low values of VA/e. There is seldom a huge increase of value added one particular year.

We will below elaborate and test the observed data with regression plots. This means that we will be able to analyze the data in a more statistically correct manner, and thereby draw conclusions that could prove the defined hypotheses.

## 5.4 Regression plots

As previously mentioned, our main statistical research method is regression analysis. This method will provide us with the two most commonly used indicators describing whether there is a linear pattern or not, i.e. the correlation coefficient  $r$  and the determination coefficient  $r^2$ , as presented in *chapter 4*.

The interpretation of these numbers is not all together easy, and differs largely depending on what data that are analyzed. A company's market value depends on a large number of factors, of which we hope to prove that IC is one, and possibly of major importance. Therefore, a degree of determination above 60 percent, and a correlation coefficient above 0,75 could be interpreted as strong.

To ensure that these interpretations are correct we have been in contact with lecturers Svante Körner and Lars Wahlgren of the Department of statistics, Lund University. According to both Mr. Körner and Mr. Wahlgren there is no outspoken rule concerning

the correlation coefficient and determination coefficient of what is considered strong or weak. To regard the degree of determination and correlation coefficient as strong, one has to put these indicators in a context, i.e. number of observations and whether it is a social science or natural science study (Körner & Wahlgren, 2002). As this thesis include 179 observations and has a social scientific perspective, we consider our interpretation regarding the two indicators to be correct. We also emphasize that comparisons are made between indicators of different regression plots, hence the indicators value in itself is not the most important but its value in comparison with others.

#### 5.4.1 All selected companies

To prove the first hypothesis, an initial regression of all the collected data has been made and is presented in *figure 5.5*.

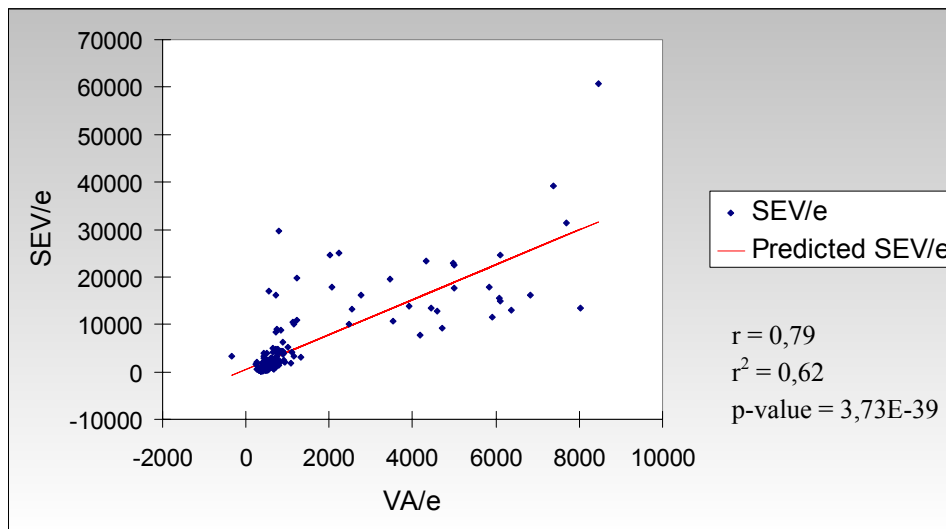


FIGURE 5.5 REGRESSION PLOT, ALL SELECTED COMPANIES

When viewing this regression plot the indicators clearly show that a correlation between VA/e and SEV/e exists. SEV/e can, to a degree of 62 percent, be forecasted by a company's VA/e, a figure that in this context can be seen as rather strong. This regression also shows a strong correlation, with a coefficient of 0,79. Although the indicators show a strong correlation, the visual presentation indicates that some caution should be taken before totally discarding the first  $H_0$ -hypothesis.

The statistical significance of the regression is undoubtedly proven, not only with 95 percent significance, but also clearly with 99 percent significance. However, there might be a disturbance caused by the Real estate and construction sector. As previously mentioned, and shown in *figure 5.3*, these companies are mainly the ones situated high on both VA/e and SEV/e, which might strengthen the correlation. As these companies are a

part of the data they shall not just be discarded as a disturbance, nor are they later in the analysis. However, to better understand the strength of this initial regression a retraction of this industry sector might be suitable. This regression is presented in *Appendix 4, figure A4.2*.

With this regression, it is clear that the Real estate and construction industry sector has a major impact on the sought correlation. Without this sector, with a correlation coefficient of 0,44 and a determination coefficient of only 19 percent, the correlation becomes significantly weaker. But since the linear pattern shows a major significance anyway, the  $H_0$ -hypothesis can still be discarded, and the initial hypothesis proves to be correct.

When discussing the first hypothesis it is also of interest to examine whether the correlation, between all the companies, has changed since the year 1996. The regressions for all the companies from 1996 to 2000 are presented in *Appendix 5, figures A5.1 through A5.5*. Throughout the period, the correlation stays strong, and the linear pattern is clearly significant for all years. Notable in this comparison is that the weakest correlation appears for the year 1996 and the strongest for the year 1997. The year 1998 have the second strongest correlation whilst for the years 1999 and 2000 the correlation coefficient is equal to the one in *figure 5.5*. The trend that can be identified is an increase until the year 1997, thereafter a small decline that levels out during the years 1999 and 2000.

The impact of the Real estate and construction companies, mentioned above, might be a sign that the second hypothesis also will prove to be correct. Our belief that the correlation will become stronger when dividing the data by industry sector might therefore also prove to be correct.

#### **5.4.2 Industry sectors**

By looking at the regression plot of Industrials presented in *figure 5.6*, it is fairly obvious that there is not any linear pattern; the line fit plot does not apply very well to the values. This is also pointed out by the p-value that shows that the line fit is not statistically significant. Since this regression is not statistically significant, the  $r$  and  $r^2$  values become less important, but it is obvious that they are both very low, i.e. at 0,25 and 6 percent. Thus when comparing solely Industrials, the  $H_0$ -hypothesis cannot be discarded.



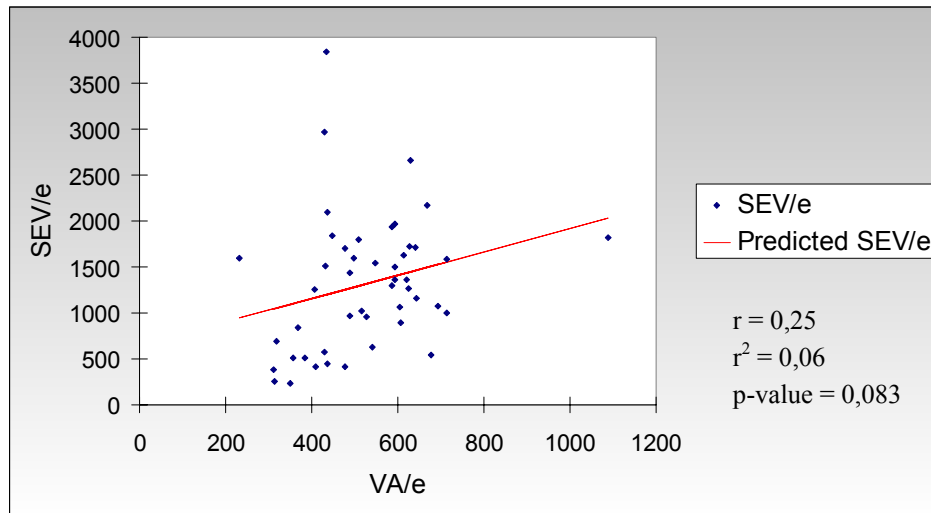


FIGURE 5.6 REGRESSION PLOT, INDUSTRIALS

In *Appendix 6, figure A6.1*, the historical development of the Industrials is presented. The outcome is, however, the same as before. None of the years show any statistical significance with the values for year 2000 being the least correlated. The line fit plot for this year even shows a negative inclination, but since the  $h_0$ -hypothesis cannot be discarded, no conclusion can be drawn.

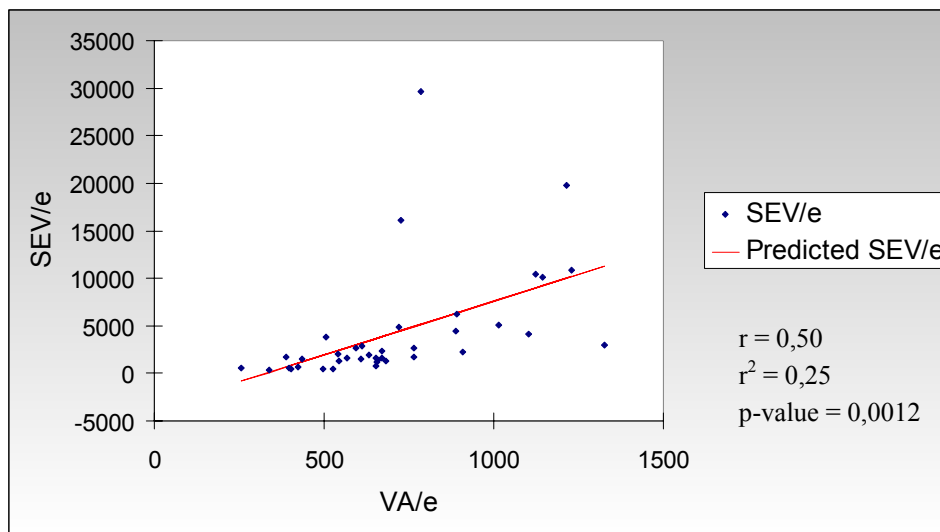


FIGURE 5.7 REGRESSION PLOT, LIFE SCIENCE,

Contrary to the Industrials sector, the Life science sector shows a clearly significant correlation, even to a degree of 99 percent, see *figure 5.7*. Despite this, the  $r$  and  $r^2$  values are weaker than when comparing all industry sectors. A correlation coefficient of 0,50 and a degree of determination of 25 percent can be interpreted as a medium strong correlation. A glance at the regression plot, *figure 5.7*, shows that one of the measurement points can be considered as an outlier, the value of Q-Med AB for the year 2000. The same regression as above, but without this outlier is presented in *Appendix 7, figure A7.1*. Although this outlier is not caused of a measurement error, and therefore probably should

not be removed, the effect of its retraction is substantial. Without this outlier, the correlation becomes rather strong and the degree of determination almost doubles, from 25 to 42 percent.

The regression of the Life science sector over all years proves to have statistical significance but a look at the industry sectors' yearly regressions tells a somewhat different story. The Life science regression plots for the years 1997-2000 is presented in *Appendix 6, figure A6.2*. These regressions only show significance for the year 1998. This year the correlation proves to be exceptionally strong, with an r-value of 0,92 and a degree of determination of 85 percent. The strong correlation for this particular year is most likely a decisive factor in the correlation for the industry sector as a whole.

As previously mentioned, the Real estate and construction companies have impact on the regression when viewing all selected companies. This indicates that the correlation when looking at only these companies probably will be rather strong. The regression plot for these companies is presented in *figure 5.8*.

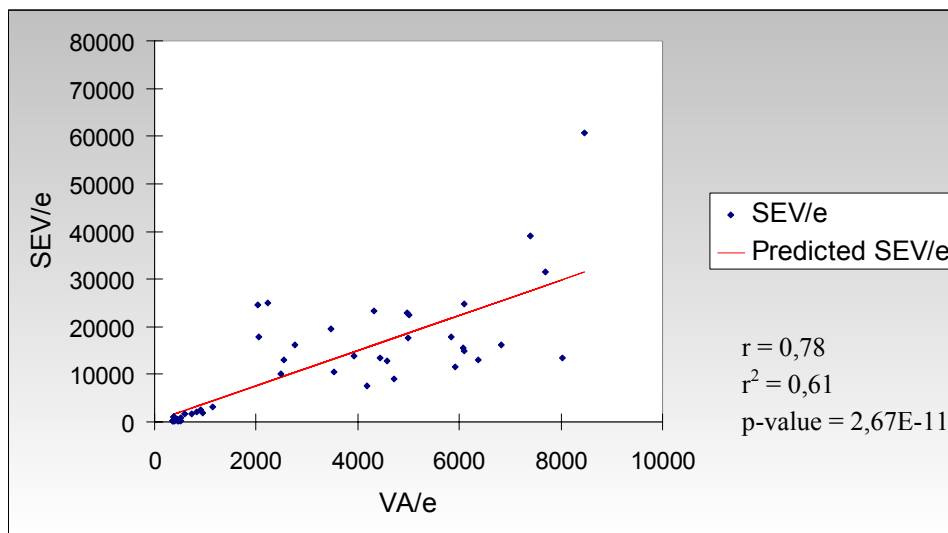


FIGURE 5.8 REGRESSION PLOT, REAL ESTATE AND CONSTRUCTION,

Contrary to what we anticipated this regression does not prove to be stronger than the one for all the selected companies, although these two comparisons can be seen as equals. Clearly significant and with an r-value of 0,78 and a 61 percent degree of determination, the Real estate and construction show an almost identical correlation as the regression of all companies, which are considered strong.

When dividing the Real estate and construction companies into yearly comparisons, the strength is similar to the yearly regressions of all companies. For the years 1997 and 1998, the correlation for Real estate and construction is slightly weaker, whilst it for 1999 and 2000 becomes slightly stronger than for all companies. These yearly regressions are presented in *Appendix 6, figure A6.3*. Noticeable is that both the correlation and

determination coefficients show high values for all years, with  $r = 0,85$  and  $r^2 = 72$  percent for the year 2000 as the highest values.

Similar to Industrials, the IT consulting and services regression plot, presented in *figure 5.9*, does not show a significant pattern, and low values for both  $r$  and  $r^2$ . A visual comparison of the regression plots for these two industry sectors shows that IT consulting and services, despite a worse p-value, seem to have a more visible pattern than Industrials.

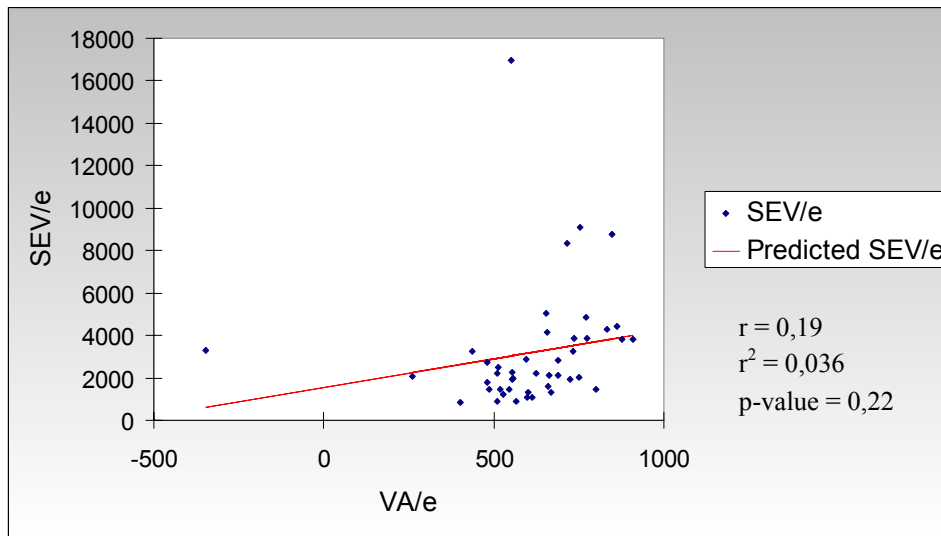


FIGURE 5.9 REGRESSION PLOT, IT CONSULTING AND SERVICES

Contrary to Industrials this regression has an obvious outlier, Adcore AB for the year 1999, and a retraction of this proves to have a considerable impact on the result. This regression is presented in *Appendix 7, figure A7.2*. Although still showing a weak correlation, with  $r = 0.33$  and  $r^2 = 11$  percent, the line fit plot just falls within the chosen level of significance. However, as stated earlier, our decision is to only subtract outliers in a descriptive purpose, which means that the  $h_0$ -hypothesis still cannot be discarded.

### 5.4.3 Company size

As mentioned previously, we have divided the statistical data in order to prove hypothesis 3, i.e. company size. The result of this selection can be viewed in *Appendix 8*. Three groups have been identified: *Large companies*, *Medium sized companies* and *Small companies*.

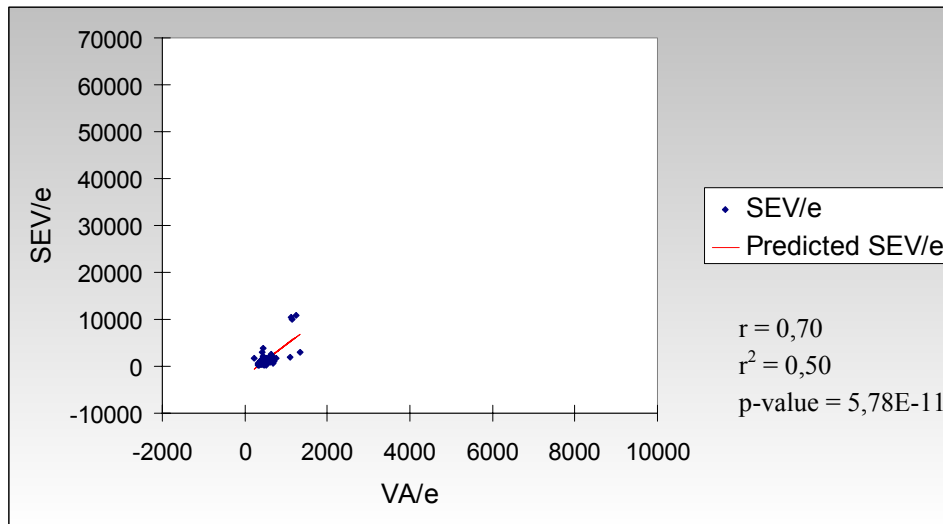


FIGURE 5.10 REGRESSION PLOT, LARGE COMPANIES

The line fit plot for the Large companies, presented in *figure 5.10*, prove to be clearly significant, and the correlation is strong with an  $r$ -value of 0,70 and a degree of determination of 50 percent. Since the Large companies mainly consist of Industrials it is interesting to see that the adding of a few companies from other sectors, e.g. AstraZeneca (Life science) and Skanska (Real estate and construction), significantly improves the correlation.

The strong correlation that exists when dividing companies according to size is also visible for the Medium sized companies, presented in *figure 5.11*.

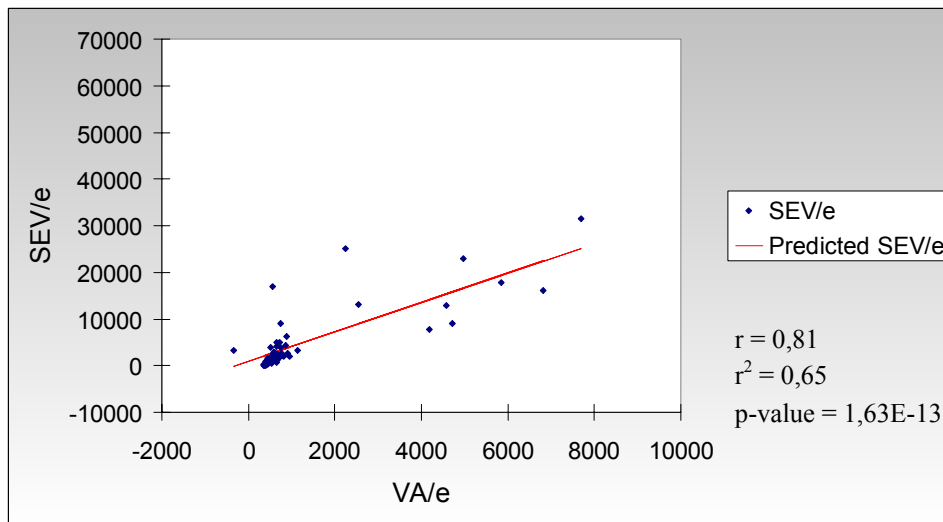


FIGURE 5.11 REGRESSION PLOT, MEDIUM SIZED COMPANIES

The Medium sized companies, much like the Large companies regression plot, also demonstrate a noticeably significant regression. But, unlike the prior regressions the correlation for this one proves to be even stronger than the regression for all selected companies. With a correlation coefficient of 0,81 and a degree of determination of 65

percent, this regression not only discards the  $H_0$ -hypothesis, but also lies in accordance with our belief that dividing the companies by size should strengthen the correlation in comparison to the regression on all selected companies.

As for the Large and Medium sized companies, the Small companies show a clearly significant regression. The Small companies regression plot is presented in *figure 5.12*.

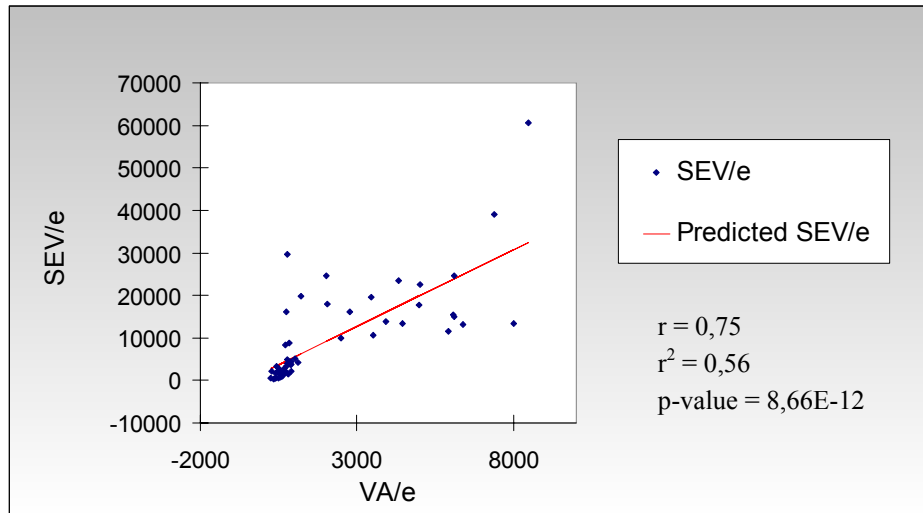


FIGURE 5.12 REGRESSION PLOT, SMALL COMPANIES

Although not quite as strong as for the Medium sized companies, this regression also shows a strong correlation. With  $r = 0,75$  and  $r^2 = 56$  percent, the correlation is nearly as strong as for all the selected companies.

#### 5.4.4 Company age

As mentioned in the Method chapter, we have divided the statistical data in order to prove hypothesis 4, i.e. company age. The result of this selection can be viewed in *Appendix 9*. Three groups have been identified: *Old companies*, *Medium aged companies* and *Young companies*.

When dividing the companies according to company age, the Old companies show an extremely strong correlation, as can be viewed in *figure 5.13*.

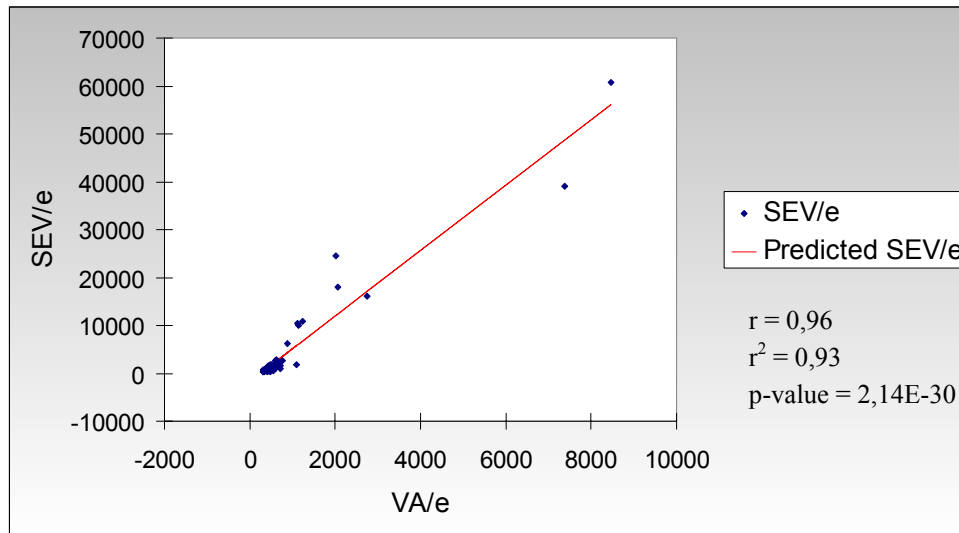


FIGURE 5.13 REGRESSION PLOT, OLD COMPANIES

Undoubtedly significant, the correlation coefficient of 0,96 and the degree of determination of 93 percent are by far the highest values we have encountered. A visual look at the regression plot, however, tells a similar story as the regression for all companies. It is quite obvious that the measurement points to the far right, in this case the data for Hufvudstaden AB, have a big impact on the strength of the correlation, and a retraction of this data might be interesting in a descriptive purpose. This regression is presented in *Appendix 10, figure A10.1*.

With this subtraction, the correlation, although still strong, proves to be somewhat less exceptional. With  $r = 0,84$  and  $r^2 = 71$  percent the correlation is still noticeably stronger than the first regression, concerning all companies.

When looking at the Medium aged companies the strong correlation persist. This regression is presented in *figure 5.14*.

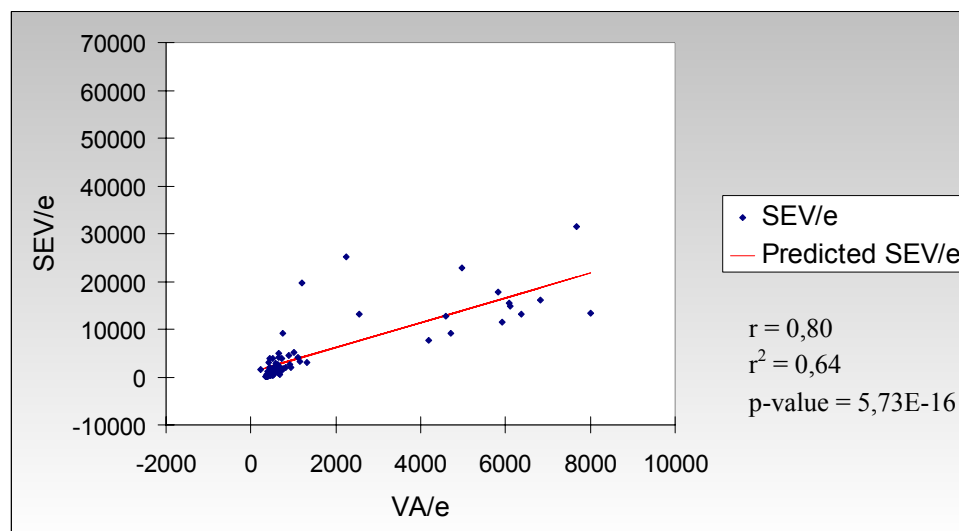


FIGURE 5.14 REGRESSION PLOT, MEDIUM AGED COMPANIES

Although not as strongly correlated as the Old companies, the Medium aged companies demonstrate a significant correlation. The correlation coefficient of 0,80 and the degree of determination of 64 percent are almost identical to the correlation when comparing all companies.

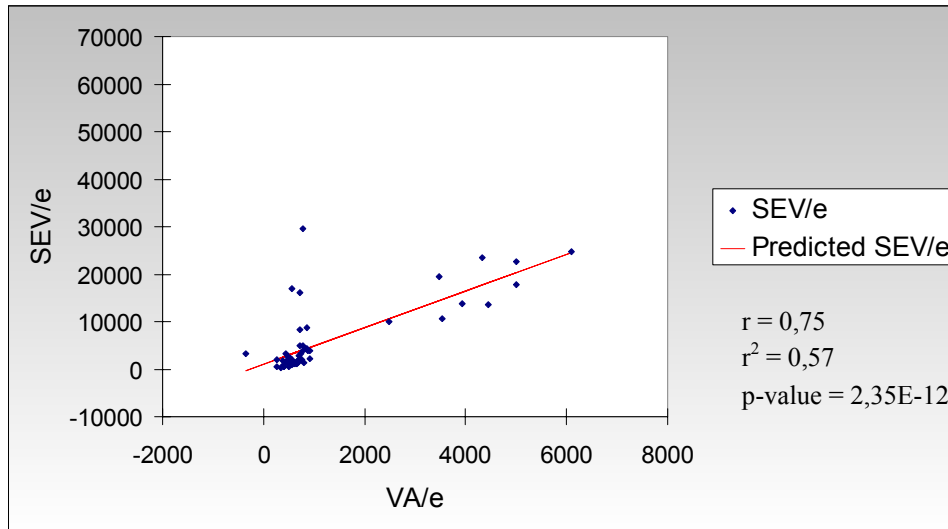


FIGURE 5.15 REGRESSION PLOT, YOUNG COMPANIES

The Young companies, like the Old and Medium aged companies, show a clear significance and a strong correlation, see *figure 5.15*. Although with an r-value of 0,75 and a 57 percent degree of determination, the correlation prove to be somewhat weaker than the Old and the Medium aged, as well as weaker than the correlation of all companies.

## 5.5 Comprehensive analysis

In order to clarify the results and analysis obtained so far, we will present a short summary followed by an analysis in connection to the hypotheses that were defined in both *chapter 1* and *chapter 4*. The results of the hypotheses will also be presented in *table 5.6* in order for the reader to form a overview picture of the results.

*Hypothesis 1: There is a linear pattern between companies' value added per employee and their stock exchange value per employee when comparing all the selected companies.*

The regression clearly proves that there is a pattern between the value added per employee and the stock exchange value per employee, i.e. according to our approximation a linear pattern between the return of intellectual capital and the market value. The

statistical significance of the regression in regards to all selected companies is indisputably proven and there is a strong correlation. The hypothesis thereby proves to be correct and the  $H_0$ -hypothesis can thus be discarded. When examining the data throughout the five-year period, the significance stays strong and the correlation have during the last few years stabilized.

The degree of determination also shows high values, which further enlightens the thoughts that in today's knowledge economy, most of a company's value creation is connected to its intellectual capital. In addition to this, the correlation proves that the market *indirectly* acknowledges an increase in a company's IC and thus raises the company's market value.

According to the authors these findings therefore indicates that external stakeholders to a greater extent should take a company's intellectual capital into consideration, when for instance evaluating and measuring a company. Our findings demonstrate that this is in accordance with the knowledge economy, that have risen and begun to dominate the global business world of today, and most certainly will keep dominating in the future.

The finding of the first hypothesis further proves to the individual companies that intellectual capital is more than merely a "management fad". Since we have proven that there actually is a connection between intellectual capital and market value, it is therefore vital that the companies do not neglect this concept. The importance of IC may vary between different industry sectors, which is something that individual companies and external stakeholders may have to bear in mind. We therefore turn to our next hypothesis.

*Hypothesis 2: There is a linear pattern between companies' value added per employee and their stock exchange value per employee when comparing companies by industry sector.*

The significance of the regressions' and the correlations differ for all the sectors but are in general, not strong enough for proving that there is a linear pattern when comparing companies by industry sector. Although two of the sectors, Real estate and construction and Life science, are significant the two other sectors show no significance. This means that the hypothesis proves to be incorrect and we cannot discard the  $H_0$ -hypothesis. However, when excluding the outliers of the various sectors, it is only Industrials that still show no significance.

The dividing of companies into industry sectors did not have the impact on the regressions that we had anticipated. The reason for this outcome will therefore be discussed and analyzed sector by sector.



As mentioned previously, the Industrials is the only sector which does not show any significance when excluding outliers. The regression on this sector does further not show any significance on any of the observed years, although the companies within the sector demonstrate the most similarities internally regarding the values of VA/e and SEV/e. This is in fact very interesting, as the sector does not in any way show a significant correlation. The question consequently asked is: why does not this sector show any significance? We have in the previous detailed analysis pursued to find a statistical explanation for this occurrence. One view is that our company composition of this sector proves to be incorrect, i.e. the companies are differentiated regarding product and customers and therefore the comparison becomes impossible. However, the regression for all the selected companies proved to be significant which certainly does not support the composition explanation.

We therefore believe the answer lies beyond a statistical explanation. The explanation could be found in the context of the sector, i.e. the characteristics of the companies. Many of these companies' possess machine parks, factories and a great deal of other tangible assets, i.e. the tangible assets constitute an important part of the business operations in comparison to for example IT consulting and services, in which the intangible assets are the most decisive factors of the business operations. This reflects how the financial market values the companies in this sector, i.e. according to substance and thereby buying Industrials stocks in regards to the same principal. Therefore, the substance of a company from the Industrials sector becomes as important as its results and perhaps even more. We have used value added, based partly on results in order to find a correlation with the stock exchange value, which is probably why the pattern between intellectual capital and market value never becomes visible. Another explanation could be the relationship between structural and human capital. This will however be further elaborated in the next chapter.

The Life science sector has grown substantially during the last couple of years, going through a similar uprising as the IT consulting and services did. That is reflected for example in the giant leap of the stock exchange value for the years 1999-2000, to which the value added does not correspond. The reason for this is that the companies in this sector has a high proportion of R&D, which may lead to misleading results since the R&D within the companies do not contribute to the value added. The R&D can, however, influence the market value since this often constitutes the potential earnings of the company. A question could be raised whether R&D mainly affects the human or the structural capital of a company. Most probable is that when the actual research is being conducted that it raises the human capital. However, if for example patents can be obtained it also boosts structural capital.

The Life science sector does show significance, but this can be discussed since it is only for, when analyzing the data yearly. We believe that the poor significance and correlation

will improve as the sector settles in a more steady state. Some companies are for example involved in biomedicine, a very new form of business. We believe that the market value is highly influenced by the potential for future profits. Thus the significance and correlation weakens during this five-year period. We believe however, that the significance and correlation could strengthen during the years to come as the industry sector stabilizes. The question that consequently could be asked is therefore: is the market values for the companies within this sector excessively high or will the value added per employee increase and better correlate with the SEV/e in the future? Perhaps the answer lies in success of the R&D.

The Real estate and construction sector demonstrate the greatest significance and the strongest correlation between market value and intellectual capital. The reason for this strong correlation is according to our opinion caused by the composition of the companies within this sector. The real estate companies demonstrate high values, both on value added per employee and stock exchange value per employee. The high value, regarding value added, stem from the fact that the companies have a lot of financial capital and a small number of employees. When the value added is divided per employee, few employees substantially increase the VA/e. This dividing per employee naturally also has an immense effect on the SEV/e. The real estate companies combined with the construction companies, with relatively low values both regarding VA/e and SEV/e, is one of the main reasons for the high correlation.

The discussion concerning the Industrials and the financial market's proposed primary focus on substance instead of results applies, according to us, in this discussion as well. In our opinion the Real estate companies, owning for example numerous properties, real estates etc. is valued mainly on its substance. The Construction companies are conversely valued by the financial market, according to their results, i.e. the profitability of the construction of real estates. This also gives the spread of the companies, which increases both the significance and the correlation.

The IT consulting and services sector does originally not demonstrate significance, although there is significance with a weak correlation when outliers are excluded. The sector has gone through a few very turbulent years, where the companies were highly valued until the end of the "IT-Boom", but have now stabilized at lower levels. This has therefore, as in the case of Life science, influenced the significance and correlation.

Interesting about this sector is the importance of the employees, which as commonly known comprise almost the entire value of these companies. This sector is differentiated from the others because it is focused on man-hours. The value added created can thus be traced almost solely to the employees, i.e. there are no other profits that disturb the VA/e as with for example the Real estate and construction companies. The human capital component of these companies intellectual capital therefore comprises a large part,

visualized previously by the extensive share of the VA/e that the salaries constitute. The relationship of structural and human capital, and the importance of structural capital regarding the IT consulting and services companies will be further discussed and analyzed in *chapter 6*.

Hence, the significance for this hypothesis was low and the correlation weak. Is it possible to distinguish a clearer pattern regarding company size?

*Hypothesis 3: There is a linear pattern between companies' value added per employee and their stock exchange value per employee when comparing companies divided by company size.*

When testing the hypothesis, we found that there is a linear pattern between VA/e and SEV/e and therefore, according to our approximation, a pattern between intellectual capital and market value is visible when dividing the companies according to company size. Our findings further prove that the various size segments show strong correlations. The hypothesis is therefore proved correct and we can discard the  $H_0$ -hypothesis.

An interesting question could be if it is possible to identify a pattern regarding size, i.e. that the larger companies have the strongest correlation followed by the medium sized companies and then the small companies, or vice versa. The strongest correlation can be found with the Medium sized companies while the Small companies show an almost equally strong correlation. However, the Large companies show a weaker correlation than the two others. Hence, we conclude that the influence of the intellectual capital on the market value is greater in smaller and medium sized companies compared to larger companies. Therefore, a size pattern is not visible in the regressions.

Compared to the regression plots of different industry sectors, the regression plots divided on company size clearly show more visible pattern between IC and market value. This could be caused by the fact that the companies within each company size segment are more similar regarding stock exchange value and value added than those that belong to the same industry sector.

One of the regression analyzes, i.e. the Medium sized companies, points to the fact that the correlation is stronger than the correlation of all companies, representing hypothesis 1. However, the two others, although with a small difference, demonstrate that the correlation actually is weaker in comparison to the correlation of all the selected companies. Hence, we conclude that, altogether, the correlations are weaker in regards to that of all the selected companies.

*Hypothesis 4: There is a linear pattern between companies' value added per employee and their stock exchange value per employee value when comparing companies divided by company age.*

There is a clear pattern between value added per employee and stock exchange value per employee when the companies are divided according to company age. This concludes that the hypothesis proves to be correct and naturally, that the  $H_0$ -hypothesis thereby can be discarded.

In fact, two age segments, i.e. the Old and Medium aged, demonstrate a stronger correlation than the one concerning all the selected companies. The Young age sector demonstrates a strong correlation, not far from the one regarding all the selected companies. We therefore consider these three regressions together, to be stronger than the first concerning all the selected companies.

As discussed above concerning size patterns, which was not visible, the same question can be formulated here, i.e. is it possible to distinguish a pattern based on the age of the companies. In fact, our regressions of company age prove that there seem to be a pattern, in which the older a company gets, the better correlation between intellectual capital and market value occurs.

We have already established that there was no significant pattern when the companies were divided by industry sector. For the different size segments there were however a significant pattern. The question consequently asked is: why is the correlation strongest when dividing the companies by age? We have previously stated that the correlation becomes stronger the older a company gets. In the problem discussion we argued that perhaps the sought pattern becomes more legible over time, i.e. as the companies settle in a more steady state so does the market value. This would according to the discussion make the relationship between intellectual capital and market value stronger. Could this be the explanation of the high correlation? As companies grow older, perhaps the credibility and the financial market's view of that credibility increased, which creates possibilities for a more correct valuation. Another argument could, according to the authors, be that the financial market, has valued and evaluated an old company for many years, thus understanding the true value of the company's intellectual capital.

An important aspect in this discussion is also the degree of structural vs. human capital that resides within the companies. The finding above could be an indicator that older companies have another degree of the mix between structural and human capital, which in turn influences the correlation between SEV/e and VA/e. This will be discussed and analyzed further in *chapter 6*.

	Statistical significance	Correlation coefficient	Determination coefficient	Stronger correlation than hypothesis 1
<b>Hypothesis 1</b> - all selected companies -	Yes	0,79	62 %	N/a
<b>Hypothesis 2</b> - industry sector -	No			
- Industrials	No	0,25	6 %	No
- Life science	Yes	0,50	25 %	No
- Real estate and construction	Yes	0,78	61 %	No
- IT consulting and services	No	0,19	3,6 %	No
<b>Hypothesis 3</b> - company size -	Yes			
- Large companies	Yes	0,70	50 %	No
- Medium sized companies	Yes	0,81	65 %	Yes
- Small companies	Yes	0,75	56 %	No
<b>Hypothesis 4</b> - company age -	Yes			
- Old companies	Yes	0,96	93 %	Yes
- Medium aged companies	Yes	0,80	64 %	Yes
- Young companies	Yes	0,75	57 %	No

TABLE 5.6 RESULTS, HYPOTHESIS 1-4

## 5.6 Regression lines

In this thesis, the regression equations, or regression lines, will serve two purposes. On the one hand they will be an indicator of how much an increase of IC affects market value, and on the other hand it is used as a tool for examining whether there are differences in this effect regarding different industry sectors.

As mentioned previously a regression analysis provides the linear pattern that best fits the analyzed data. This pattern is presented in the form  $Y_t = \alpha + \beta X_t$ , which is a simple line equation. With our examined data, this equation becomes  $SEV/e = \alpha + \beta * VA/e$ , thus explaining the effect an increase of VA/e has on SEV/e. Since the importance lies in the effect that VA/e has on SEV/e, the important value consequently is the slope coefficient,  $\beta$ .

When discussing the regression equation it is also of importance to recognize the confidence interval for the  $\beta$ -value, especially in cases where the statistical significance is weak or none existing. The confidence interval provides the slope in which the regression equation with 95 % significance resides, i.e. the interval showing how much an increase of one in VA/e will affect SEV/e. Those regressions that include the value 0 in this

confidence interval are also the ones showing no statistical significance in their regression analyses.

The regression lines visualizes, as mentioned before, how much an increase of IC really affects the market value. For a single company, this means that the regression line, and especially the confidence interval, describes how an increase of VA/e can affect the SEV/e. An understanding of this correlation helps the company when, for example deciding on what action to take in order for a higher market value, and what resources to divide among the existing divisions within the company.

For an investor, the regression lines and the confidence intervals serve as an indicator of the company's potential of elevating the market value by raising the VA/e. The VA/e measurement is as mentioned in *chapter 4* closely tied to profitability, which also makes the measure and the regression lines interesting from an investors' perspective.

### 5.6.1 Industry sectors

The regression lines of the four industry sectors can be viewed in *figure 5.16*. Remarkable is the Life science companies which show a much steeper slope than the other industry sectors. The  $\beta$ -value of 11,32 gives a slope that is almost three times as steep as the second steepest line, that of Real estate and construction.

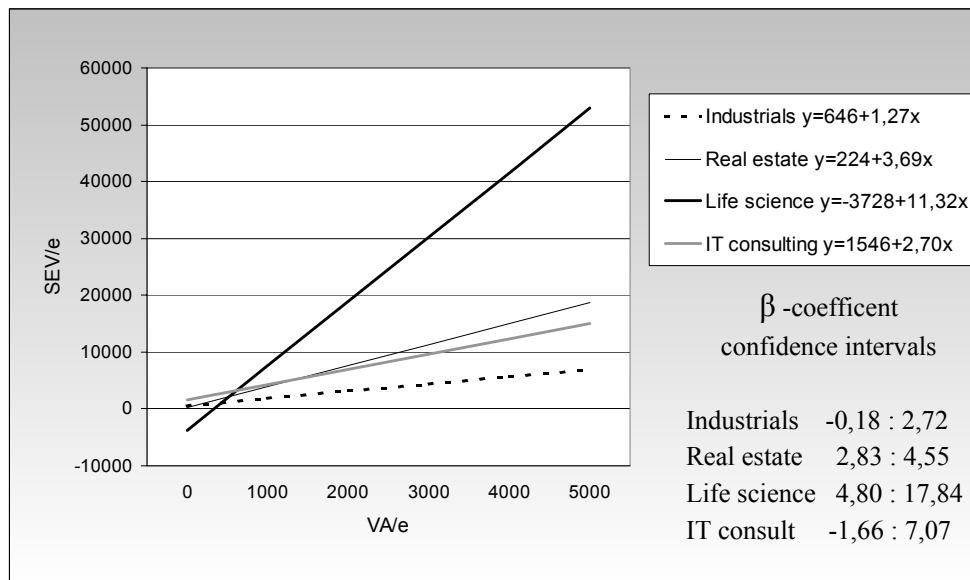


FIGURE 5.16 REGRESSION LINES, BY INDUSTRY SECTORS

One of the reasons to why the Life science sector has the steep slope is that many companies within this sector lately have experienced a substantial raise of their market value, especially during the years 1999 and 2000. When comparing these conditions to

the ones of the Real estate and construction sector, which have had an increase in both stock exchange value and value added, it becomes clear to why the noticeable difference have occurred.

The reason for the substantial increase can be discussed. It may well be just temporary, and could be resembled to the "IT boom". However, it could also be the fact that the Life science sector is a very successful industry sector, which has high future earnings potential, hence its high market value. Furthermore, there are, as illustrated in *Figure 5.7*, a few companies with extremely high SEV/e. Not all these points of measurement are outliers but the fact that they highly affect the regression still has to be considered when analyzing the outcome. Nevertheless, the fact remains that the VA/e cannot, regarding this sector, explain the increase of SEV/e in the year 2000, and this has to be considered when analyzing the outcome.

IT consulting and services show a close slope value, of 2,7, to that of Real estate and construction. The sector with the lowest gradient regarding its regression line is, however, Industrials. This is quite understandable, when comparing this result with *Figure 5.6*, since that regression did not have an established significance, thus meaning that the confidence interval resides on both sides of the zero value.

When analyzing the regression lines, the confidence interval for the  $\beta$ -coefficient is, as previously mentioned, of great importance. As easily noticeable, the regression equation  $\beta$ -value is accounted by the mean of the confidence interval, but to examine the actual 95 percent significance the confidence interval must be used.

This means, for example, that the regression line for Industrials, although it did not show a significant correlation, does not completely need to be discarded. The confidence interval for Industrials include the value zero, and the 95 % significance can thereby not be proven. However, since the interval reaches from -0,18 to 2,72, most values are clearly above zero and the conclusion can consequently be drawn that an increase in VA/e most likely will improve the SEV/e. This conclusion also corresponds when viewing the values for IT consulting and services, although that interval stretches further below zero, from -1,66 to 7,07.

The confidence interval also shows with higher certainty what effect an increase in VA/e will have on SEV/e. The width of this interval is linked to the correlation coefficient, the stronger the correlation - the tighter the confidence interval. This means that although the Life science regression line has a much steeper gradient than the other industry sectors, it is also wider than for example the Real estate and construction sector. An increase of VA/e of 1 will therefore increase the SEV/e for a Life science company with a value between 4,80 and 17,84 while it will increase the SEV/e for a Real estate and construction with a value between 2,83 and 4,55.

In this perspective, the IT consulting and services sector becomes interesting. With a confidence interval ranging from  $-1,66$  to  $7,07$  an increase of the VA/e in one of these companies might have a larger impact on the SEV/e than for the companies in the Real estate and construction sector. The interval of IT consulting and services indicates that this sector provides the greatest risk for an investor, which corresponds well with opinions of the stock exchange market analysts at the moment. Our examination further shows that an increased VA/e in the IT consulting and services sector might have no, or even a negative, effect on SEV/e. However, it also indicates that there are high earnings potential and that investing in this sector can provide high payoffs since the interval also contains the second largest value compared to the intervals of the other sectors.

The reason for that the event of an increase of VA/e leads to a decrease of SEV/e can be discussed. We can identify a couple of events, which may influence the correlation in this manner. The company may have made investments in a market or customer segment, which give rise to an increase of VA/e. The stock exchange market however sees this investment as, for instance, strategically incorrect, thus lowering the market value. Other events can be increases of employee salaries without increasing the results or depreciations, which also lead to an enlargement of the VA/e but have no effect on the SEV/e.

Most of the regressions have few identifiable outliers. In, *figure 5.17*, the regression lines for the industry sectors are presented with these identified outliers excluded. The Industrials did not, however, have any identifiable outliers and this is also the only regression that is not significant. The exclusion of the outliers had a rather limited effect on the regressions except for IT consulting and services, which substantially increased the gradient of the regression line to actually level out just above Real estate and construction.



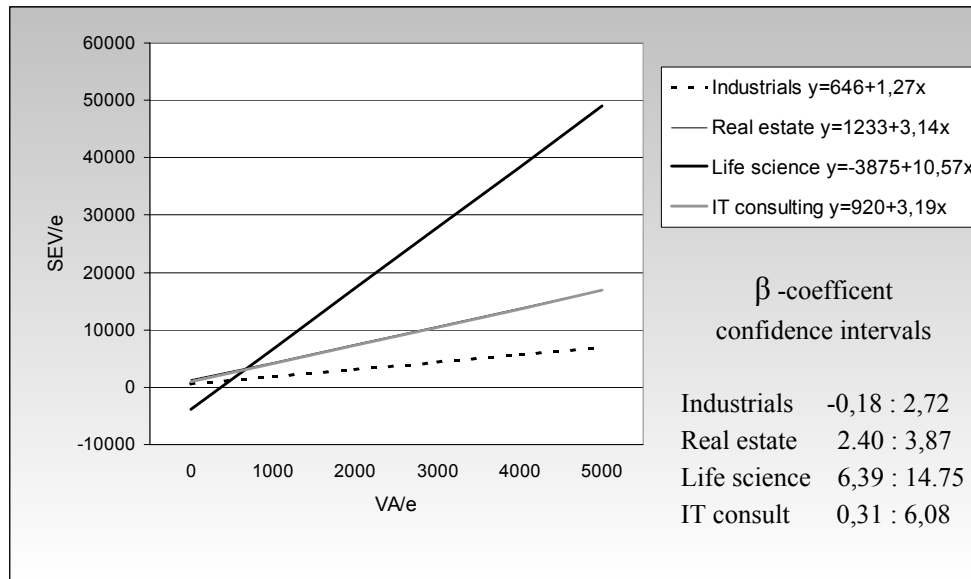


FIGURE 5.17 REGRESSION LINES, BY INDUSTRY SECTORS, EXCLUDING OUTLIERS

The confidence intervals for these regression lines also display some interesting facts. Since no outliers were excluded from the Industrials, the interval for this sector naturally still stretches from a negative to a positive value. Without outliers, and thus an increased correlation, the other three industry sectors have all tightened their intervals. What is most interesting regarding this is the fact that the interval for IT consulting and services has changed to a significant positive slope. This interval is still wider than the one for Real estate and construction which means that although IT consulting and services show a steeper regression line, the impact of VA/e on SEV/e is still very uncertain.

## 5.7 Comparison of $\beta$ -value and P/e-ratio

In order to put the obtained  $\beta$ -coefficients ( $\beta$ -value) of the industry sectors' regression lines into a context we will compare them with the stock indicator *price per earnings* (P/e) ratio. As some prior knowledge of Business and Economics is presumed we will not explain this indicator thoroughly. However, shortly explained the P/e is the ratio of a company's share price to its per-share earnings. For example a P/e-ratio of 10 means that the company has SEK 1 of annual per share earnings for every SEK 10 in share price. The price/earnings ratio is commonly used as a tool for determining the value the market has placed on a common stock and like other indicators, P/e is best viewed over time, looking for a trend. This is the main reason why we find it interesting to compare the  $\beta$ -coefficients and the P/e-ratios of the different industry sectors. We are aware that the P/e-ratio is used primarily as a measure for the individual company versus the mean of the industry sector, but in this case it is used merely as an example from a practical context. Since the  $\beta$ -coefficients can be seen as a predictor of what the sectors' stocks have the

potential of earning in the future, we have used the business journal *Veckans Affärer's* price per *predicted* earnings, and calculated the average ratio for every sector.

We emphasize that we are not going to compare the different  $\beta$ -coefficients and P/e-ratios “number by number”, rather the aim is to discern the relationship of the sector values for each indicator. We also view it as important for the reader to understand that this is not a test conducted to verify or discard either the  $\beta$ -coefficients that we have extracted, the P/e-ratio or VA/e. The point is rather, merely to analyze a predictor based on intellectual capital and compare it with a commonly used financial indicator and thereby deriving deviations and similarities. In this analysis we will use the perspective of a private investor, i.e. not using a perspective of the market, in order to emphasize that the  $\beta$  - values could be used in other contexts as well.

Industry sectors	P/e	$\beta$ -value <sup>17</sup>
Industrials	25	1,27
Real estate and construction	17	3,69
Life science	39	11,32
IT consulting and services	54	2,7

TABLE 5.7 P/E-RATIOS, BY INDUSTRY SECTORS

In *table 5.7*, the average P/e-ratios for the four industry sectors are presented. The Real estate and construction sector demonstrate the lowest P/e-ratio of 17. In contrast the  $\beta$ -value is the second highest, after Life science. Thus, the market indicates to the private investor that the Real estate and construction stocks are undervalued and that a future profit could be expected. From the  $\beta$ -value, a similar conclusion can be drawn, indicating that investing in a company in this sector could prove to be the second best profitable alternative out of the four sectors.

An interesting P/e-ratio is the one for the IT consulting and services sector, calculated to 54. Hence, the market indicates that the stocks in this sector are highest valued of the four sectors, which for the private investor indicates that a profit is not likely to be gained. The same conclusion can be drawn from the  $\beta$ -value, since this sector demonstrates the second smallest value.

In regards to the Life science sector the  $\beta$ -value clearly indicates to the investor that this is the best stock option when comparing the four sectors. However, the P/e-ratio indicates that stocks for this sector are highly valued by the market with the second highest value out of the four sectors. This point in the direction, for the private investor, that this sector is likely to be overvalued. Hence, regarding the two sectors first discussed, both the indicators pointed to the same direction. Concerning the Life science sector, the indicators

<sup>17</sup> Including outliers

point in different directions. It is though important to remember that the Life science sector have had a huge increase in its stock exchange value during the last two years, which as mentioned previously probably has a major impact on the various results.

The last sector, Industrials, has a P/e-ratio clearly above the lowest, but still far from the two highest. Thus the indication from the market would be that this sector of stocks are neither overvalued nor undervalued. The conclusion that can be drawn from the  $\beta$ -value is clear, this is the worst alternative out of the four sectors. Once again we emphasize that there could be misleading results due to the prior outcome obtained regarding the Industrials sector.

This comparison shows that there were similarities, perhaps more than deviations, between the  $\beta$ -value and P/e-ratio. But, according to the authors' opinion, the  $\beta$ -value display less variation between the different sectors. It also indicates more clearly which sectors have potential for profits in the future. Another comparison that can be made is the degree of depth that the different indicators provide. On the one hand the  $\beta$ -value offers more profundity, but on the other hand it is more complicated and time consuming to use and calculate. Contrary to this, the strength of the P/e-ratio is its uncomplicated calculation but it is instead more superficial.

We have throughout this chapter on several occasions brushed the ratio between human and structural capital. In the next chapter we will therefore, in accordance to hypothesis 5, examine and analyze this ratio and its effect on our previous findings.

## 6 Leveraging Human Capital

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*In the sixth chapter we relate our findings to the IC Multiplier. We first present and analyze the degree of structural and human capital of the selected companies. Furthermore we present the regression plots concerning VA/e and IC Multiplier, presented in the same order as in the previous chapter. Lastly we relate the results to the market value and the meaning of these findings.*

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### 6.1 Introduction

So far in this thesis we have made two central findings. Firstly that there is a general correlation between IC and market value, and secondly that the effect of an increase of IC affects different companies in different ways. What these results thus indicate is that if a company wants to increase its market value and communicate this increase to the financial market, VA/e can, and should probably, act as an internal performance measurement and an external indicator.

The increase of VA/e within the company might not fall as natural as improving the value of classical key figures such as solidity, liquidity etc. Instead, for most companies, VA/e is rather difficult to grasp and thus even more difficult to improve, but there are exceptions. From 1995 to 1997 Skandia managed to increase its VA/e from approximately SEK 480 000 to SEK 1 025 000 mainly by transforming human capital into structural capital, thus raising the company's IC multiplier ([www.skandia.com](http://www.skandia.com)). This increase in Skandia's value added raises a new question. Does an increase in a companies IC Multiplier correlate with an increase in VA/e? If this is the case, then working with the IC Multiplier is probably the most suitable way to improve a company's IC, and consequently raise its market value. We emphasize that the purpose of this analysis is not to explain how the IC Multiplier, in theory or practice, can be raised. Rather, our intention is to enlighten that the IC Multiplier could prove to be an important indicator that could be closely tied to VA/e.

As previously mentioned the IC Multiplier is calculated by dividing structural capital with human capital. To exactly calculate the SC/HC-ratio a thorough examination of each company must be performed. Since this option was not available for us, an approximation of the IC Multiplier will be used. This approximation is calculated by stating that a company's HC-ratio equals its salaries divided by its VA. Since the SC-ratio equals 1-HC this approximation gives us SC, HC and consequently also the IC Multiplier.

Although this approximation serves our purpose in an adequate matter, it has some limitations. For instance, companies showing a negative operating profit, get an HC-ratio of above 1, thus leaving SC with a negative value. A similar phenomenon also occurs for Adcore AB for the year 2000. Since the company shows a negative value added for this year, the HC-ratio becomes negative and the SC-ratio gets a value above 1, in this case 2,99. This questionable data consists of 13 out of the 179 available calculations, with 7 of them residing in the IT consulting and services industry sector. We have chosen not to handle this data in any special way, as we feel that it does not have any major effect on our results. Nevertheless, it is important that the reader is aware of that our IC Multiplier is just an approximation, and that it has some limitations.

## 6.2 Initial approach to Human vs. Structural capital

As implied by the IC Multiplier discussion in *chapter 3*, all companies need a large proportion of SC in order to fully use its HC, i.e. to utilize the full potential of its employees. As shown in *figure 6.1*, a quick look at the SC/HC-ratio clearly shows that this is not the case for the selected companies in this study.

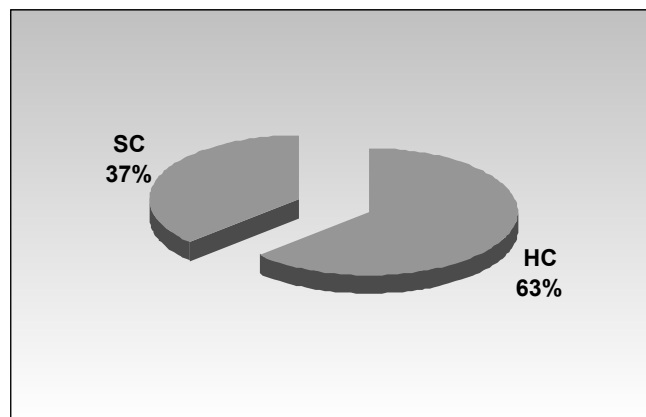


FIGURE 6.1 AVERAGE PROPORTIONS OF STRUCTURAL AND HUMAN CAPITAL

Using our approximation in calculating the HC- and SC-ratios shows that the HC, in average, accounts for 63 percent of the total IC value. This HC-value must be seen as surprisingly high. As implied by the term IC Multiplier the SC-ratio should be at least equal to the HC-ratio. Otherwise an erosion rather than an multiplication of the HC occurs.

Since HC is the only capital that a company cannot own, this high HC-ratio implies a large risk for the companies. A company's employees are, for a number of reasons, always at risk of leaving the company, and with this high ratio of HC, the consequences of a large loss of employees might be disastrous for the company's value. The process of transforming HC into SC is therefore of great importance. A larger amount of SC also

makes a company more enduring, with a value that becomes more stable over time. This will furthermore make the company stock less volatile.

With the diverse aspects of our four industry sectors, one might expect the SC/HC-ratio to differ between sectors. For instance are the companies in the IT consulting and services sector commonly known to have a large degree of HC, sometimes even up to 90 percent of total IC value. (Edvinsson, 2002) As presented in *table 6.1*, the difference between the industry sectors also proves to be evident, although the outcome does not completely correlate with our thoughts.

	<b>Industrials</b>	<b>Real estate and construction</b>	<b>Life science</b>	<b>IT consulting and services</b>
<b>Structural Capital</b>	0,32	0,64	0,31	0,21
<b>Human Capital</b>	0,68	0,36	0,69	0,79
<b>IC Multiplier<sup>18</sup></b>	0,53	6,04	0,62	0,15

TABLE 6.1 AVERAGE PROPORTIONS BY INDUSTRY SECTOR

As suspected, IT consulting and services, with focus on man-hours, does in fact show the highest HC-ratio, with HC almost four times as large as SC. At these companies, when the employees go home at night, so does most of the company value. The process of transforming HC into SC is therefore of utter importance for these companies. An average IC Multiplier value of 0,15 further strengthens the previous statement, as there in this sector lays a major erosion in the value created by the HC. A larger amount of SC would probably also stabilize these companies' stocks, thus halting the volatility that historically has characterized the IT stocks.

Notable regarding the discussion above is that our approximation of HC has its largest amount of questionable data within the IT consulting and services industry sector. This therefore means that our approximated IC Multiplier, for this sector, might get a lower value than is correct. In the report "IC Multiplier and the importance of structural capital" (Åberg, 2002), a more deepened examination of the IC Multiplier is performed on 43 Swedish companies, with 38 in the IT and communications sector. In the report an average HC-ratio of 52 percent is presented, thus showing that our values regarding the IT consulting and services might be questionable. On the other hand it is stated in the report that most companies with high SC-ratios are not situated in the IT and communications sector. As we nor do include communications companies, it is reasonable to say that although a bit to high, our approximation of the HC-ratio can be seen as fairly correct.

Life science, with the second highest HC-ratio, does also correspond with our expectations. With focus on research and development, a lot of value obviously lies in the

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<sup>18</sup> Calculated by an average of the IC multiplier value for each company, not by dividing the average SC with the average HC.

tacit knowledge of the employees. But with an average IC Multiplier of below 1, this tacit knowledge is still not used to its full potential.

More surprising is the high HC-ratio in the Industrial companies. As most people picture industrials, they probably think of companies with large machine parks and a high degree of automation, thus limiting the importance of HC. But possibly these companies high HC-ratio might be explained by the knowledge of highly educated engineers. Our conclusion is nevertheless that an IC Multiplier of 0,53 still is unpredictably low, as it is even lower than the value for Life science. Our previous thought that the non-existing correlation between VA/e and SEV/e for Industrials could be explained by the SC/HC-ratio, cannot be strengthened by this examination.

As the above mentioned three industry sectors show quite similar values, the Real estate and construction companies tell a completely different story. With an average HC-ratio of only 0,36, the relationship between SC and HC is almost the opposite of the other sectors. The average IC Multiplier for this industry sector, at 6,04, does also show an extremely high value. This value can probably to a large extent be explained by the large amount of financial capital, residing in the real estate companies. It is also interesting to notice the difference in IC Multiplier between the real estate segment and the construction segment of this sector, where the average value for the construction companies, at 0,52, more resembles the Industrials.

When dividing the companies by size, presented in *table 6.2*, the average SC and the average HC are quite similar for all three segments. They do also, logically, resemble the ratios for all companies, with HC about twice the size of SC. However, more interesting is the difference in IC Multiplier, although the most probable explanation for this change in value is the low amount of employees in the real estate portion of the small companies.

	Large	Medium sized	Small
<b>Structural Capital</b>	0,34	0,38	0,38
<b>Human Capital</b>	0,66	0,62	0,62
<b>IC multiplier</b>	0,64	1,86	3,10

TABLE 6.2 AVERAGE PROPORTIONS BY COMPANY SIZE

When looking at the companies divided by age, as in *table 6.3*, the results are rather similar to those above. All three segments show HC and SC ratios in the vicinity of the ones for all companies, although there is a difference between the Young and Medium aged companies. Notable is also that all three segments have IC Multipliers above 1. One thought, presented previously in *chapter 5* would be that the Old companies would have a larger SC-ratio because of stronger customer relations and a larger amount of patents, but the IC Multiplier implies that this is not the case.

	Old	Medium aged	Young
<b>Structural Capital</b>	0,39	0,42	0,31
<b>Human Capital</b>	0,61	0,58	0,69
<b>IC multiplier</b>	1,33	2,80	1,25

TABLE 6.3 AVERAGE PROPORTIONS BY COMPANY AGE

### 6.3 All selected companies

Our examination of the relationship between IC Multiplier and VA/e is also conducted using regression analyzes. Our first regression is made comparing all companies and all years, presented in *figure 6.2*.

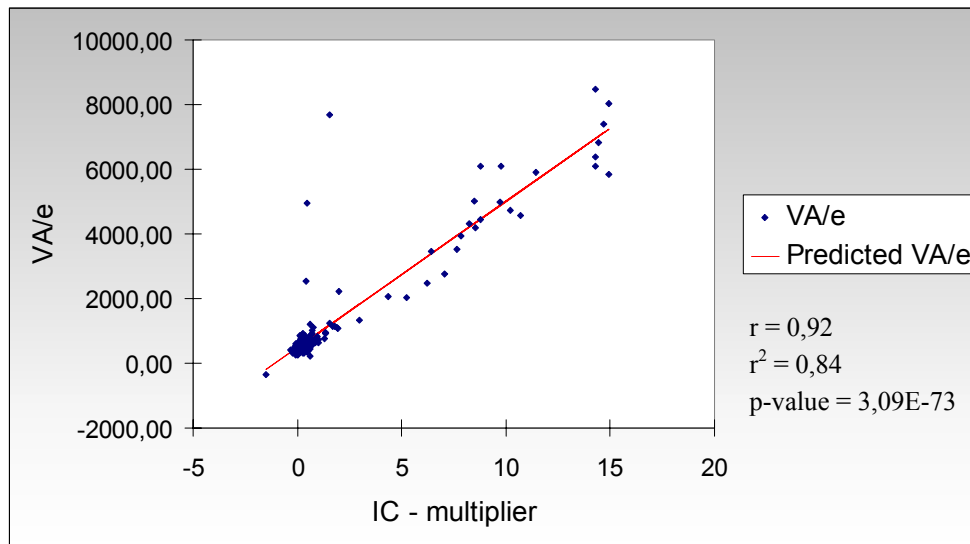


FIGURE 6.2, REGRESSION PLOT, ALL COMPANIES

The regression plot undoubtedly proves that there is a significant, even at 99 percent, relationship between VA/e and IC Multiplier. The correlation coefficient of 0,92 and an 84 percent degree of determination also show that the correlation in this regression is very strong.

However, the regression presented in *figure 5.5* was highly influenced by the Real estate and construction sector, which also represents the values to the far right in this regression. Therefore we think it is appropriate to examine this regression by excluding that sector once again. This regression plot is presented in *figure 6.3*



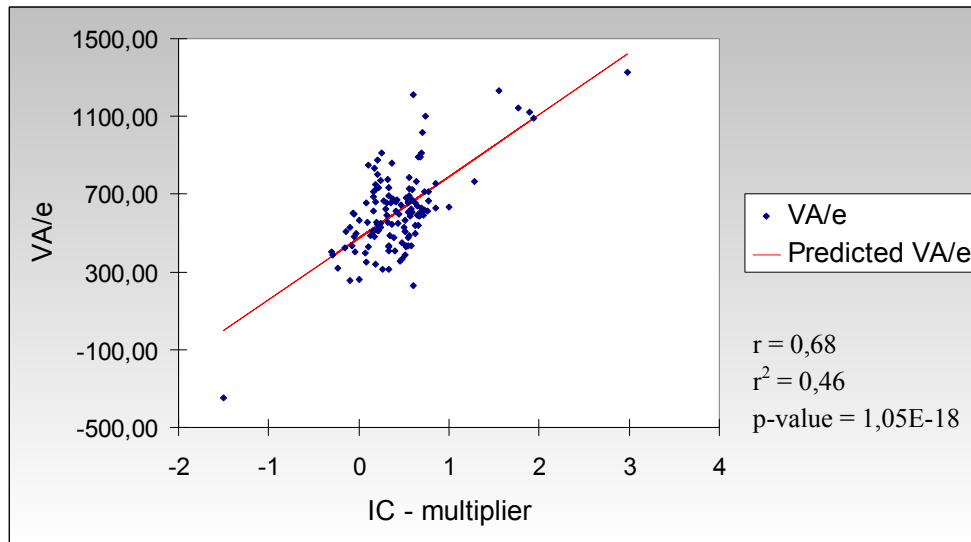


FIGURE 6.3 REGRESSION PLOT, ALL SELECTED COMPANIES, REAL ESTATE AND CONSTRUCTION EXCLUDED

When examining this regression it is clear that the Real estate and construction industry sector, once again, has a major impact on the sought correlation. The correlation coefficient drops to 0,68 percent and the determination coefficient to 46. These values are, nevertheless, still strong and there is a clear proven significance. Consequently it is clear that the IC Multiplier has a big impact on the VA/e. This further enlightens the use of the SC/HC-ratio as a tool for improving value added and consequently also stock exchange value.

Next, a comparison between the regressions of the four industry sectors will be presented, in order to examine how this effects the correlations. When the regression with companies divided by industry sector was made regarding VA/e and SEV/e, see *paragraph 5.2.2*, no statistical significance could be proven. One might therefore ask oneself if the same is going to occur this time.

## 6.4 Industry sectors

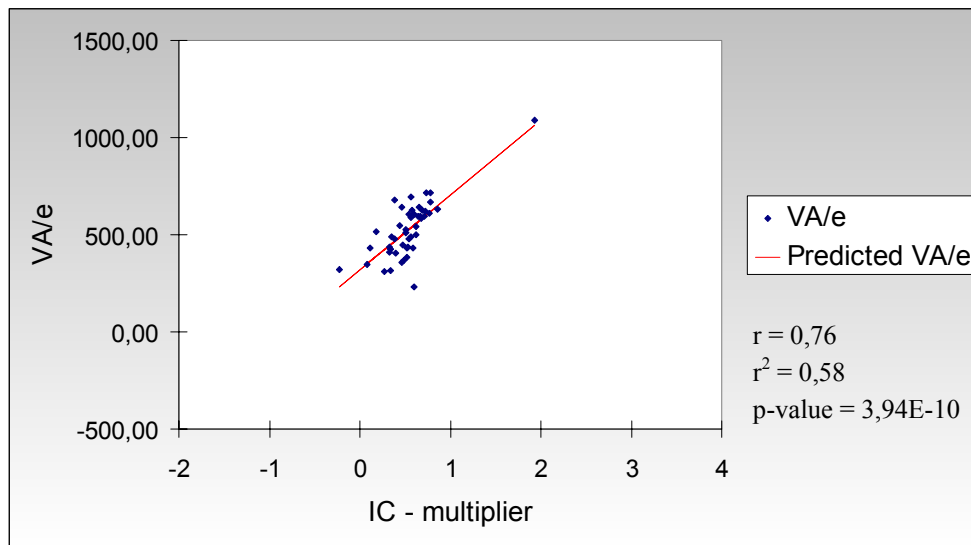


FIGURE 6.4 REGRESSION PLOT, INDUSTRIALS

When examining the regression plot of the Industrials, presented in *figure 6.4*, it is clear that there still is a linear pattern. The correlation coefficient at 0,76 and the degree of determination of 58 percent is, however, lower than in the same regression for all companies. Although the correlation proves to be stronger than we expected, there is still an apparent difference compared to the regression for all companies.

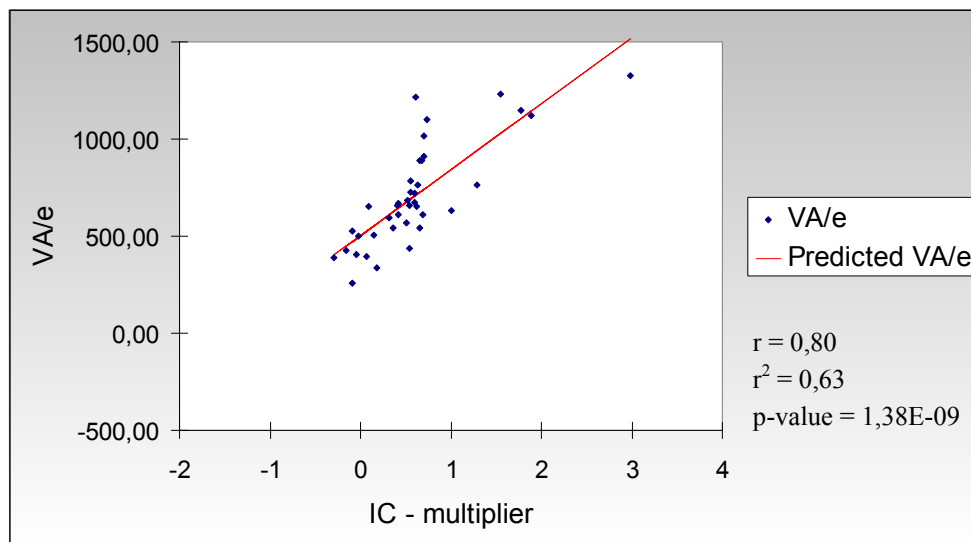


FIGURE 6.5 REGRESSION PLOT, LIFE SCIENCE

The regression for the Life science sector, presented in *figure 6.5*, show similar values as the Industrial sector did in the previous regression. The statistical significance is unquestionable, and with an  $r$ -value of 0,80 and a  $r^2$ -value of 63 percent the correlation is still strong.

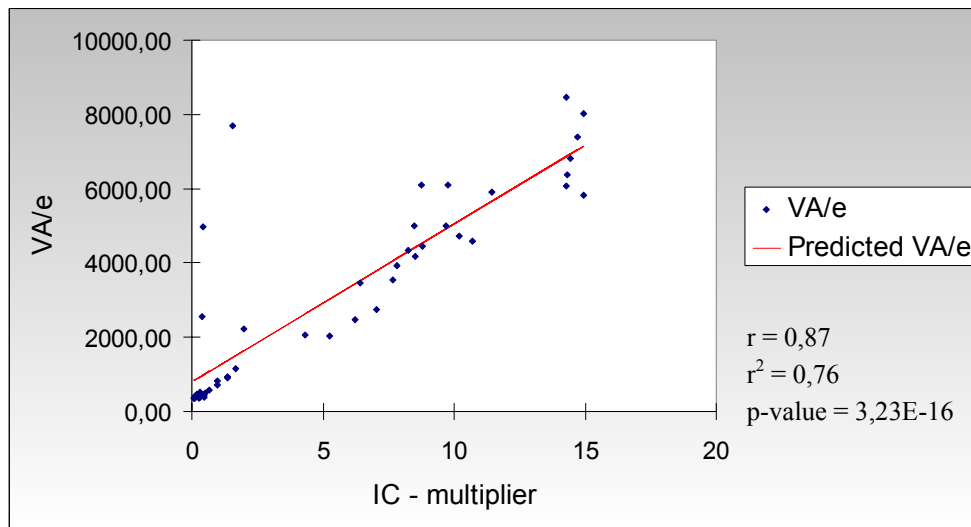


FIGURE 6.6 REGRESSION PLOT, REAL ESTATE AND CONSTRUCTION

When observing the regression plot for the Real estate and construction sector, visualized in *figure 6.6*, it is clear that there is a linear pattern. The only disturbances are a few units with low IC Multiplier and high VA/e. The VA/e can, nevertheless, to a degree of 76 percent be explained by the IC Multiplier, and the correlation is 0,87.

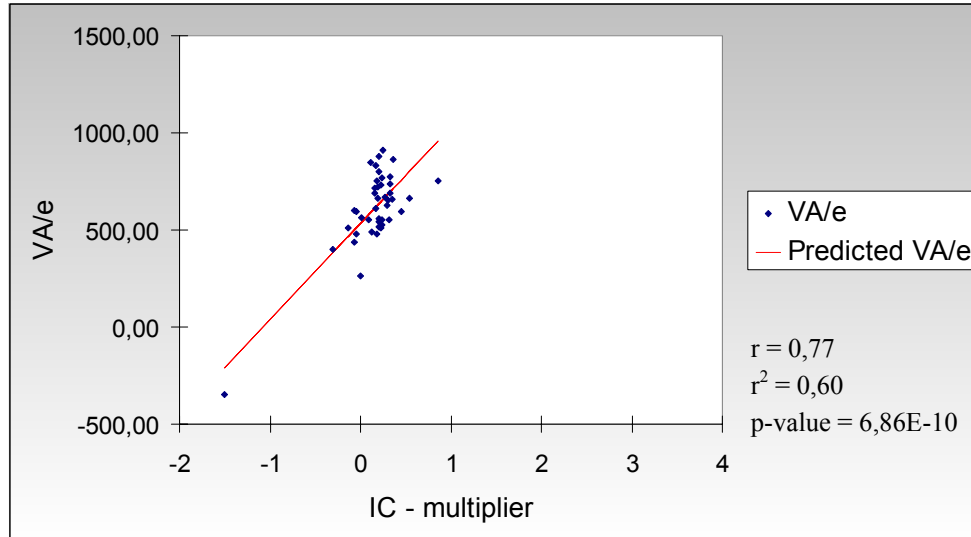


FIGURE 6.7 REGRESSION PLOT, IT CONSULTING AND SERVICES

Similar to the other sectors, IT consulting and services, presented in *figure 6.7*, also show a significant pattern, and fairly high values for both  $r$  and  $r^2$ . When visually comparing the regression plot with the other industry sectors, it shows that IT consulting and services have most similarities with the Industrials sector. This is also proved by the very similar determination and correlation coefficients.

In conclusion, there is still a clear linear pattern when dividing the companies into industry sectors. The degree of explanation and the correlation coefficients are, however, much lower than in the regression for all companies. Next, we will examine if the linear pattern and correlation becomes stronger when the companies instead are divided depending on size.

## 6.5 Company size

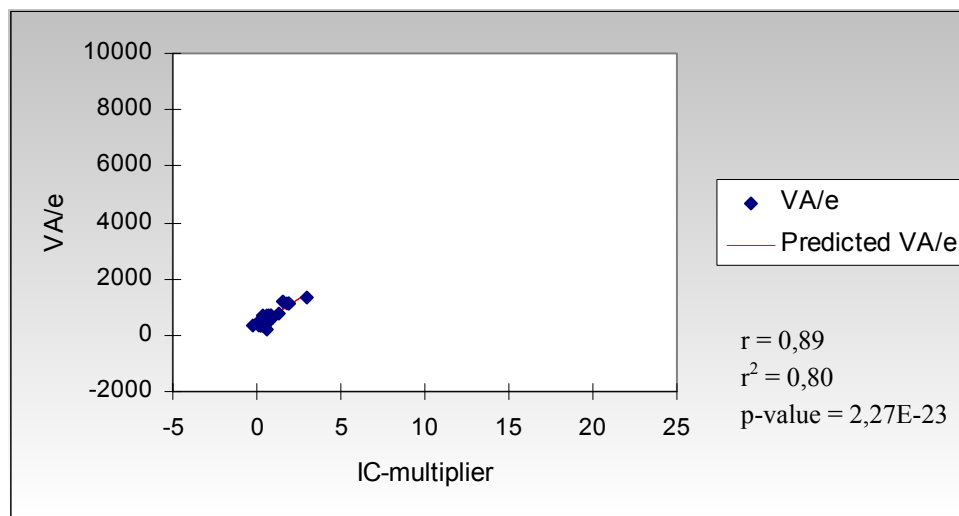


FIGURE 6.8 REGRESSION PLOT, LARGE COMPANIES

The regression of the Large companies, visualized in *figure 6.8*, demonstrate a high significance with a strong correlation coefficient at 0,89 and a determination coefficient of 80 percent.

The strong correlation that exists when examining the Large companies becomes even stronger in the regression for the Medium sized companies, illustrated in *figure 6.9*.

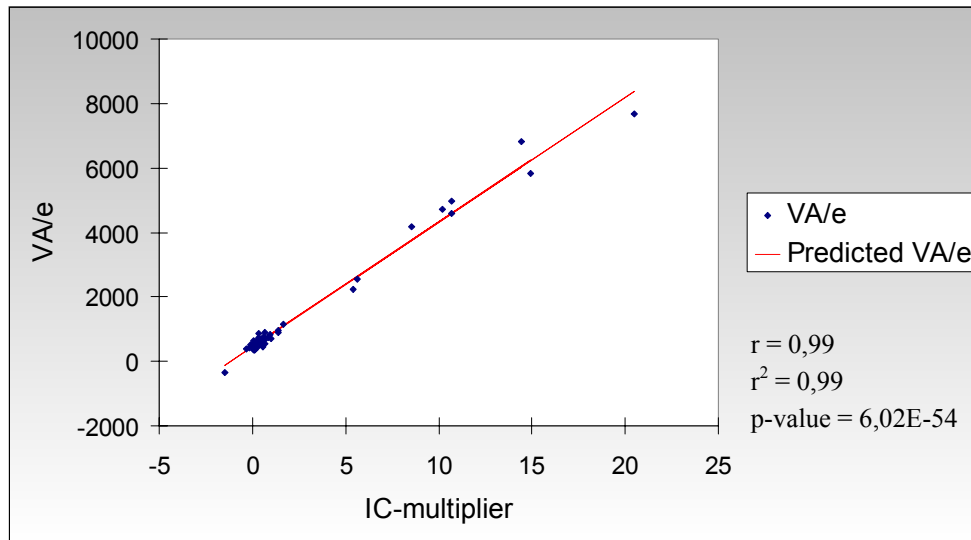


FIGURE 6.9 REGRESSION PLOT, MEDIUM SIZED COMPANIES

This regression plot has a definite linear pattern, which is also strengthened by an extremely strong correlation coefficient of 0,99 and a degree of determination of 99 percent. This means that the IC Multiplier can forecast the VA/e to a degree of 99 percent.

Lastly, we examine if this strong correlation continues when investigating the Small companies, presented in *figure 6.10*.

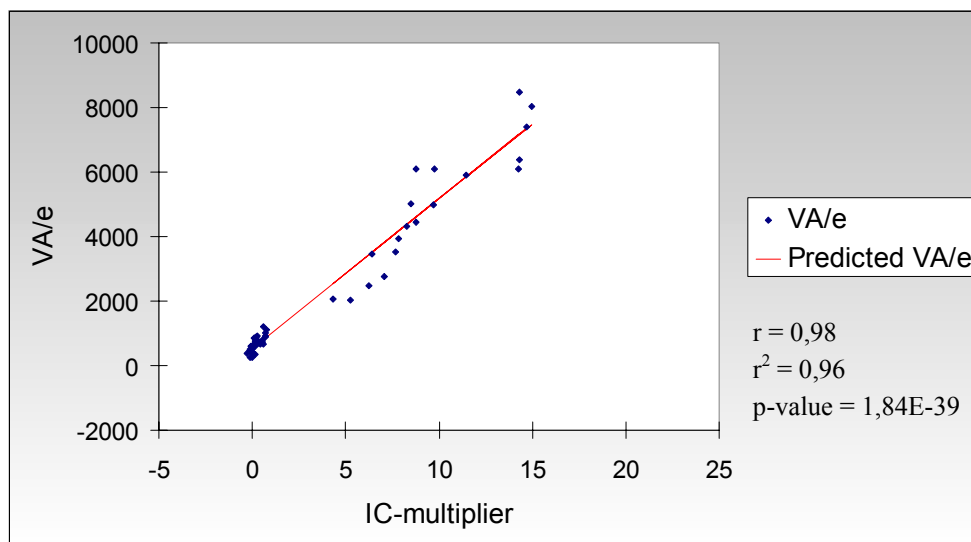


FIGURE 6.10 REGRESSION PLOT, SMALL COMPANIES

The regression plot for the Small companies also proves to have a very high degree of determination and correlation. When visually examining the regression, it becomes clear that the linear pattern is somewhat weaker than the Medium sized companies but it is, nonetheless, still very strong.

What can be said is that the correlation between IC Multiplier and VA/e, when dividing companies according to size, is generally extremely strong. With the lowest degree of determination at 80 percent, for the Large companies, the hypothesis does not only prove to be correct, but the relationship between IC Multiplier and VA/e is exceptionally strong.

## 6.6 Company age

The next question is if the strong correlation observed previously when dividing the companies depending on size still will exist when they are divided by age or will if it will become weaker? The regression plot for the Old companies is presented first in *figure 6.11*.

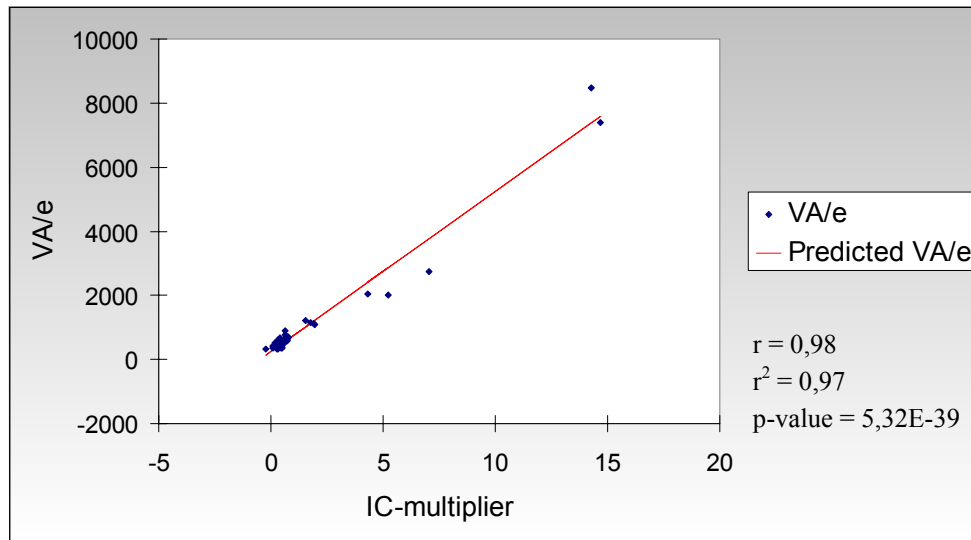


FIGURE 6.11 REGRESSION PLOT, OLD COMPANIES

This regression plot also proves to have a high degree of the correlation coefficient of 0,98 and a determination degree of 97 percent. This regression has, however, a few measurement points to the far right, just as the regression of Old companies in *figure 5.13* had. The retraction of this data had a rather big impact on the strength of that correlation which is why we have chosen to do the same, in a descriptive purpose, with this regression of Old companies. This regression is presented in *Appendix 11, figure A11.3*.

This retraction of Hufvudstaden AB lowers the correlation coefficient to 0,89 and the determination coefficient to 79 percent. The outcome was thereby not quite what we expected and the regression still demonstrates a strong correlation.

Does this outcome also apply to the Medium aged companies? This regression is visualized in *figure 6.12*.

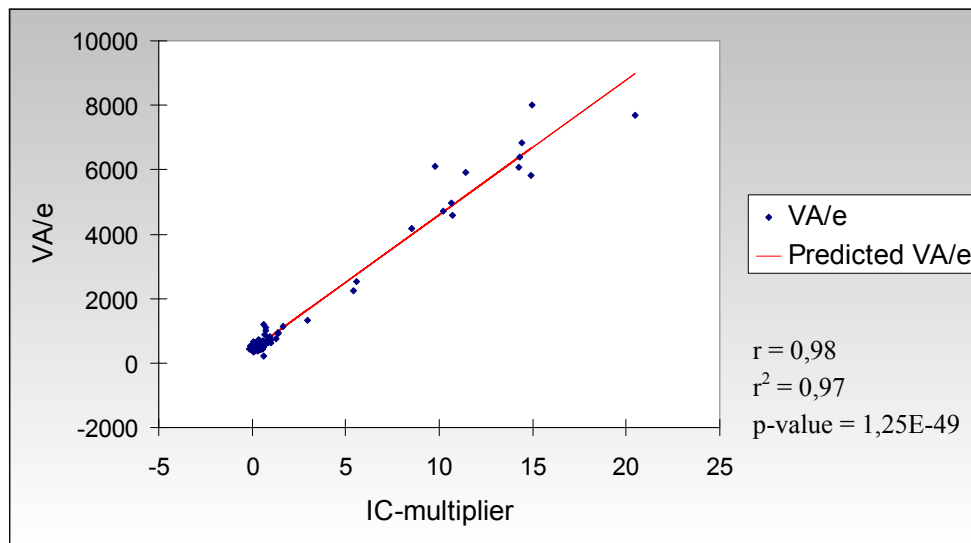


FIGURE 6.12 REGRESSION PLOT, MEDIUM AGE COMPANIES

The above regression proves to have almost the exact same determination and correlation coefficients as the regression for the Old companies, and also shows an extremely strong correlation.

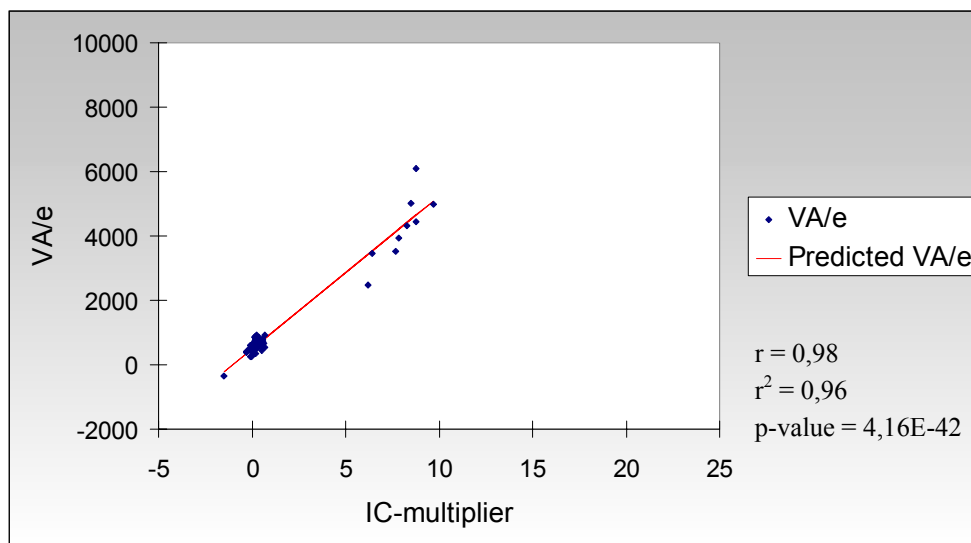


FIGURE 6.13 REGRESSION PLOT, YOUNG COMPANIES

The regression plot of the Young companies demonstrates nearly the same strength and correlation as the previous two regressions divided by company age.

Thus, the three regressions clearly state that the correlation between VA/e and IC Multiplier is most apparent when dividing the companies into groups depending on age, as in the previous chapter concerning the correlation of VA/e and SEV/e. With the lowest

degree of determination at 96 percent, these regressions show an almost perfect correlation between IC Multiplier and VA/e.

In the same way as for the regressions between VA/e and SEV/e, the *regression lines* for the IC Multiplier and VA/e can be calculated. These are presented in *Figure 6.14*. As can be seen the effect of an increase in IC Multiplier has a major effect on VA/e, for all industry sectors. For instance, an improvement of IC Multiplier by 0,1 in IT consulting and services, leads to an increase in VA/e of almost 50. The slope of the regression lines is an illustrative example of the “springboard effect”.

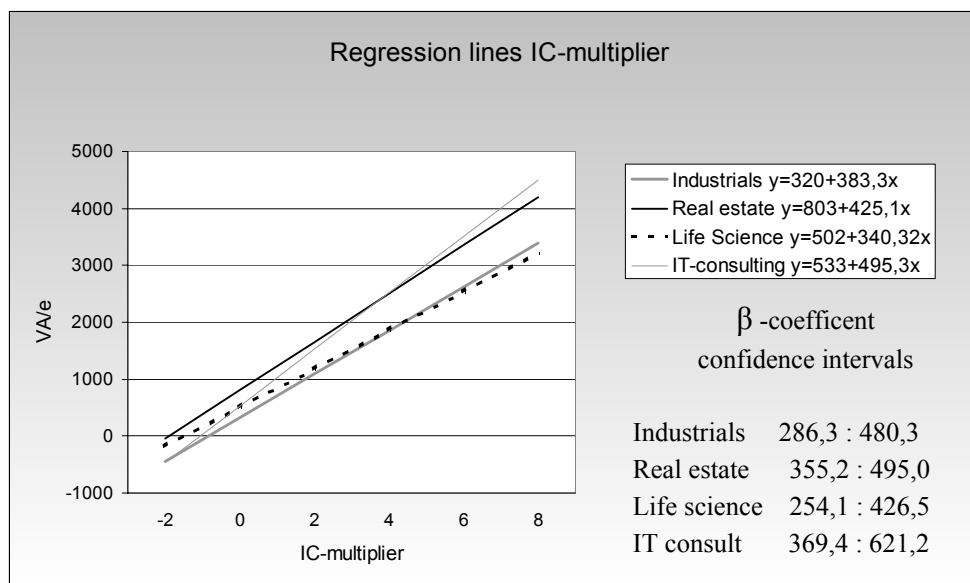


FIGURE 6.14 REGRESSION LINES, INDUSTRY SECTORS

## 6.7 The relationship of IC Multiplier and Market value

*Hypothesis 5: There is a linear pattern between companies' IC Multiplier and their value added per employee.*

As the regression analyzes clearly prove, our fifth hypothesis turns out to be correct. There is a linear pattern between IC Multiplier and VA/e. Furthermore, the correlation between these variables proves to be exceptionally strong, especially when dividing the companies by size or age. Thus stated the IC Multiplier is an excellent measurement in the quest to improve a companies' value added.



As also has been shown above, the companies belonging to the industry sectors Industrials, Life science and IT consulting and services, all have IC Multipliers below one. With this in mind it can be said that the observed companies in general do not use the minds of their employees to their full potential. Rather the low amount of SC does instead constrain most companies' employees. So, what does this mean? With the rising of the knowledge economy, the knowledge and potential of the workforce are in many companies the prime assets and the strategic success factor. As our findings demonstrate, Swedish companies do not seem to emphasize the importance of turning HC into SC. Thus, the employees' knowledge is at risk of being hollowed out by this simple fact. As more companies are increasingly becoming more knowledge intensified this is alarming. Furthermore SC can be reproduced and spread, and therefore can be used by anyone to increase his/hers HC, thus multiplying the IC value of the company.

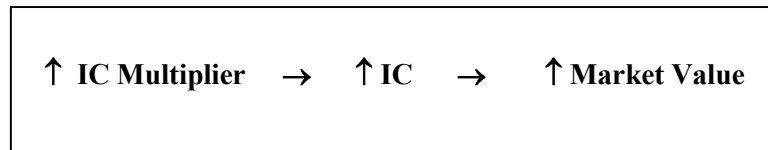
This is most evident regarding the IT consulting and services sector, with an average IC Multiplier of 0,15. This low value is possibly the reason to why the IT stocks have fluctuated heavily during the last few years, thus raising the rhetorical question; shall consulting companies really be on the stock market. As the SC/HC-ratio for these companies looks today, the amount of risk regarding these companies value is tremendous. As a result, if the IT consulting and services companies do not improve their IC Multiplier, the stocks for these companies will most certainly keep its high volatility, and should probably not be listed on the stock exchange. But if the consulting companies' SC-ratio improves, thus making them more enduring and less risky, their existence on the stock market is more justified.

Of course for the IT consulting and services companies, working with the IC Multiplier is not only about being listed or not. It is fore and foremost about raising the value of the company. If the "average" company in this sector managed to raise its IC Multiplier, the effect can be read from the regression lines. An increase of IC Multiplier from 0,15 to 1 leads to an increase in VA/e by SEK 371 000, which in turn will increase SEV/e with more than SEK 1 000 000. As the Swedish IT companies are among the leading in comparison to other IT companies throughout the world, the potential lying in the "packaging effect" of SC is obviously enormous.

The calculations presented above are of course only an approximation, but the pattern is clear, and furthermore applicable on all four industry sectors. The same calculation, i.e. raising the IC Multiplier to 1, would for the "average" Life science company mean an increase in VA/e of SEK 129 000, and consequently a tremendous increase in SEV/e of over SEK 1 400 000.

With this in mind a more general statement can be made, not only regarding the companies in our study, but to all Swedish companies and possibly in addition most foreign companies. By working with and increasing their IC Multiplier companies can

raise their intellectual capital, and according to our findings, consequently increase their market value. This relationship between IC Multiplier and market value is visualized in *figure 6.15*.



*FIGURE 6.15 THE RELATIONSHIP BETWEEN IC MULTIPLIER AND MARKET VALUE*

## 7 Emerging insights

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*In this final chapter we present the insights that have emerged among the authors during the work of this thesis. We first present the conclusions that have been drawn from the results and analysis of the five hypotheses. Thereafter the contribution of the study is discussed; in this part we also include some short interviews that have been made to place the results of this thesis in a practical context. We then provide the reader with some suggestions for future research and finish with some hints for the practitioner.*

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The purpose of this thesis has been to visualize whether there is a correlation between the intellectual capital and the market value among Swedish companies, listed on the Stockholm stock exchange. The purpose was furthermore to enlighten if there are factors that might alter the strength of this correlation. By using these results the aim has been to further examine IC Multiplier as a possible indicator for leveraging the efficiency of intellectual capital. We consider this purpose to be fulfilled since we have defined various hypotheses derived from the purpose, and thoroughly tested them in a statistical manner. In addition we have discussed and analyzed the results of these tests.

*Hypothesis 1: There is a linear pattern between companies' value added per employee and their stock exchange value per employee when comparing all the selected companies.*

Our first hypothesis proves that there, in general, is a correlation between companies' value added and their stock exchange value, i.e., according to our approximation, between intellectual capital and market value. The correlation is also significant, and fairly strong, over the entire examined period. What this strong correlation further implies is that most company's perceived value, in today's knowledge economy, is related to the company's intellectual capital.

*Hypothesis 2: There is a linear pattern between companies' value added per employee and their stock exchange value per employee when comparing companies by industry sector.*

The second hypothesis proves, in contrast with our expectations, to be incorrect. We have drawn this conclusion due to the fact that two sectors, Industrials and IT consulting and services, do not show statistical significance. An interesting observation in our findings is, however, the results of the *Industrials* sector. This is the only sector which does not show any significance without outliers. We believe that this is caused by a larger degree of tangible assets than intangible assets, which would mean that the investors/financial

market values and buys Industrials' stocks on substance instead of results. Since the chosen approximate measure is partly based on results, this affects the correlation between intellectual capital and market value. The *Life science* sector shows, although significant, weak correlations, which we believe is caused by the R&D having a large proportion of the companies' business operations. Since the R&D does not contribute to the value added, but have an influence on the market value, we believe the market value at this point is highly influenced by the potential for future profits. This is the main reason for the weak correlation. The *Real estate and construction* sector shows a strong correlation, which we believe is caused by the spread of the companies in two sub-sectors. The IT consulting and services sector is very interesting because the employees comprise almost the entire value of the company. The sector also differs from the others because it is focused on man-hours. The value added can therefore be traced almost solely to the employees. Although the test on this sector proved to be incorrect, we believe that this missing significance is highly affected by the "IT-Boom".

*Hypothesis 3: There is a linear pattern between companies' value added per employee and their stock exchange value per employee when comparing companies divided by company size.*

When testing the third hypothesis, we proved that there in fact is a linear pattern between the intellectual capital and the market value when dividing the companies into size segments. Our findings, however, also prove that there is no identifiable size pattern, i.e. the correlation is not stronger within the larger companies, compared to the correlation of the medium or small companies.

*Hypothesis 4: There is a linear pattern between companies' value added per employee and their stock exchange value per employee value when comparing companies divided by company age.*

Our study further proves, regarding the fourth hypothesis, that there also is a clear pattern between the intellectual capital and the market value of the companies, when they are divided into segments according to age. What is most interesting about these results is that there in fact is a pattern which proves that the older a company gets, the clearer the correlation becomes between companies' intellectual capital and their market value, i.e. the sought pattern becomes more legible over time. We believe that this observed fact originates from that the investors/financial markets knowledge of the companies' intellectual capital increases over time.

What we have found is also that the relationship between intellectual capital and market value differs largely between companies. An improvement of the intellectual capital in the Life science sector proves, in comparison with the other sectors, to have three times the effect on the market value. There are also differences between the other three industry

sectors. The worst leverage effect resides in the Industrials sector and the second worst in the IT consulting and services sector. Notable with the Industrials and IT consulting and services sectors are that an increase in intellectual capital does not surely raise the market value. This is most evident for the IT consulting and services sector, thus this sector is presenting the greatest risk for the investor/financial market. This sector might, however, also provide high payoffs, according to our study topped only by the Life science companies.

*Hypothesis 5: There is a linear pattern between companies' IC Multiplier and their value added per employee.*

The fifth hypothesis has been proven to be correct in our study, i.e. there is, according to our approximations, a correlation between the IC Multiplier and the intellectual capital. Our findings further show strong correlations, especially concerning companies divided by size and age. However, the results also prove that most companies do not have enough structural capital to support the individuals, i.e. the human capital. The conclusion can therefore be drawn that Swedish companies in general cannot exploit the value of its employees' brains to their full potential. In fact the low amount of structural capital that exists within companies constrains the employees, i.e. the employees' knowledge is being hollowed out. This is something we consider alarming since the knowledge intensity is increasing within the companies and in the whole economy of today.

The low structural capital ratio makes the companies risky for the investors. This is most evident in the IT consulting and services sector but can, of course, be found in all knowledge intensive companies. In order for these companies to lower the volatility of their stocks and make them more attractive for investors, the IC Multiplier must be improved. This would also provide them with an argument in the debate concerning the consulting companies be or not to be on the public stock market, which has begun to flourish in the wake of the IT recession. Improving the SC/HC-ratio is although, according to the results we have obtained, not something that only is applicable on the IT companies. On the contrary, our findings prove that these types of calculations are applicable on all four industry sectors.

Our study also indicates that there seem to be a relationship between the IC Multiplier and market value. The reason for this is that the IC Multiplier affects the intellectual capital, which in turn affects the market value. The leverage effect regarding these both relationships means that a small improvement of the SC/HC-ratio dramatically can affect the market value.

## 7.1 Contribution of the study

As this study is performed on 40 Swedish companies, listed on the Stockholm stock exchange, the degree of generalization must be considered fairly high. The industry sectors chosen provide a broad spectrum of companies, thus making it possible to assume that the same statistical patterns could be identified on most listed Swedish companies.

Although thoroughly executed, the study has some weaknesses. The industry sectors that we have chosen may have caused misleading results. The real estate and construction sector has, as we have mentioned, had big impact on the statistical analyzes. We have however, on some occasions chosen to exclude companies from this sector. By doing this we have highlighted the impact of these companies, as well as proven the pattern without them.

The study has been conducted on data gathered from the past five years. This time span has been characterized by turbulence on the stock market, especially regarding the IT consulting and services industry sector. This have had a disturbing effect on our results.

Another possible weakness is the calculation of the IC Multiplier. Our approximation of the IC Multiplier has some limitations in the way that companies showing a negative result might get a negative SC-ratio, consequently raising the HC-ratio to a value above one. Although the number of occasions when this phenomenon occurs is very limited. We therefore feel that this does not affect our results in a significant way.

Finally, we have in order to place the results of our study in a more practical context, discussed our findings and methods with two journalists, Björn Wilke from Dagens Industri and Nils-Olof Ollevik from Svenska Dagbladet, and two market analysts, Mats Dahlberg of Handelsbanken Securities and Jan Ihrfelt from Swedbank Markets. We emphasize that the respondents have not been given the opportunity to read the thesis. Therefore the respondents' answers and thoughts should perhaps merely be seen as interesting remarks, not findings.

The respondents' general thoughts were that intellectual capital is of utter importance for all companies, independent of industry sector. However, they were all skeptical on the possibility of measuring intellectual capital externally, as conducted in our study. This relates well to the two schools discussed in *chapter 3*. The majority of the respondents, were of the skeptical school, i.e. they were of the opinion that IC never can, nor should it be measured in monetary values.

Regarding the market analysts, they focus on a particular industry sector and therefore feel that they have extensive knowledge of this sector and the companies within the

sector. Valued added per employee is considered to be an adequate measure, but since the analysts have extensive knowledge of the companies they feel that a picture of the IC of the concerned companies have grown out of this extensive knowledge. For them, value added per employee, may therefore seem somewhat too superficial.

This raised the question regarding value added as an approximation of the return of intellectual capital. Nevertheless, although only proved theoretically, we consider the measure value added per employee to be an appropriate approximate measure for this kind of study. Although, it might not be an answer to the skeptical schools' questions, we however, definitely consider the measure and its correlation with market value and IC Multiplier to be a step in the right direction.

## **7.2 Suggestions for future research**

During the work of thesis some further suggestions for future research has come up:

- We would find it interesting to use data from all the companies listed on the Stockholm stock exchange. Thereby, the framework for industry sectors that this stock exchange provides could be used to its full extent in the study. This framework breaks down the companies into smaller sub-sectors, which could be very interesting considering the various comparisons that could be made. The large amount of companies would also increase the credibility of the study so that more generalizations could be made.
- Another idea that has come up is to use external reports/analyzes of each sector or to conduct such a report/analysis each sector in an in-depth manner. This would mean doing a qualitative study, in contrast to our quantitative approach. The aim would be to find the similar and deviating characteristics of each sector, or more precisely; analyze the context of each sector and thereby understanding why there are deviations and similarities in the intellectual capital of each sector. This could be followed up with in-depth interviews of analysts, journalists etc.
- A third alternative is to compare the results of this study and conduct a similar one, using the same industry sectors and number of companies, on another stock exchange, e.g. London stock exchange. The similarities and deviations between two different stock exchanges would, according to us, be of great interest.

### **7.3 Hints for the practitioner**

We have, based on the findings of this thesis, formulated some hints that could be used by the practitioner. With practitioner we mean employees within companies that have an interest to focus more on their IC and the development of their intellectual capital. The employees that we believe could be interested of these hints are primarily those who belong to Human Resource departments, such as for instance a Human Resource manager. However, we also believe that executives of both middle management and top management could be interested in these hints as well.

1. Use value added per employee as an approximate measure of the return of intellectual capital. The measure could be used as an internal performance measurement, thus creating consciousness within the organization that IC does matter. The measure could also be used as an external benchmark measurement, i.e. comparing results of competitors, partners and other companies.
2. Use the total cost of salary per employee to derive the approximate human capital component, and thereby also the structural capital component. In this way a HC/SC-ratio can be used to understand the structure of a company's IC.
3. Use the IC Multiplier as an approximate measure, thereby focusing on improving the SC/HC-ratio, i.e. increasing the degree of structural capital. This reduces the risk within the company and makes the company less sensitive to changes that could occur, e.g. a big proportion of the employees leaving the company etc.



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## Appendix 1 – selected companies within each industry sector

<i>Industrials</i>	<i>Revenue, 2000</i>
Assa Abloy	14394
Atlas Copco	46527
Avesta polaris	31861
Electrolux	124493
SAAB	17840
Sandvik	43750
SCANIA	53823
SKF	39848
SSAB	19271
Volvo	120392

### *Real estate and construction*

Castellum	1435
Hufvudstaden	1145
JM	6849
Lundbergföretagen	735
NCC	38728
Peab	15704
Skanska	108022
Tornet Fastighets	1969
Wallenstam Byggnads	756
Wihlborgs Fastigheter	2239

### *Life science*

AstraZeneca	172974
Biacore International	439
Elekta	1789
Feelgood Svenska	325
Gambro	22245
Getinge	5254
Meda	728
Nobel Biocare	2110
Perbio Science	1409
Q-Med	237

### *IT consulting and services*

Adcore	1295
Enea Data	869
Frontec	1128
Know IT	548
Modul 1 Data	452
Pro Act IT Group	671

Semcon	1007
Sigma	992
TurnIT	1550
WM-data	13125

## Appendix 2 – Six Trust data

231	Operating profit after depreciation
205	Depreciation according to plan
350	Total salaries including including social fees
355	Total salaries excluding including social fees
351	Total number of employees at year end
493	Stock exchange value at closure

### Industrials

Company	Var	1996	1997	1998	1999	2000
Assa Abloy	231	460300	707300	962800	1193400	1720200
	205	265000	461400	622900	667300	985500
	350	<b>1838398</b>	2457000	3012300	3576500	4617400
	355	1404500	1877100	2248800	2784300	3539600
	351	6317	8088	10545	12654	16881
	493	7942400	14853742	22104624	37571832	64851395
Atlas Copco	231	2931000	3813000	4345000	4470000	6392000
	205	771000	1451000	1876000	2616000	1567000
	350	6585000	7803000	8563000	9107000	10905000
	355	4947000	6031000	6593000	7089000	8792000
	351	21085	22296	23857	24249	26392
	493	30218900	43279300	32543792	52714948	41956027
AvestaPolarit	231		-160000	40000	-1154000	944000
	205		501000	556000	478000	401000
	350		<b>3113479</b>	3386000	2956000	2163000
	355		2125000	2311000	2283000	1641000
	351		8009	7726	7151	6494
	493		12087000	7900000	4977000	4060600
Electrolux	231	4377000	2687000	7052000	7215000	7621000
	205	4438000	4266000	4125000	3905000	3810000
	350	26423000	26068000	24294000	23130000	22099000
	355	20249000	19883000	18506000	17812000	17241000
	351	112140	105950	99322	92916	87128
	493	28856200	40278644	51135648	78177208	44800774
SAAB	231			810000	1103000	1525000
	205			773000	918000	1336000
	350			3401000	3587000	7534000
	355			2351000	2482000	5247000
	351			7742	8092	15356
	493			8995800	8729693	8250625
Sandvik	231	3937000	4070000	4599000	6050000	6327000



	205	1159000	1486000	2099000	2273000	2336000
	350	9356000	10928000	13286000	12825000	13331000
	355	7001000	8306000	10100000	9638000	10173000
	351	30249	32431	37963	35695	34306
	493	51343520	58405180	36217428	70106616	58723992
SCANIA	231	2757000	2762000	3279000	4719000	4727000
	205	1328000	1672000	1883000	1948000	2043000
	350	6548000	7370000	7788000	7797000	8829000
	355	4786000	5451000	5575000	5649000	6491000
	351	21342	22278	21836	22984	25456
	493	34000004	35649992	29749996	61100000	41500000
SKF	231	2874000	3004000	-888000	2520000	3667000
	205	1392000	1528000	2097000	1873000	1633000
	350	13066000	13708000	14497000	13068000	13608000
	355	9696000	10243000	10543000	9886000	10353000
	351	42451	41863	44958	40747	39557
	493	17833600	18567596	10634526	23564418	16221882
SSAB	231	1656000	1679000	1307000	517000	1942000
	205	750000	789000	880000	1077000	1131000
	350	3357000	3562000	3665000	3659000	3946000
	355		2540000	2575000	2567000	2686000
	351	9705	9630	9661	9595	9831
	493	14528000	16575997	8673333	14798362	9831052
Volvo	231	3710000	8418000	6679000	33249000	6154000
	205	5351000	6796000	9626000	5171000	6251000
	350	25997000	26950700	30064400	19832000	21509700
	355	18029300	19081900	21353500	14752200	15765100
	351	71905	71838	76628	53470	54264
	493	69391600	93463800	81196232	97134592	68890111

**Real estate and construction**

Company	Var	1996	1997	1998	1999	2000
Castellum	231		484000	592000	680000	891000
	205		119000	126000	135000	100000
	350		94000	87000	96000	113000
	355		64000	59000	64000	72000
	351		201	186	182	181
	493		3925000	4350000	4100000	4472174
Wallenstam	231	379400	394000	359900	470500	397800
	205	1300	29300	31500	33100	34100
	350	<b>26684</b>	29600	34200	33700	44200
	355	18300	20300	23500	22400	29200
	351	67	71	72	67	78
	493	1041163	927581	832930	899186	1160391
Hufvudstaden	231	390900	313200	456400	746800	738500
	205	57900	60800	139700	131700	116100
	350	85500	86300	84500	59800	59800
	355	61100	52700	57500	40800	39700

	351	264	224	247	127	108
	493	6487100	4012661	3995162	4969116	6549430
JM	231	667600	928100	685900	990000	1518000
	205	127500	125000	121000	134000	40000
	350	806700	769500	831900	825000	928000
	355	545000	498700	538400	553000	638000
	351	2221	1930	1993	2140	2163
	493	3918360	3836727	4055401	5451524	6947369
Lundbergföretagen	231	532000	2039900	1051900	1580700	923100
	205	8100	11400	115300	149700	5500
	350	<b>99951</b>	100100	208400	162100	2362400
	355	67200	67300	142000	109500	1705600
	351	286	280	541	381	5610
	493	7170700	8802123	7094814	8726244	9697518
NCC	231	866000	139000	1064000	1146000	2122000
	205	548000	651000	678000	1200000	1022000
	350	4523000	7171000	8564000	9114000	9681000
	355	3120000	5416000	6438000	6952000	7387000
	351	15964	20283	21645	24122	25192
	493	7211900	8959721	6574135	10735146	7294734
PEAB	231	159000	146000	215000	66000	713000
	205	103000	101000	152000	216000	216000
	350	<b>2442727</b>	2601000	2851000	3088000	3428000
	355	1744000	1857000	2089000	2249000	2455000
	351	7535	7966	8048	9153	9678
	493	1486540	1272202	1209974	1244545	2776486
Skanska	231	3345000	1529000	3692000	6244000	6891000
	205	1198000	1317000	1148000	1377000	1787000
	350	9955000	10776000	12326000	15048000	18504000
	355	7469000	8043000	9266000	11445000	14414000
	351	38245	37240	39246	45063	63368
	493	37777152	37002852	25332726	36092024	44403438
Tornet Fastighets	231	555000	791100	746700	875100	979500
	205	62100	136800	126600	150000	153000
	350	99200	121000	111400	116800	116800
	355	70300	85900	76200	79200	79400
	351	289	297	251	257	250
	493	2893079	3143442	3453092	3467849	4427041
Wihlborgs Fastigheter	231	310037	415700	1110900	1191500	1416000
	205	39963	58100	154100	191500	186000
	350	<b>23440</b>	44300	148200	135700	111000
	355	16138	30500	101600	91300	73000
	351	64	113	338	322	251
	493	1139535	1451086	2589623	2932827	4057540

**Life science**

Company	Var	1996	1997	1998	1999	2000
AstraZeneca	231	12222000	13544000	15243000		

	205	2366000	2721000	3435000		
	350	7718000	9170000	12023000		
	355	5870000	6865000	9043000		
	351	19851	22206	24958		
	493	206264896	224261424	271647680		
Biacore International	231		40863	52794	67639	77974
	205		13800	14573	17929	19408
	350		80510	96169	116153	159846
	355		60372	68998	85971	112719
	351		152	161	183	212
	493		672800	823875	760500	4192500
Feelgood Svenska	231		-3365	1348	-1895	-26016
	205		1276	5102	11314	17226
	350		22575	35718	131232	197026
	355		16549	26479	92354	135700
	351		80	125	355	467
	493		43560	41600	182383	219844
Elekta	231		-18000	-217000	-137000	-37000
	205		59000	125000	90000	79000
	350		<b>270285</b>	585000	504000	476000
	355		219000	474000	411000	382000
	351		614	1161	866	794
	493		2357000	766300	383200	607000
Gambro	231	4050000	14135000	5374000	2304000	204000
	205	1384000	1876000	2078000	2009000	2400000
	350	5423000	5364000	5783000	6265777	7191000
	355	4125000	4194000	4659000	5048120	5874000
	351	17145	16108	17332	17354	17999
	493	33845100	48787068	30110120	26193650	23358176
Getinge	231	536300	542400	668800	692200	720200
	205	116100	134800	149700	188200	195100
	350	<b>994849</b>	1325000	1318500	1624200	1756500
	355	792200	1055100	1042700	1302200	1417800
	351	3051	3530	3276	3816	3911
	493	6086498	5723124	5450594	4360477	5041801
Meda	231	32358	19700	-18700	-41000	43300
	205	13741	16300	16000	13900	9100
	350	<b>77459</b>	87300	103200	93500	75000
	355	59625	67200	77700	66100	54200
	351	184	187	202	171	140
	493	300700	261068	96692	298462	315729
Nobel Biocare	231	107572	112622	73759	219074	289607
	205	31539	42382	70396	111362	121558
	350	335945	368449	459527	519361	625051
	355	263326	283802	342901	438898	479684
	351	775	782	1016	1111	1164
	493	2198258	1838198	2711721	2990752	7294975
Perbio Science	231				92000	174900

	205				44800	80900
	350				250500	430700
	355				204300	353900
	351				890	952
	493				1338627	4639910
QMED	231				18240	33712
	205				6375	10584
	350				44500	79759
	355				31991	57896
	351				95	158
	493				1527935	4688573

**IT consulting and services**

Company	Var	1996	1997	1998	1999	2000
Adcore	231		20195	-66578	1768	-1459194
	205		7526	24872	30033	128942
	350		76520	137430	132765	885800
	355		53281	95921	97551	648867
	351		121	239	299	1275
	493		533900	206411	5078120	4201224
Pro Act IT Group	231		4021	7476	2453	10282
	205		2548	11036	15403	19745
	350		26174	56706	102884	146241
	355		17702	43432	77708	108708
	351		36	109	145	201
	493		138100	229133	622190	764095
Enea Data	231	16870	22966	23867	35394	17734
	205	6640	8920	11044	13911	45548
	350	<b>142019</b>	168271	222025	303080	571049
	355	98086	116217	154198	213651	432008
	351	270	303	373	493	748
	493	298019	484204	1063036	4110929	6551601
Frontec	231	-60543	-68213	-42439	-172688	-17921
	205	33345	45704	46096	59587	17537
	350	<b>380092</b>	445329	535640	809417	320794
	355	290005	339780	364068	599302	227687
	351	810	878	954	1368	1225
	493	2633499	1560446	833705	3011160	2535275
Semcon	231		50936	81892	84421	48877
	205		13745	16611	23229	31969
	350		290166	405909	499115	652712
	355		207181	285861	354354	462415
	351		695	955	1173	1504
	493		615500	1161681	1733852	2167315
Sigma	231	24407	51195	79853	112555	191130
	205	5981	13916	22241	43600	98340
	350	<b>134752</b>	316496	506759	891322	1399495
	355	95464	224219	359932	629200	1000716

	351	555	701	1096	2185	3290
	493		1017641	2154193	5966477	8161697
Modul 1 Data	231	11641	21766	48408	47935	-22749
	205	287	347	453	2968	8556
	350	<b>65349</b>	98981	150927	213342	298934
	355	43724	66227	99152	143129	196889
	351	103	165	258	343	477
	493	209100	532675	1001000	1671312	517071
TurnIT	231	4076	30733	57764	97322	94492
	205	1474	17399	34820	51796	84935
	350	<b>6488</b>	88274	207091	447510	657373
	355	4620	62854	157736	324304	484354
	351	16	206	503	811	1253
	493	145345	434015	1436589	3152693	1663577
WM-data	231	407570	535700	881600	955600	137200
	205	102523	139500	148700	221600	248100
	350	<b>1617999</b>	2305100	2948500	3845900	4336600
	355	1223800	1743500	2222400	2863500	3220600
	351	3840	4769	6068	7689	8520
	493	8702975	10583701	25150122	38794624	16299642
Know IT	231			17876	36309	-73040
	205			5601	20921	48052
	350			123364	278537	360060
	355			88422	195665	246890
	351			203	420	558
	493			396000	608500	731065

### Appendix 3 – correlation of average VA/e and SEV/e, by industry sectors

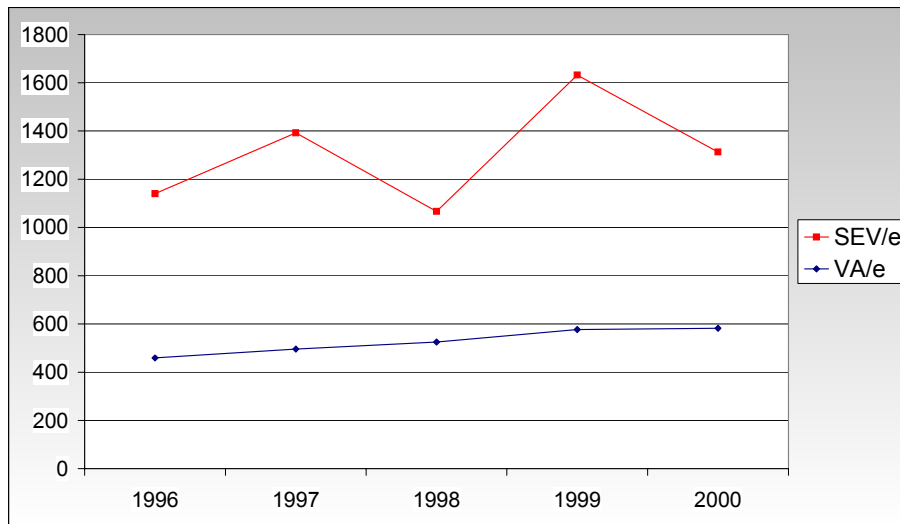


Figure A3.1 Average industrials

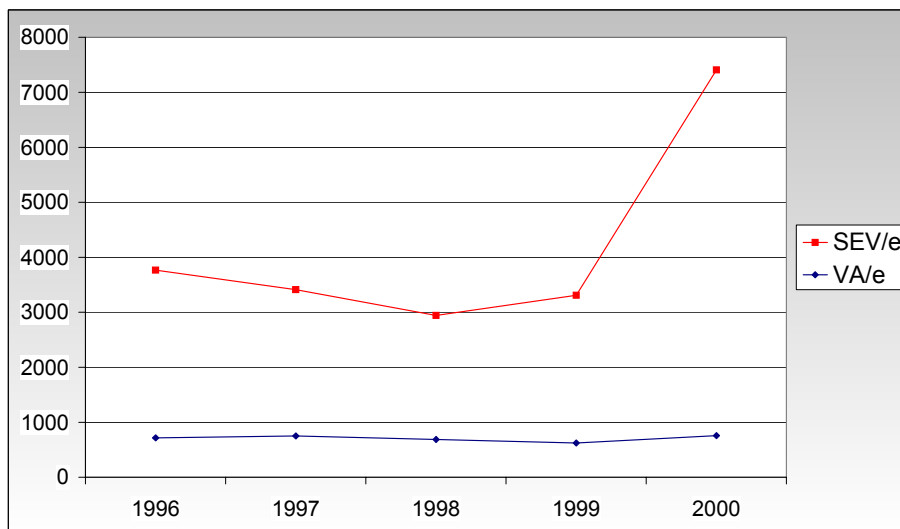


Figure A3.2 Average Life science

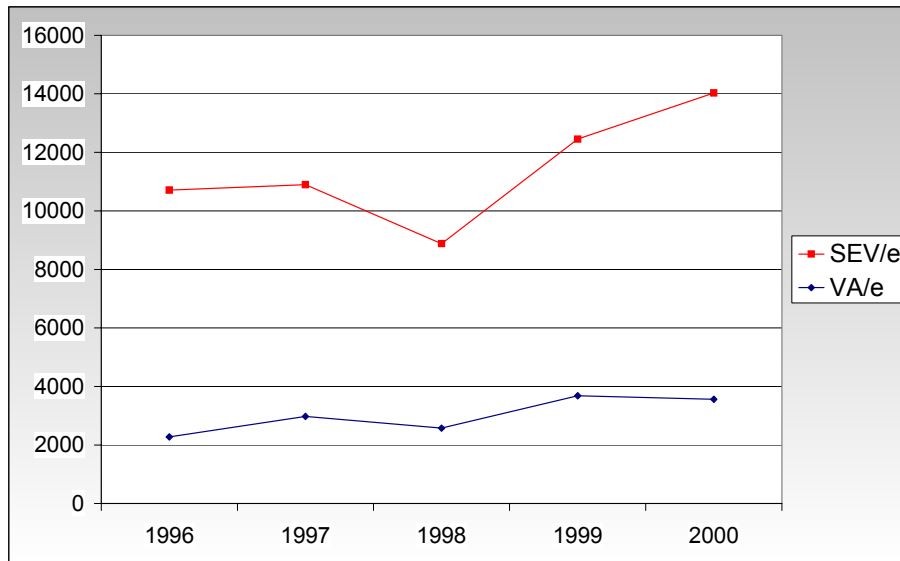


Figure A3.3 Average Real estate and construction

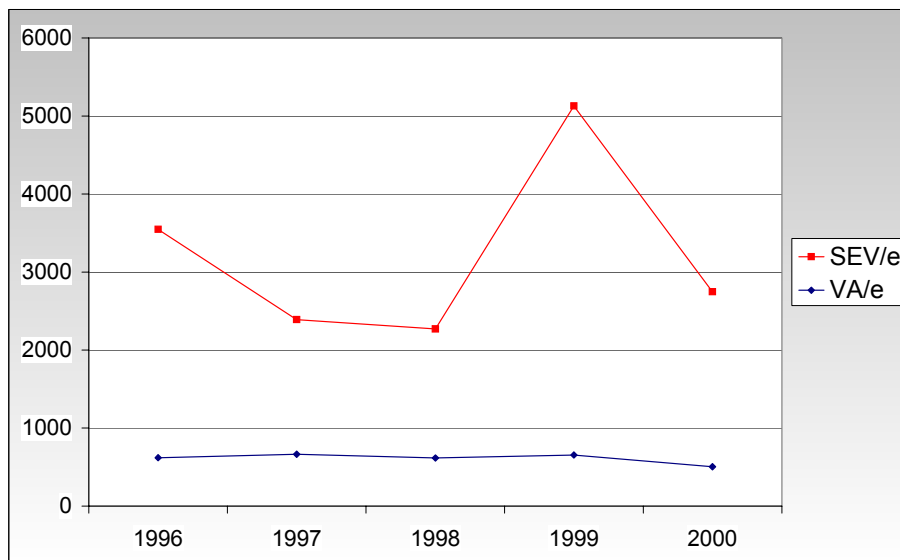


Figure A3.4 Average IT consulting and services

## Appendix 4 – regression plots, all companies, extraordinary cases

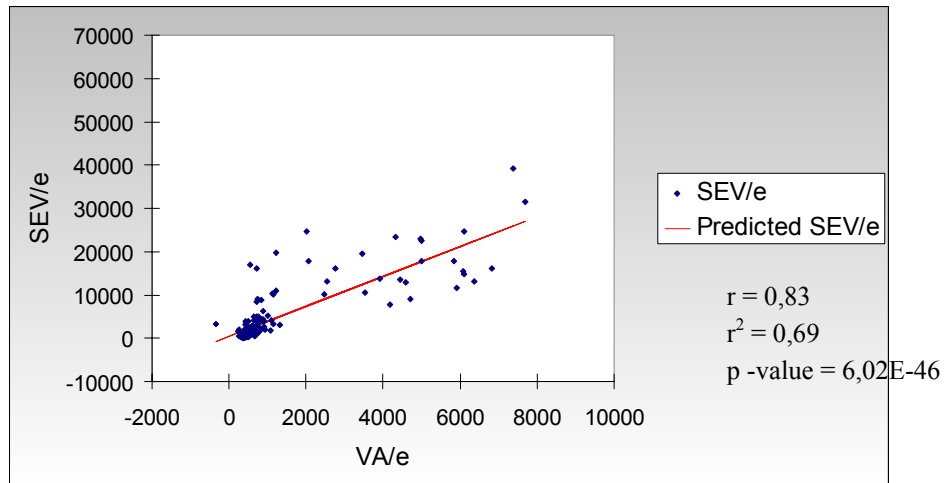


Figure A4.1 Regression plot, all companies, excluding outliers

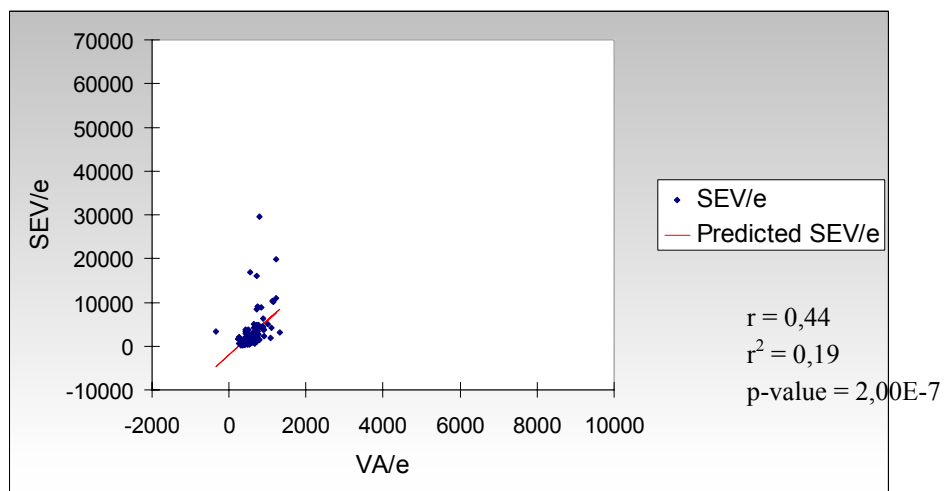


Figure A4.2 Regression plot, all companies, excluding Real estate and construction



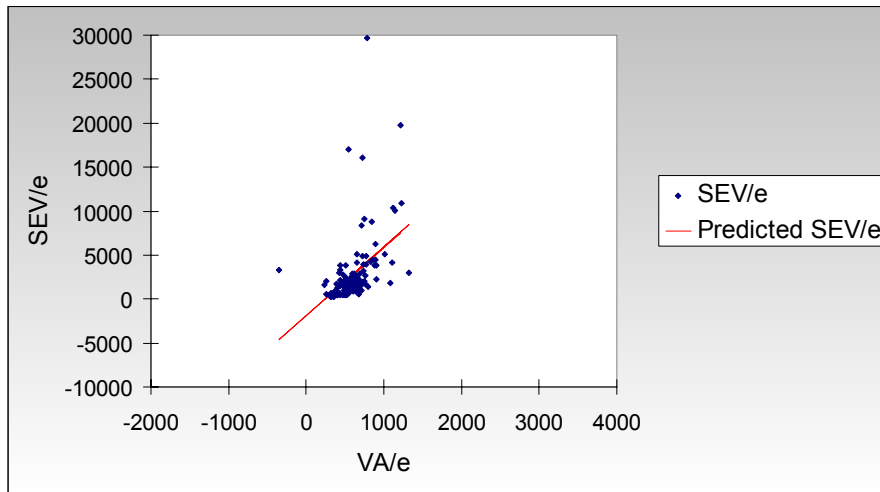


Figure A4.3 Regression plot, excluding Real estate and construction, scale -10000 to 30000

## Appendix 5 – regression plots, all companies, yearly 1996 – 2000

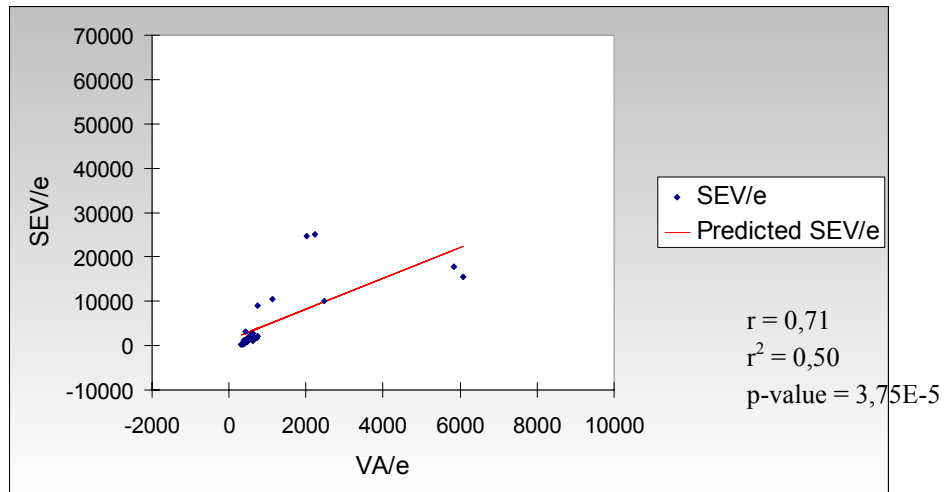


Figure A5.1 Regression plot, all companies, 1996

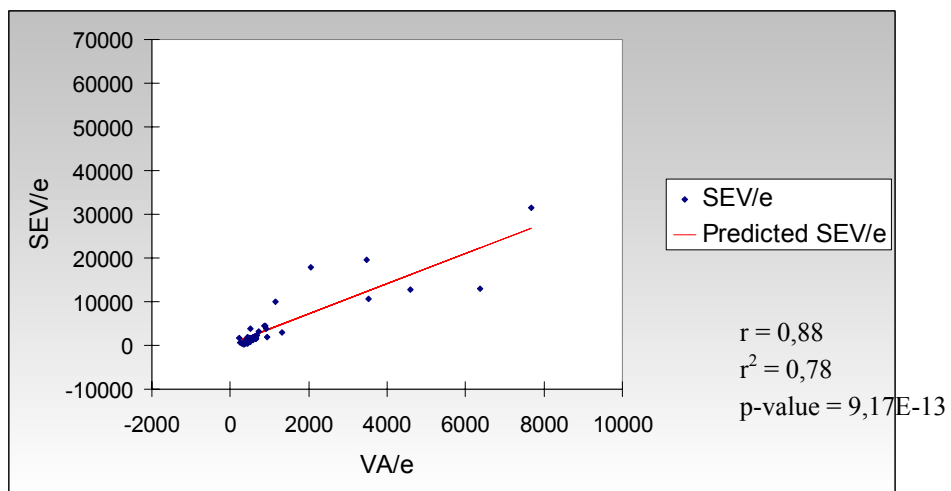


Figure A5.2 Regression plot, all companies, 1997

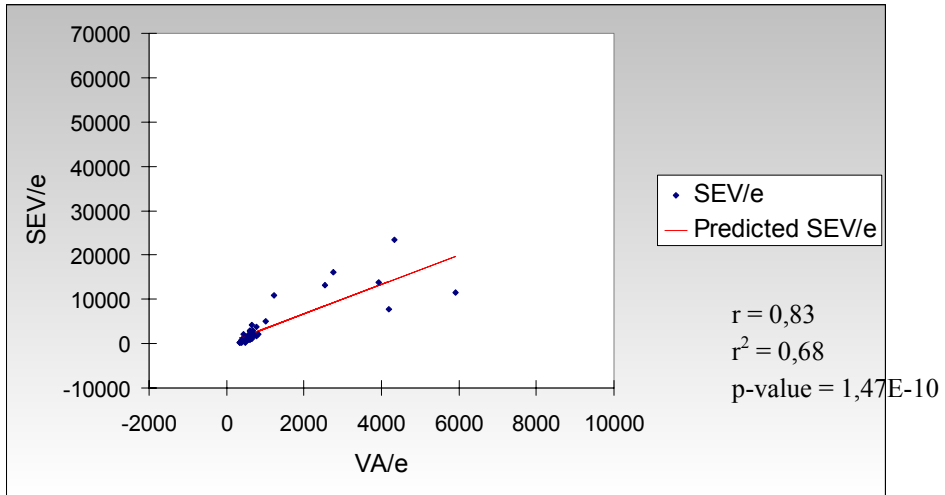


Figure A5.3 Regression all companies 1998

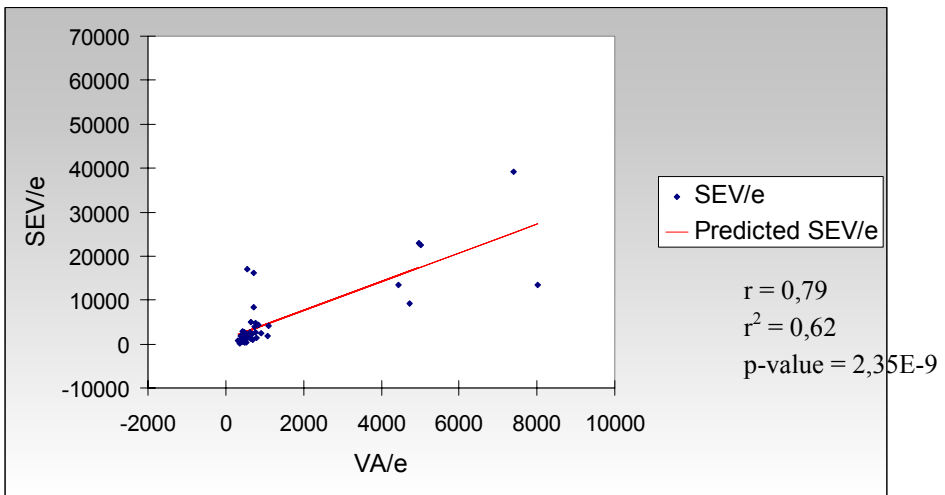


Figure A5.4 Regression plot, all companies, 1999

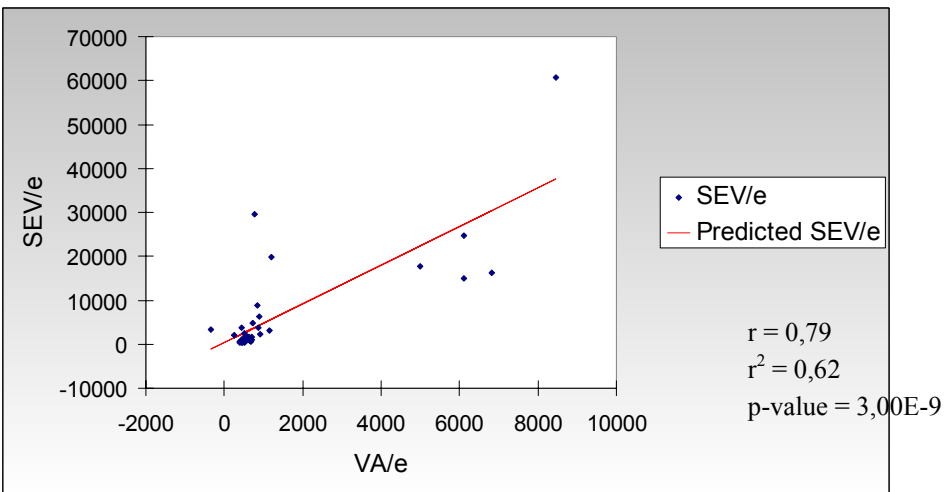


Figure A5.5 Regression plot, all companies, 2000

## Appendix 6 – regression plots, by industry sector, yearly 1997 – 2000

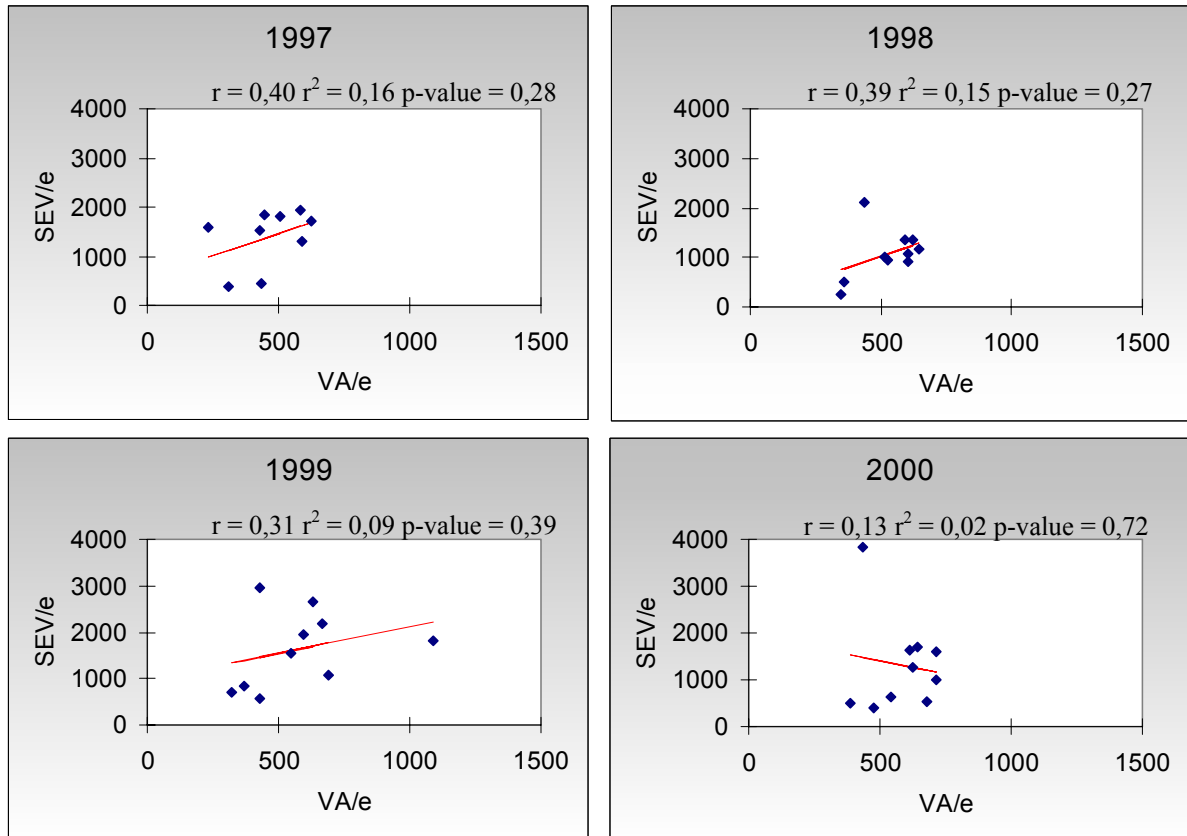


Figure A6.1 Regression plots, industrials

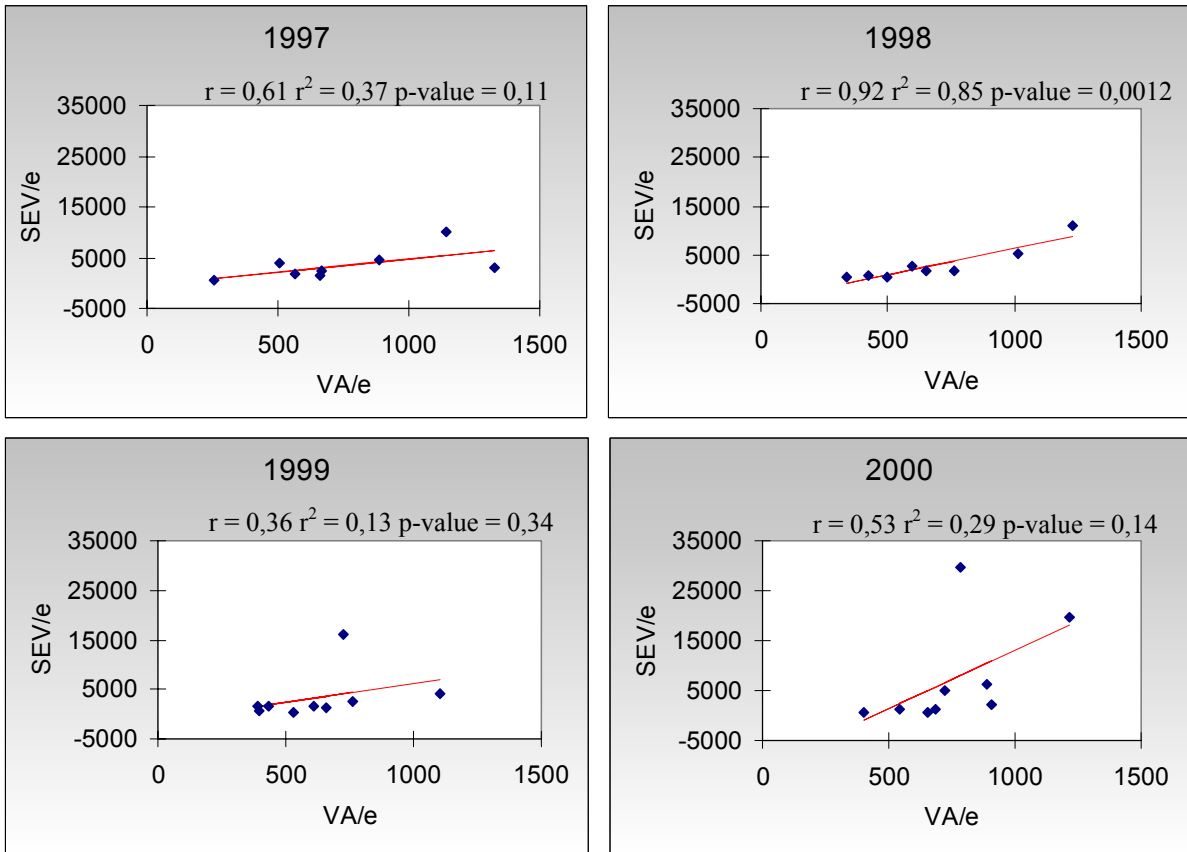


Figure A6.2 Regression plots, Life science

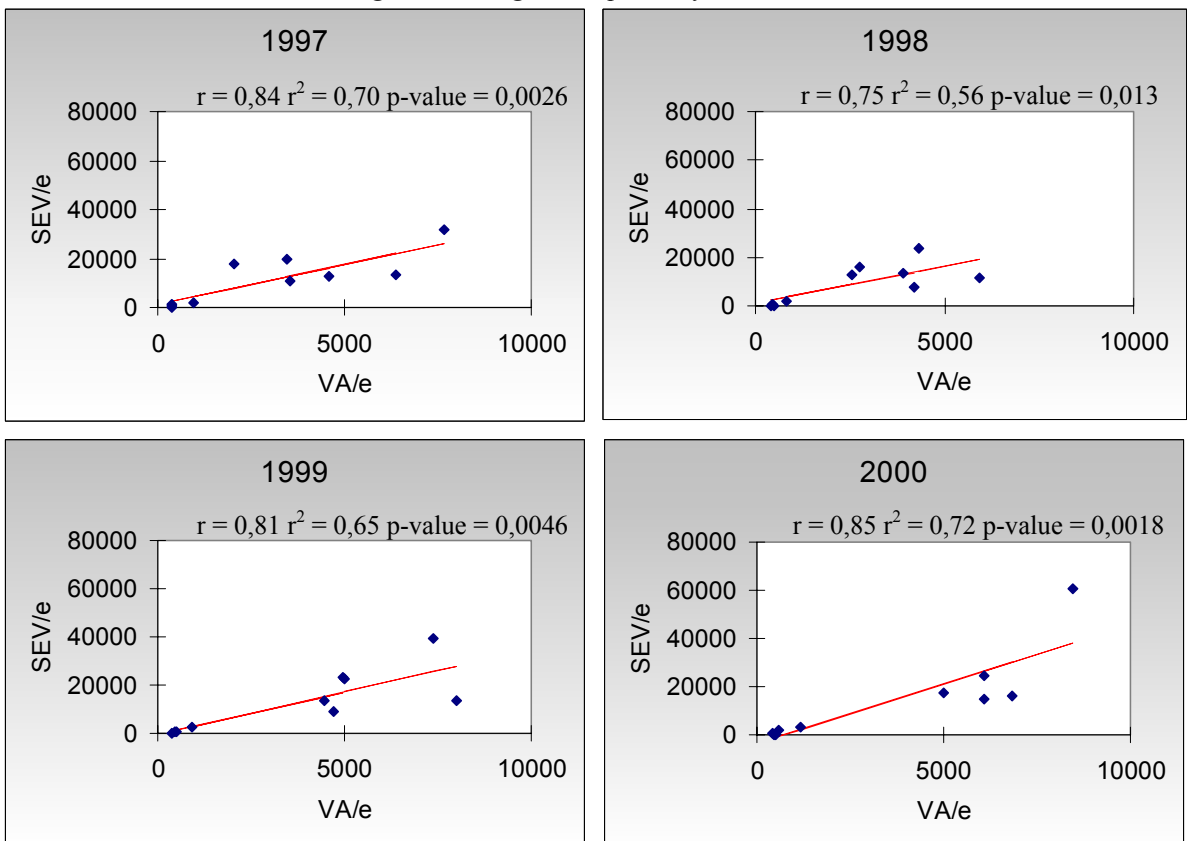


Figure A6.3 Regression plots, Real estate and construction

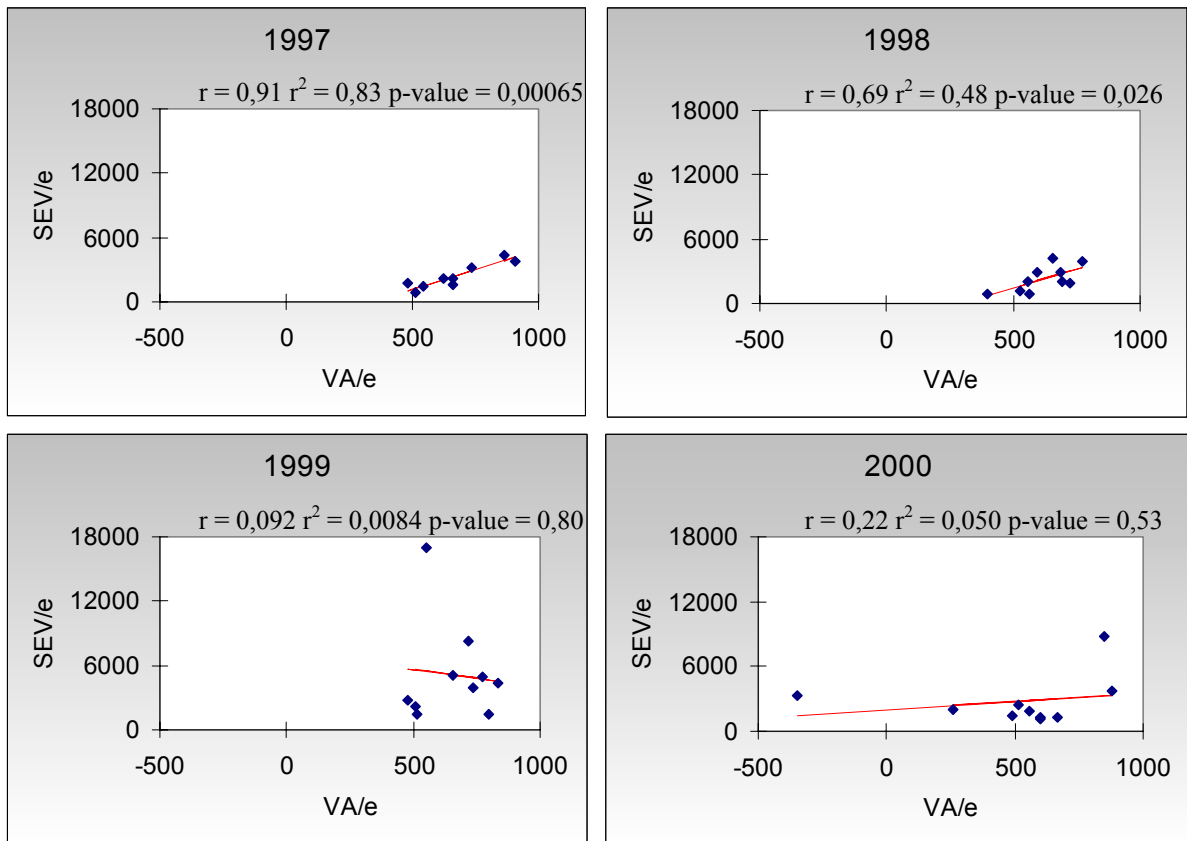


Figure A6.4 Regression plots, IT consulting and services

## Appendix 7 – Regression plots, Industry sectors, extraordinary cases

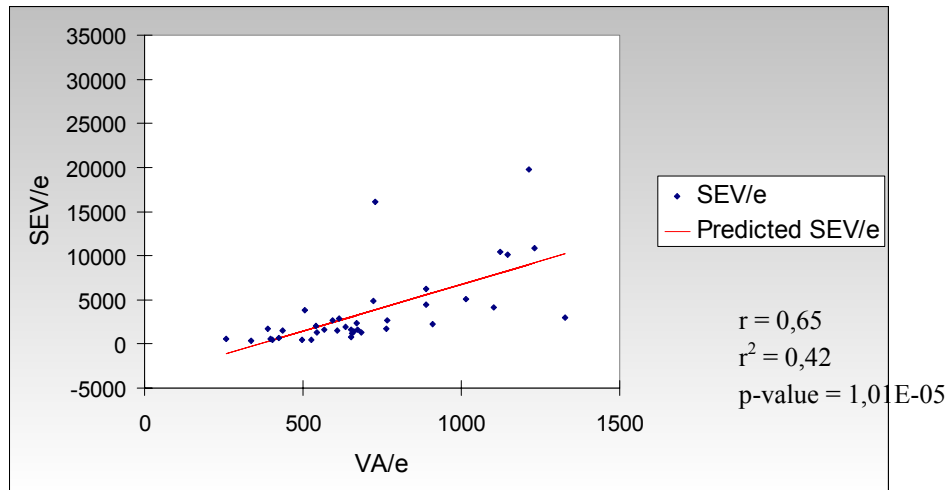


Figure A7.1 Regression plot, Life Science, excluding outliers

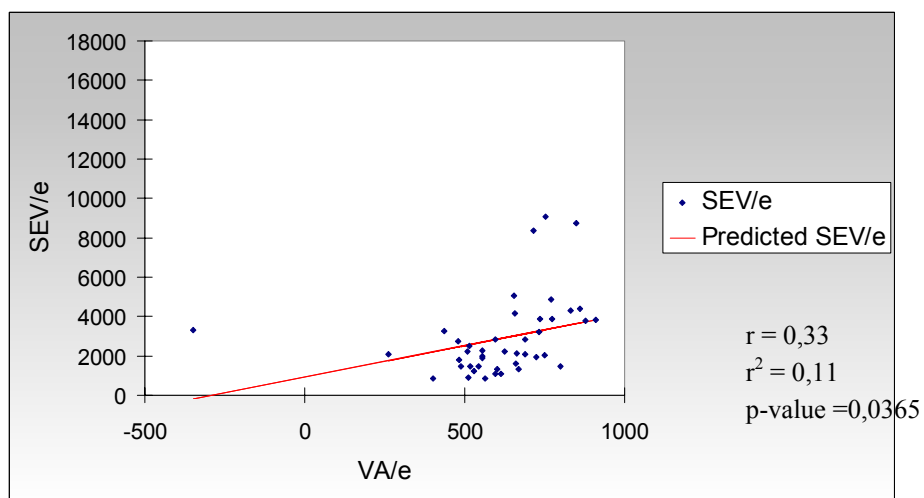


Figure A7.2 Regression plot, IT consulting and services, excluding outliers

## Appendix 8 – company size selection

<b>Large Companies</b>			
	<b>Company</b>	<b>Revenue 2000</b>	<b>Number of employees 2000</b>
1	AstraZeneca	172971	57000
2	Electrolux	124493	87128
3	Volvo	120392	54264
4	Skanska	108222	63368
5	SCANIA	53823	25456
6	Atlas Copco	46527	26392
7	Sandvik	43750	34306
8	SKF	39848	39557
9	NCC	38728	25192
10	AvestaPolarit	31861	6494
11	Gambro	22245	17999
12	SSAB	19271	9831
13	SAAB	17840	15356

<b>Medium sized companies</b>			
	<b>Company</b>	<b>1) Revenue 2000</b>	<b>Number of employees 2000</b>
14	PEAB	15704	9678
15	Assa Abloy	14394	16881
16	WM-data	13125	8520
17	JM	6849	2163
18	Getinge	5254	3911
19	Wallenstam	3473	78
20	Wihlborgs Fastigheter	2239	251
21	Nobel Biocare	2110	1164
22	Tornet Fastighets	1969	250
23	Elekta	1789	794
24	TurnIT	1550	1253
25	Castellum	1435	181
26	Perbio Science	1408	952
27	Adcore	1295	1275

<b>Small companies</b>			
	<b>Company</b>	<b>2) Revenue 2000</b>	<b>Number of employees 2000</b>
28	Hufvudstaden	1145	108
29	Frontec	1128	1225
30	Semcon	1007	1504
31	Sigma	992	3290
32	Enea Data	869	748



33	Lundberg företagen	735	5610
34	Meda	728	140
35	Pro Act IT Group	671	201
36	Know IT	548	558
37	Modul 1 Data	452	477
38	Biacore International	439	212
39	Feelgood Svenska	325	467
40	QMED	237	158

## Appendix 9 – company age selection

Old companies	Registered
Sandvik	1897-03-08
Skanska	1897-03-29
AvestaPolarit	1898-01-17
Nobel Biocare	1898-02-14
SKF	1907-03-11
Electrolux	1910-02-10
AstraZeneca	1913-10-31
Hufvudstaden	1915-10-15
Volvo	1915-12-31
Atlas Copco	1917-03-30
SSAB	1918-10-18

Medium aged companies	Registered
NCC	1935-09-30
SAAB	1937-04-26
Gambro	1942-11-06
JM	1945-04-06
Wihlborgs Fastigheter	1947-01-07
SCANIA	1947-12-31
Lundberg företagen	1952-06-10
Assa Abloy	1954-04-02
PEAB	1955-05-17
Wallenstam	1960-05-27
TurnIT	1968-04-17
WM-data	1969-03-19
Biacore International	1969-11-20
Elekta	1972-10-10

Young companies	Registered
Enea Data	1981-04-16
Tornet Fastighets	1985-04-18
QMED	1985-06-17
Frontec	1986-02-08
Sigma	1989-01-25
Know IT	1990-06-14
Getinge	1990-10-16
Modul 1 Data	1991-05-24
Meda	1991-06-06
Castellum	1993-10-27
Adcore	1994-02-04

Pro Act IT Group	1994-09-27
Feelgood Svenska	1995-04-03
Semcon	1997-03-07
Perbio Science	1999-02-17

## Appendix 10 – regression plots, company age, extraordinary cases

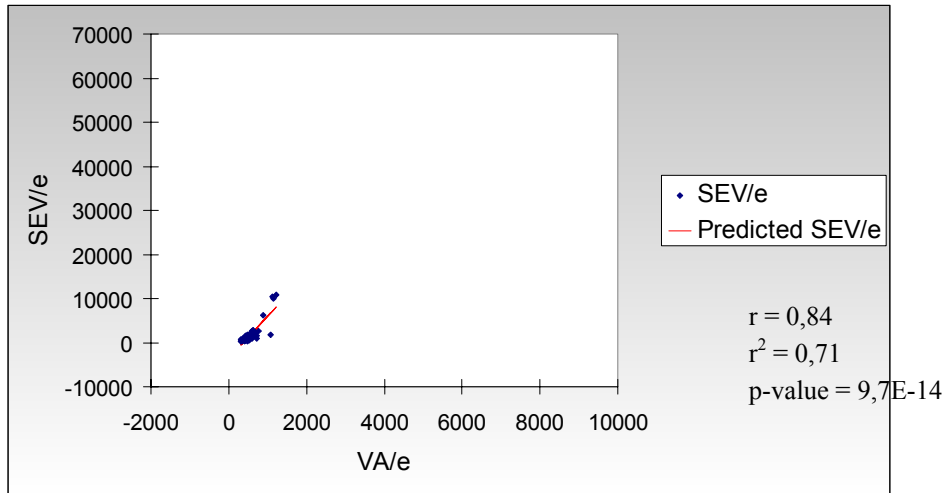


Figure A10.1 Regression plot, Old companies, excluding Hufvudstaden

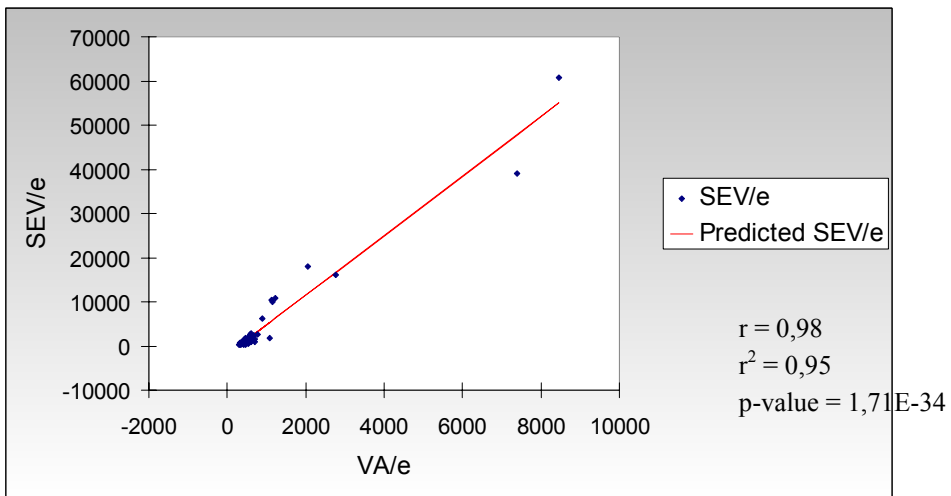


Figure A10.2 Regression plot, Old companies, excluding outliers

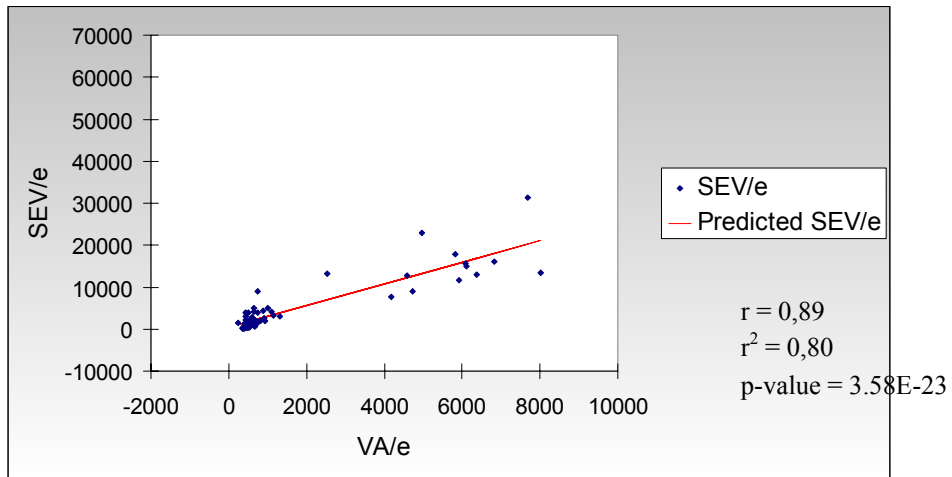


Figure A10.3 Regression plot, Medium aged companies, excluding outliers

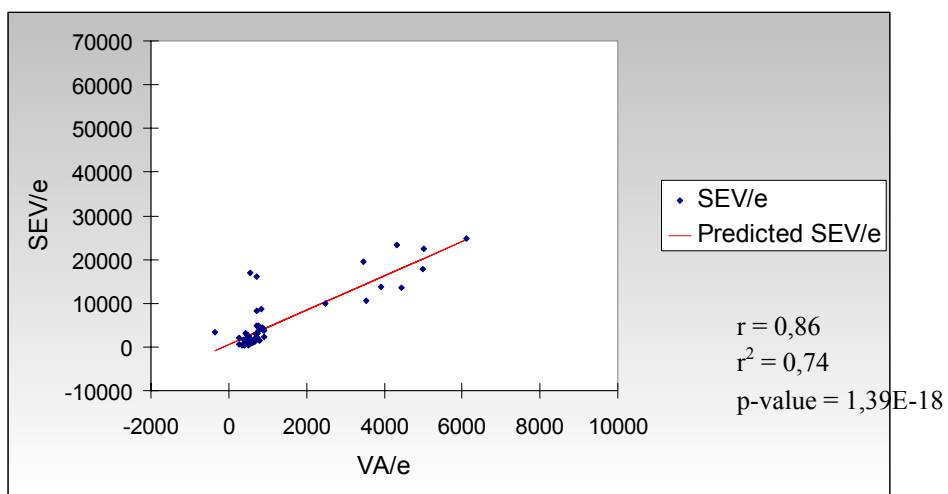


Figure A10.4 Regression plot, Young companies, excluding outliers

## Appendix 11 – IC multiplier, extraordinary cases

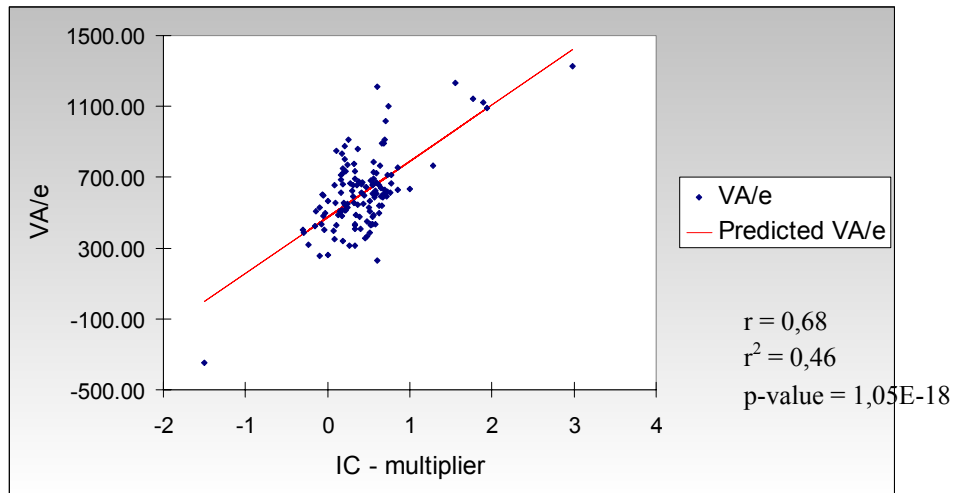


Figure A11.1 Regression plot, IC-multiplier, excluding Real estate and construction

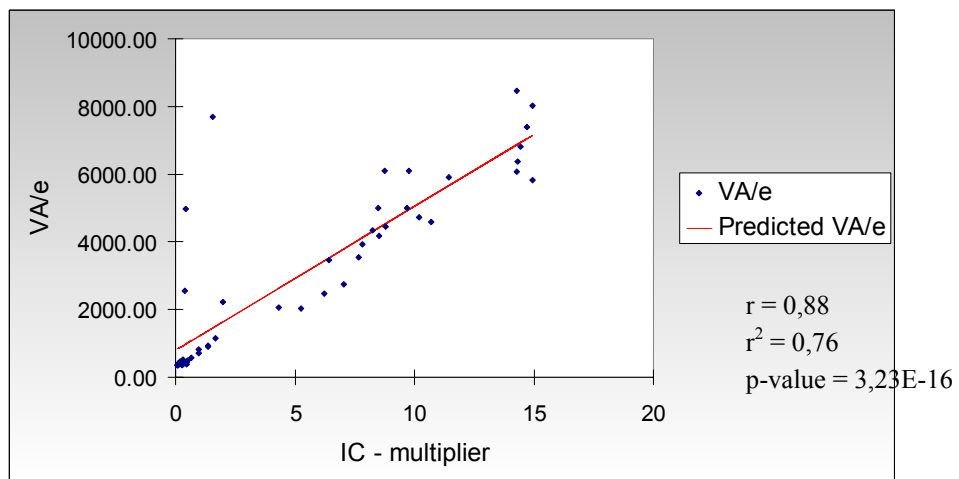


Figure A11.2 Regression plot, IC-multiplier, Real estate and construction

## Appendix 12 – Key words

### **Book Value**

*Accounting term. Value in the company's financial accounts. Book value of equity or of entity (total equity and debt capitalization) or of (individual) assets and/or liabilities.*

### **Capital employed**

*Net asset value, borrowings for investments in subsidiaries and minority interests.*

### **Capitalization**

*Creating financial value out of intangible assets/intellectual capital.*

### **Customer**

*The value of customer base, customer relationships and customer potential. Component of structural capital.*

**capital**

### **Explicit**

*Explicit knowledge is formal and systematic and can be easily communicated and shared, in product specifications, scientific formulas or computer programs (Ikujiro Nonaka). Explicit knowledge is articulated knowledge - the words we speak, the books we read, the reports we write, the data we compile (Hubert Saint-Onge).*

**knowledge**

### **Financial capital**

*The value that is shown in the balance sheet.*

### **Human**

*The accumulated value of investments in employee training, competence, and future. The term focuses on the value of what the individual can produce; human capital thus encompasses individual value in an economic sense (Gary S. Becker). Can be described as the employees' competence, relationship ability and values. Work on human capital often focuses on transforming individual into collective competence and more enduring organizational*

**capital**

**capital.**

### **IC**

**value**

**scheme**

*A model which illustrates building blocks that together form the foundation of the company's intellectual capital and its relation to market value. Intellectual capital is broken down into human and structural capital, which is further broken down into*

customer and organizational capital. This is then subdivided into process and innovation capital (Leif Edvinsson).

**Intangible** **asset**

An asset that is not visible in the traditional balance sheet but still adds value to the company. The intellectual capital contains intangible assets.

**Intellectual** **Capital** **(IC)**

The consolidation of structural capital and human capital, indicating future earnings capability. A concept developed by Leif Edvinsson.

**Knowledge**

Information that has value in the inter-action with human capital. The ability people have to use information to solve complex problems and adapt to change. The individual ability to master the unknown. The ability to act (Karl-Erik Sveiby). Knowledge can be classified as explicit or tacit (Ikujiro Nonaka).

**Market value**

An approximation of the fair market value of a company's entire debt and equity capitalization (Stern Stewart). Most often the market value of equity capital in a (publicly traded) company.

**Multiplicative** **effect**

Leveraging that takes effect in the interaction between human capital and structural capital, often nourished by IC leadership.

**Organizational** **capital**

Systematized and packaged knowledge, plus systems for leveraging the company's innovative strength and value-creating organizational capability.

**Performance measurement**

The ongoing process of assessing progress toward achieving predetermined goals and objectives.

**Process capital**

The combined value of value creating and non-value creating processes.

**Structural** **capital**

Customer capital and organizational capital. What is left in the company, when the human capital, the employees, have gone home. The result/value of past IC transformation efficiency/performance. The potential for future IC and financial value creation. The tool(s)/vehicles for human capital relationship value creation: Consists of



*value-creating and non value-creating (value-consuming) components. The sum of intangible assets and intangible liabilities (Leif Edvinsson).*

**Tacit****knowledge**

*Tacit knowledge is highly personal and hard to formalize and communicate. Tacit knowledge consists of know-how and mental models, beliefs and perspectives (Ikujiro Nonaka).*

**Tangible assets**

*A physical or monetary asset. Often associated with the financial focus area.*

**Value****added**

*Operating result after depreciation, plus wage costs, payroll overheads and business development costs.*

**Value****creation**

*Refinement and transformation of human capital, customer capital and organizational capital through mutual collaboration, into financial as well as non-financial value. A direct result of how people generate and apply knowledge.*