What is the correlation level between returns of real estate price index and stock exchange index in Sweden during the period 1989-2008?

Correlation between Three types of Real Estate price index and OMX Stockholm 30 price index

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Abstract

Making an investment in any financial instruments require the investor to keep in mind the returns and risk associated with that investment. Many financial instruments are available to make an investment like T bills, shares, bonds, real estate and so on. T bills are considered least risky or can be said almost risk free financial instruments and bonds are considered more risky than T bills. Shares are considered more risky than real estate and other financial instruments. But better returns are associated with high risk. With increase in risk return associated with that risk also increases and it depend upon the type of investor whether he is risk lover, risk neutral or risk averse investor to go for risky investment or not. Investor can choose portfolio of his own choice that may contain stock, bonds, real estate and so on. In this research thesis the emphasis was on keeping stock and real estate in portfolio because it was supposed that when there are two securities in portfolio, and one security has high risk while other has less risk and when we take average of diversification effect than average risk is less than the weighted average risk of individual risks because this highest risk is offset by lowest risk. In this way investor can decrease some of his risk.

Then there is need to find out the correlation between shares and real estate. It is the most important part because if there is low no correlation between these securities then it is good for investors because through no correlation investor can have advantage of diversification of risk. And if there is some correlation between these securities then investors need to choose the risk level and then calculate the return before choosing proportions of each security in the portfolio. The emphasis of this paper is to find out the correlation between returns of real estate and stock exchange index excluding the bonds and other types of financial securities. For that purpose researcher choose OMX Stockholm 30 (OMXS30) and three types of real estate in Sweden i.e. one or two dwelling buildings, building for seasonal and secondary use, and multi dwelling buildings. Real estate price index data and stock price index data for last 20 years gathered for empirical study. Deductive approach used to find more about the known theory and cross sectional research design used as research design. Quantitative research methods used as it involved various calculations and statistical tools to find about the correlation between them.

Pearson correlation used to find the correlation between the returns of stock price index and real estate price index and correlation between stock price and all three types of real estate calculated separately. And it was found that there is almost no correlation between the stock price index and all three types of real estate. It was found that there is 0.071, 0.042, 0.072 correlation between the returns of stock price index and one or two dwelling buildings, buildings for seasonal and secondary use and multi dwelling buildings respectively. It is quite clear from the results that there is no correlation between them. Furthermore regression analysis used to check the relationship of returns of stock price index and returns of all three types of real estate price index. And it was found that the P value of slopes that is represented by (returns of real estate price index) \( \beta_1 = 0.814, \beta_2 = 0.813 \) and \( \beta_3 = 0.997 \) is larger than the significance value which support the null hypothesis that there is no correlation between the returns of stock price index and real estate price index. So, it can be said that there is no statistical significance relationship between returns of stock price index and real estate price index.
So finally it is concluded on the basis of the studies as well as from the results generated by Pearson correlation and regression analysis that putting the real estate into portfolio will diversify the portfolio risk as there is very small or can be said that no correlation between the returns of real estate and stock exchange.
Table of Contents

CHAPTER 1: INTRODUCTION ........................................................................................................... 7
  1.1 BACKGROUND .................................................................................................................. 7
  1.2 RESEARCH QUESTION .................................................................................................... 9
  1.3 PURPOSE OF STUDY ...................................................................................................... 9
  1.4 DEFINITIONS ................................................................................................................ 10
  1.5 LIMITATIONS ............................................................................................................... 12
  1.6 DISPOSITION OF THE THESIS .................................................................................. 12

CHAPTER 2- THEORETICAL REVIEW ......................................................................................... 14
  2.1 REAL ESTATE ................................................................................................................. 14
  2.2 CREATION OF VALUE IN REAL ESTATE ..................................................................... 14
  2.3 LIFE CYCLE OF REAL ESTATE ..................................................................................... 14
  2.3.1 CHANGES IN RURAL PROPERTY ............................................................................. 15
  2.3.2 DECLINES AND RENEWAL .................................................................................... 16
  2.4 PROPERTY FACTORS .................................................................................................... 16
  2.5 INFORMATION ABOUT THE MARKET TIMING THROUGH REAL ESTATE CYCLE .. 16
  2.5.1 RECOVERY ................................................................................................................. 16
  2.5.2 EXPANSION ............................................................................................................... 17
  2.5.3 HYPER SUPPLY ......................................................................................................... 17
  2.5.4 RECESSION ................................................................................................................. 17
  2.6 INVESTMENT AND PORTFOLIO THEORY .................................................................. 17
  2.7 THE ECONOMIC THEORY OF CHOICE (UNDER CERTAINTY) .................................. 18
  2.7.1 OPPORTUNITY SET .................................................................................................. 18
  2.7.2 THE INDIFFERENCE CURVE ...................................................................................... 18
  2.8 PORTFOLIO ANALYSIS ................................................................................................. 19
  2.8.1 OPPORTUNITY SET UNDER RISK ......................................................................... 19
  2.8.2 VARIANCE OF COMBINATION OF ASSETS .............................................................. 20
  2.8.3 CHARACTERISTICS OF PORTFOLIOS IN GENERAL ............................................... 20
  2.9 SPECIAL CASES ............................................................................................................ 20
  2.9.1 CASE 1: PERFECTLY POSITIVE CORRELATION .................................................. 21
  2.9.2 CASE 2: PERFECTLY NEGATIVE CORRELATION .................................................. 21
  2.9.3 CASE 3: NO CORRELATION, CORRELATION COEFFICIENT ZERO .................... 22
  2.10 EFFICIENT SET OR EFFICIENT FRONTIER ................................................................. 22
  2.11 ARTICLE REVIEW ....................................................................................................... 23
  2.11.1 DIVERSIFICATION: REAL ESTATE AND EQUITY MARKET ................................ 23
  2.11.2 ASYMMETRIC VOLATILITY, CORRELATION AND RETURNS DYNAMICS .......... 24
  2.11.3 MARKET EFFICIENCY AND RETURNS .................................................................. 25
  2.11.4 GLOBAL ASSETS PERFORMANCE AS RISK ADJUSTED TOOL ....................... 25
  2.11.5 REAL ESTATE RISK AND RETURN ..................................................................... 25

CHAPTER 3- METHOD SECTION .............................................................................................. 27
  3.1 SELECTION OF STUDY SUBJECT ............................................................................... 27
  3.2 METHODOLOGICAL ASSUMPTION ............................................................................ 27
  3.3 DEDUCTION AND INDUCTION ................................................................................... 28
  3.4 RESEARCH DESIGN ...................................................................................................... 29
  3.5 RESEARCH STRATEGY .................................................................................................. 29
  3.6 DATA COLLECTION METHODS .................................................................................... 30
  3.7 MATHEMATICAL AND STATISTICAL PROCEDURES ................................................. 30
3.8 DATA TYPE ........................................................................................................... 31
3.9 CHOOSING STATISTICAL TEST ............................................................................ 31
3.10 METHODS .......................................................................................................... 32
3.11 CORRELATION AND COVARIANCE ................................................................. 33
3.12 CONFIDENCE INTERVAL ..................................................................................... 33
3.13 HYPOTHESIS ....................................................................................................... 34
3.14 P VALUE ............................................................................................................... 34
3.15 PEARSON CORRELATION .................................................................................... 34
3.16 REGRESSION ANALYSIS ...................................................................................... 35

CHAPTER 4- EMPIRICAL OBSERVATIONS AND FINDINGS: ....................................... 36

4.1 CALCULATION OF RETURNS ............................................................................... 36
4.1.1 OMX STOCKHOLM STOCK 30 INDEX ............................................................... 36
4.1.2 CORRELATION BETWEEN THE RETURNS OF ONE OR TWO DWELLING BUILDING PRICE INDEX AND OMX STOCKHOLM STOCK 30INDEX: ...................................... 37
4.1.3 CORRELATION BETWEEN THE RETURNS OF SEASONAL AND SECONDARY USE BUILDINGS PRICE INDEX AND OMX STOCKHOLM STOCK 30INDEX .................................................. 39
4.1.4 CORRELATION BETWEEN THE RETURNS OF MULTI DWELLING AND COMMERCIAL BUILDINGS PRICE INDEX AND OMX STOCKHOLM STOCK 30INDEX ................................................................. 41
4.1.5 CORRELATION BETWEEN THE RETURNS OF ALL THREE TYPES OF REAL ESTATE AND OMX STOCKHOLM STOCK 30INDEX ........................................................................ 42
4.1.6 HYPOTHESIS TESTING ...................................................................................... 43
4.2 REGRESSION ANALYSIS ....................................................................................... 44
4.2.1 ANALYSIS OF VARIANCE ................................................................................. 46
4.3 FINDINGS .............................................................................................................. 47

CHAPTER 5- CONCLUSION ......................................................................................... 48

5.1 CONCLUSION ....................................................................................................... 48
5.2 FURTHER RESEARCH .......................................................................................... 49

CHAPTER 6- CREDIBILITY CRITERIA .......................................................................... 50

6.1 RELIABILITY ....................................................................................................... 50
6.2 VALIDITY ............................................................................................................. 50
6.3 GENERALIZATION ................................................................................................ 50

REFERENCES .......................................................................................................... 51

APPENDICES .............................................................................................................. 53

APPENDIX 1. PEARSON CORRELATION BETWEEN THE RETURNS OF ONE OR TWO DWELLING BUILDING PRICE INDEX AND OMX STOCKHOLM STOCK 30INDEX .................. 53
APPENDIX 2. CORRELATION BETWEEN THE RETURNS OF SEASONAL AND SECONDARY USE BUILDINGS PRICE INDEX AND OMX STOCKHOLM STOCK 30INDEX .................................................. 54
APPENDIX 3. CORRELATION BETWEEN THE RETURNS OF MULTI DWELLING AND COMMERCIAL BUILDINGS PRICE INDEX AND OMX STOCKHOLM STOCK 30INDEX ................................................................. 55
APPENDIX 4. CORRELATION BETWEEN THE RETURNS OF ALL ABOVE THREE TYPES OF REAL ESTATE AND OMX STOCKHOLM STOCK 30INDEX ........................................................................ 56
APPENDIX 5. REGRESSION ANALYSIS: ................................................................. 57
List of Figures

Figure 1: Risk and Returns of various securities ......................................................... 8
Figure 2: Life Cycle of Real Estate, (USA) ................................................................. 15
Figure 3: Indifference Curves ................................................................................. 19
Figure 4: Risk and return of assets in portfolio, Source ........................................... 23

List of tables

Table 1: Annual returns of OMX 30 index ................................................................. 36
Table 2: Annual returns of one or two dwelling buildings ........................................ 37
Table 3: Annual returns of buildings for seasonal and secondary use .................... 39
Table 4: Annual returns of multi dwelling and commercial buildings .................... 41
Table 5: with all results ............................................................................................ 43
Table 6: Regression analysis of three types of real estate price index and stock price index ............................................................................................................. 44
Chapter 1: Introduction

Chapter 1 includes background, research question; and purpose of study, definitions, limitations and disposition.

1.1 Background

When someone has excess of money or extra money then he will definitely want to save or invest this money in such a way that he will earn more money from this saving or investment. Or we can say everyone in this world wants to earn more and more money and from his earning he will definitely want to save or invest some money after making necessary expenditure for his daily life in such a way that he can make an attractive earning in the form of returns from that investment of the saved money. It means that the money provides the investor with more attractive returns in a long time.

One can save and earn money while opening a bank account and get approximately risk free return on his deposit. But if we talk about the investment and someone wants to invest his excess money then the things that mostly come in mind are shares and bonds and other financial instruments. There is also another thing that can also give good returns if someone makes investment in it and it is real estate (property). Some time balance between risk and returns of real estate are much better than the returns of shares, bonds and other types of financial securities. So, when we talk about the investment then we should keep in mind that real estate is one of the possibilities. One of the main reasons of including the real estate in portfolio may be the quality of real estate to provide protection against inflation. But we also keep in mind that real estate has different time frame and less liquid as compare to other financial securities.

Now the next thing for the investor is to think how much to invest in shares? How much to invest in bonds, and how much to invest in other types of financial securities, and how much to invest in real estate? Whether he invests only in shares, or invests only in bonds or invests only in real estate, or invests somewhere else. There are different possibilities for the investor like he can choose to invest all his money only in shares, or only in bonds, or only in real estate or may be somewhere else. Investors can choose to invest equally in all of them. There is also possibility that an investor can choose a combination of several instruments to invest all his money. There is also choice for investors whether to choose combination of shares and bonds only, or combination of shares and real estate, or bonds and real estate and invest equally or not. But they can also choose a portfolio that is composed of shares, bonds, real estate and other securities. In that portfolio an investor can invest equally or he can invest according to his preference in term of balance between risk and return.

The decision how much to invest in each of them is depending upon the returns and risk associated with each instrument. It is sure that if the risk/returns from shares are better, then everyone likes to invest in share, if the risk/returns of bonds are better then everyone like to invest more in bonds and same is the case with the risk/returns of real estate and other assets. We should also keep in mind that high returns are associated with high risk. Risk loving investors will like to take more risks to expect better returns. But risk averse and risk neutral investors have to think before making investment decision. They will definitely go for the portfolio that is best for them. They will like to have portfolio that gives them higher returns for given level of risk.
In order to answer the question *whether or not investment generate adequate returns* depends upon number of different factors like, nature of different securities, different alternatives that investors can avail, returns from those alternative investments and risk difference between these alternatives and securities that are considered (Brueggeman & Fisher, 2007, p.289-290). Let’s explain risk and returns of different alternative investments with the help of diagram.

![Diagram: Risk and Returns of various securities](image)

**Figure 1: Risk and Returns of various securities**

In the Fig.1 (Brueggeman & Fisher, 2007, p.289-290) we take average risk as risk and it is clear from the graph that different securities have different risk associated with them. As we moved to right of the graph risk increases and decrease to left. But, higher the risk higher the returns associated with that risk. T bills consider risk free or we can say that showing lowest risk and will generate less return. Similarly risk also differ within each class of assets e.g. if we consider bond’s class than some bonds will show higher risk than others and even some bonds show higher risk than shares. Returns associated with real estate are also higher but risk associated with these higher returns is also higher than risk associated with investing in T bills. It is clear from the graph that as we move right to the graph risk will increase but also increase the returns.

If the investor chooses to invest only in shares, not in bonds, and real estate then risk associated with this type of investment will be higher. Same is the case with bonds, real estate and other securities if the portfolio is composed of only bonds or real estate or any other asset. So it is clear that if an investor wants to avoid the risk than he should choose to invest some of his money in shares, some in bonds and some in real estate and some in other securities. So portfolio should consist of shares, bonds, other securities and real estate.

When we talk about the portfolio then the investor usually chooses a portfolio that contains different securities or assets and returns on those different securities or assets is usually the weighted average of all the returns. Similarly when we talk about the risk that is associated with each of these securities or assets then the risk of portfolio is different from weighted average of risk of all the securities or assets in portfolio. And it is generally known by every one that when we take average then the average risk of all the securities or assets will be less than that of individual security or asset. This is because we suppose that when there are two securities in portfolio, and one security has
high risk while other has less risk and when we take average of diversification effect than average risk is less than the weighted average risk of individual risks because this highest risk is offset by lowest risk. In this way investor can decrease some of his risk.

Next thing that needs consideration is to find out the correlation between these securities. There is need to find out the correlation between shares, bonds, other securities and real estate. It is the most important part because if there is low or no correlation between these securities then it is good for investors and investors can combine proportions of shares, bonds, other financial securities and real estate. And if there is some correlation between these securities then investors need to choose the risk level and then calculate the return before choosing proportions of each security in the portfolio.

The emphasis of this paper is to find out the correlation between returns of real estate and stock exchange index excluding the bonds and other types of financial securities by keeping in view that low or no correlation is tool for diversification. A portfolio is considered more capable of diversifying the risk of the securities if there exist low or no correlation between them. Dependence of any specific diversification strategy to be consider doing well largely depend upon the correlation between the securities in that portfolio (Lee, 2003, p.45). Previous studies are mostly considering more than two securities and found the correlation, in this study author try to focus only on two securities i.e. Real estate price index and stock exchange index for period of 1989 to 2008.

There has been a vast literature about diversifying the portfolio by putting various securities in that portfolio (Reilly & Wright, 2004, p.63-75; Oppenheimer & Grissom, 1998, p.291-293; Riddiough, 2002, p.4-6; Eichholtz, 1996, p.56-58). However, there are not many studies that focus or check the impact of real estate price index and stock price index on diversification especially in Sweden. Therefore, author want to know the correlation level between real estate price index and stock price index in Sweden to observe whether putting these two securities in portfolio help to diversify the portfolio or not. This study is limited only to OMX Stockholm 30 index and three types of real estate in Sweden.

1.2 Research question

What is the correlation level between returns of real estate price index and stock exchange index in Sweden during the period 1989-2008?

1.3 Purpose of study

Is there any correlation?

What is the correlation between the returns of real estate price index and OMX Stockholm 30 price index in Sweden? As I want to find is there any correlation between returns of stock exchange and real estate price index. Whether the distribution of the returns of stock exchange index is positively correlated, negatively correlated or has no correlation. Positively correlated returns show that returns of both investments are moving positively in same direction, similarly negatively correlated returns show that returns are moving opposite to each other. And no correlation shows that returns are
independent of each other. My purpose is to identify the risk associated with it the portfolios combining stock index and real estate.

**If hypothesis is true, what can we learn?**

Hypothesis is that there is no correlation between returns of real estate index and stock index returns. And correlation below 1 is also considered good. It means that returns of both are approximately independent of each other. Hence it depend upon the investors whether he is risk lover, risk averse or risk neutral to choose proportion of each security or choose only one security in his portfolio. It is up to investor what proportion of each security he wants to have in his portfolio. And if there exists strong correlation or we can say that correlation above 1, between returns of real estate and stock exchange then investors are supposed to have equal proportion of the securities that have strong positive correlation. While doing all this I would like to suggest the investors whether to choose portfolio that is either compose of shares or bonds or other financial securities. In the case of strong positive correlation choose optimal combination for their investment. By knowing this correlation between returns of real estate and stock exchange index I will be able to suggest the investors both individual as well as institutional investors whether if it is good idea to combine proportions of shares and real estate in their portfolio or this strategy is useless. Because as I mentioned above that investing in real estate and share will generate higher risk as compare to investing in T bills. And if there is no correlation between the returns of real estate index and stock index than it mean that risk associated with stock index will diversify by real estate and vice versa.

**1.4 Definitions**

**a) Portfolio**

A combination of two or more securities or assets is called as portfolio. (Van Horne & Wachowicz, n.d, p.74-76)

**b) Real estate**

A piece of land, the air above it and the ground blew it is called property. When it also includes any building or structure on that piece of land it is called real estate (Investor words, 2009).

Or

A piece of land and all physical things like building on it. (The free Dictionary, 2009)

**c) Shares**

Shares are the certificates that are issued by state owned. Or private companies to share holders in form of security in order to raise money. Shares pay dividend to share holders if BOD announced to pay the dividend. (Van Horn & Wachowicz, n.d, p.74-76)

Share is basic unit of capital stock. Term capital stock is widely use by companies while issuing only one type of stock. However, in order to attract adequate investors companies can issue different types of shares with different opportunities. Common stock is basic type of capital stock issue by almost every organization, it has ownership
rights, voting rights dividend participation and liquidation residual claim. Other types of capital stock called preferred stock, some organizations issue one or more types of preferred stock. Preferred stock differs from common stock. As name shows that preferred stocks have preference over common stock both in dividend and liquidation of organization.

d) Bonds

*Bonds are the long term debt instrument issued by any organization to raise fund.* (Van Horne & Wachowicz, n.d, p.71-72)

Bonds after specific period of time pay stated amount of interest and finally reaches its maturity. Bonds normally have *face value* that is normally a *round amount per bond*, stated maturity date and *coupon rate or nominal annual interest rate* and this annual interest rate is obligation for company to pay to the holders every year until the maturity date.

e) Returns

*Income received on an investment plus any change in market price.* Returns can be calculated by using following formula.

Return for one period = ending price – beginning price / beginning price

If the organization pay dividend than the formula will be

Return for one period = dividend + ending price – beginning price / beginning price

f) Covariance

Covariance is measure of degree to which two variables (e.g. returns on securities) move together. A positive value means that, both variables on average are moving in same direction Covariance can be calculated by using following formula.

\[
\text{Covariance (Rs, Rr)} = \sum [(Rs-Rs*) (Rr-Rr*)] 
\]

Where

Rs = return on stock

Rr = return on real estate

g) Correlation

Correlation is a measure of linear relation between two variables. It ranges from -1 i.e. perfect negative correlation, through 0, i.e. no correlation to +1 i.e. perfect positive correlation.

\[
\text{Correlation (Rs, Rr)} = \rho = \frac{\text{covariance (Rs, Rr)}}{\sigma_s \sigma_r} 
\]
1.5 Limitations

In my research paper I will keep myself limited to Sweden’s stock exchange and real estate only. I will use historical stock prices and historical real estate prices that range from 1990 to 2008. In real estate I will study three types of real estate in Sweden that is as follow.

a). One or two dwelling buildings

b). Buildings for seasonal and secondary use

c). Multi dwelling and commercial buildings.

I am limited to these three types of real estate. Agricultural real estate is not included in my studies because. One of the reasons is that I have chosen these three types of real estate randomly and secondly I think that with the modernization and increasing needs and wants of increasing population most of agricultural real estate is converted into residential as well as commercial real estate. So I will just focus on these three types of real estate. I am just focusing to find only correlation between returns of real estate and stock returns I am not going to calculate the returns on bonds. In this paper I will only choose 30 listed companies of Sweden. And again I have chosen these 30 listed companies randomly. And I will try to calculate the returns of all these companies along that 30 companies I will calculate the returns of real estate in Sweden.

1.6 Disposition of the thesis

Disposition section will explain the readers about the upcoming chapters in thesis step by step, by following and keeping in mind the guide line for research.

Chapter 1 background

First chapter provides the readers with detail understanding of basic concept of this research thesis. Detail background knowledge followed by research question, purpose of study, definitions and limitations makes a road map for readers to understand rest of chapters.

Chapter 2 Theoretical Reviews

In this chapter readers will find deep and appropriate explanation of articles, academic sources and journals related to research area. Theories and analysis of the theories will help the readers to understanding and reaching the research methodology and conclusion.

Chapter 3 Methodology of the research

This chapter will explain the readers about the study subject, fundamental methodological assumption, research design and data collection methods used to conduct research.
Chapter 4 Mathematical and statistical procedures

This chapter will explain mathematical and statistical procedures like which type of data and methods will be used in conducting research.

Chapter 5 Empirical observations and findings

As the name shows that this chapter will explain observations and findings that contain calculations and conclusions.

Chapter 6 Credibility criteria

Criteria credibility explains the reliability and validity of the research report.

7. Appendix

This part explains and provides all the calculation in tabular form.
Chapter 2- Theoretical Review

Theories and academic knowledge that are related to research question and that are important and helpful to understand the research questions are going to be discussed in this chapter. And the literature reviews of relevant studies that are done by researcher are also discussed in this chapter. It will review issues related to real estate and portfolio theory.

2.1 Real estate

When an investor invests in real estate he acquires both physical land that includes structures and buildings on this land and also gets some property rights or ownership rights that includes taking the control of that land and right to make any change in building make improvement, right to sell it etc. According to USA law the term real in real estate is evolved from the term reality and the meaning of this term is land and all types of buildings and structures build on that land (Brueggeman & Fisher, 2007, p.2-4). And the term estate shows the ownership by any person. There is a difference between reality and personality. Reality contains all immovable things while personality contains all moveable things. The term real estate means immovable things like land and building on that land, and the person who owns that land has ownership right. The ownership right is said to be real property. There is also difference between real property and personal property. As real property shows ownership rights and personal property shows land. Property right is generally considered as person’s ownership right. Interest is another legal term that is also associated with property right. The value of property is equal to whole amount that an individual is willing to pay for enjoying all the benefits associated it with this property rights.

2.2 Creation of value in real estate

It is necessary to know about the value creation in real estate especially for making an investment in real estate. Some investors get more than expected benefits while some get normal benefits and some time may be lose as well (McMahan, 2006, p.5-6). This is because real estate value is created every day and most important the risk associated with these returns. There are investors that never want to invest in real estate; they only like to invest in shares, bonds and other type of financial securities. The reasons for not investing in real estate may be longer time periods that is different from those of other securities, less liquid nature of real estate and rules and regulations of state, federal government and local government bodies.

2.3 Life cycle of real estate

Life cycle of all other securities is less than that of real estate this is because that real estate has many features that are different from those of all other securities, like real estate is hard security, immovable, and property is under the ruling of state and local government (McMahan, 2006, p.6-7).
2.3.1 Changes in rural property

Cities came into being as a result of changes occurring in rural areas. These changes were like increase in population and as population increases then other activities also increases including economic actions. Due to increase in all activities there is need for more property. As need increases availability of property decreases and also price of the property goes up. With emerging developments new roads were constructed along with transportation facilities, which linked new growing cities to rural areas. Meanwhile the property prices continued to go up. Many farmers sold out their property and moved to cities.

This shift of rural property into cities is not automatic. There are many institutes, and many people are involved in it. But mostly local government facilitates these property shifts. Local governments do this by rearranging and adding new facilities to the agriculture property of farmers, and also providing other facilities like creation of canal, setting rules and regulation for water distribution etc. in doing so local government generates revenue in the form of tax.

Most people that like to invest in property, or we can say that property investors always keep an eye on these matters to get maximum benefits. They normally purchase agriculture property at comparatively low price and when local government starts developments in that area they sell out those properties at higher price than that of purchase price and get profit. The benefits an investor gets out of real estate are normally very high ranging from 30%-50% (McMahan, 2006, p.7-10). While getting good benefits we cannot ignore high risk associated with these properties. There is risk that normally the developments that were announced by local government about the specific rural area usually take long time. These delays in developments gradually decrease the possibility to get good returns.

With important communication developments the rural areas converted to cities, so the investors could purchase agriculture property at low price and sold at higher price starting to invest in construction of buildings.
2.3.2 Declines and renewal

With the construction of buildings the cities became larger and larger. It is to be expected there should be area away from these complicated cities that charge less than the cities. These are normally the areas with very less buildings. But as time passes down, fall of these areas starts to be followed by renewal of all types of buildings including, residential areas and commercial areas.

This is life cycle of real estate that continues over the 15 to 30 years, Including growth, decline and renewal (McMahan, 2006, p.7-10). This life cycle provides great variety of possibilities for real estate investors to earn more on their investment and also increases the competition among various companies.

2.4 Property factors

There are many factors that affect the property and especially the future price of real estate. Now a day more focus is on planning about property location. Soil is an important factor that can affect the planning about the real estate. This is because the soil sample decides whether this location is best for plants or best to build huge buildings on it. Change in government rules and regulation at all level like central and local government levels also have affect on real estate (McMahan, 2006, p.7-10).

2.5 Information about the market timing through real estate cycle

The investors that are booming in real estate are of the viewpoint that they get success because they know the timing of market. Mean they can choose when it is time to enter in real estate market, and when to depart from that market (McMahan, 2006, p.7-10). But it is true only for the investors that know the inside information about the market. One or two times it is possible to get inside information about the changing real estate market. But an investor can not be a part of every real estate investment agreement. The point here is that real estate investors and all investors give consideration to time in order to make investment decision. So, mostly investor get idea from real estate cycle to make decision that it is time to entry and it is time to leave. According to McMahan (2006, p.15-19) a research conducted to find out the effect of real estate cycle on real estate market. The research focused on two cycles’ i.e. physical cycle (demand and supply) and financial cycle (money flow). There are various phases in real estate cycle that are as follow.

2.5.1 Recovery

It is first phase in real estate cycle and starts after recession. There is over supply of buildings because many new buildings were constructed in last period. There is low demand at this phase. With the passage of time demand will start increasing, and this increase in demand decreases the number of empty property. It will also increase the rate of property. As recovery phase moves further there are good hopes about the rate that gives encouragement to owners of real estate to increase the prices but not more than the inflation (McMahan, 2006, p.15-19).
2.5.2 Expansion

In this 2nd phase price continues to increase and gets to the point called "cost feasible" that starts the construction of new buildings (McMahan, 2006, p.15-19). It is a period of tense supply. At this point demand is higher than supply because it needs more time to construct new buildings. Real estate cycle reaches its top point when demand and supply become equal. Prior to this equilibrium point growth in demand is higher than in supply but after passing that point growth in supply is higher than in demand.

2.5.3 Hyper supply

It is some time difficult for real estate investors to understand this equilibrium point due to the reason that at this point market is showing very strong position to investors. In fact it is beginning the growth of supply. With increasing supply there is increase in competition between different suppliers. That also results in decrease in price. When price goes slow down then real estate investors feel that construction of new building is not good at this time that results in completely stop the construction process. That stage leads to last stage recession.

2.5.4 Recession

Difference between the growth in demand and growth in supply can use as a parameter to check the real estate market slump. At this recession stage owners know that if they want to be a competitor and want to have new investors then they should decrease the prices. So they decrease the prices. Real estate market is less liquid at this stage because bid and ask difference is high. This stage again leads to stage 1 that is recovery. In which demand starts to increase slowly.

It is also kept in mind that every city has its own cycle that can differ from those of other cities. Real estate cycle also exhibits differences in different types of properties. After knowing the real estate cycle one can say that it is good to buy or sell at equilibrium, for that equilibrium analysis (McMahan, 2006, p.15-19), is one of the tool that can help to predict expected risk and return for different real estate classes.

2.6 Investment and portfolio theory

When talking about the portfolio risk and returns then investor needs to think about the number of securities in which he should invest. So while choosing the portfolio investor must hold more than one asset. This is because if the investor has only a single security in his portfolio then there might be more risk associated to that single security. Risk of portfolio is not simple average risk. This is because when we talk about the portfolio risk, calculating this risk is depend upon the returns of all the securities in that portfolio. And there is a possibility that returns of these securities are moving in same direction meaning that if one security gives good returns then other will also give the good returns under the same conditions or the returns from these securities move in opposite directions meaning that one security gives good returns and other give bad returns. In this case good returns compensate bad one, reducing the risk of portfolio. Returns are calculated on average basis. From these average returns it is possible to calculate the mean returns. After calculating the mean return it is also good to check how much variability these securities are showing from their mean returns. For that
variance is calculated which can be calculated by simple formula like \( (R_i - R^*) \) (Elton, Gruber, Brown & Geotzmann, 2007, p.4-6) where \( R_i \) shows return of security \( i \) and \( R^* \) show mean return.

It is general observation that everyone has something in his possession. Mean that everyone owns portfolio of assets and this portfolio are generally consisting of both real assets that include house, car and refrigerator etc. as well as financial assets that consist of shares, bonds and real estate etc. One can say that selection of the portfolio is the result of series of disorganized and central decision or it may be a result of previous planning about portfolio.

2.7 The economic theory of choice (under certainty)

When an investor is going to make investment choice, he has to take certain decision about specific investments. Then definitely faces problems regarding decision making. As large numbers of alternatives are available to investor, decision making is important. There are certain things that should be kept in consideration while making decision like there are different alternatives available, then there is a selection criterion from those available alternatives to select single alternative and then reach to solution to decision problem. Economic theory of choice describes this decision making problem by dividing this analysis into two parts that are, a).first of all specify the available alternative. b) How to select from those alternatives (Elton et al., 2007, p.5-6).

2.7.1 Opportunity set

When we talk about the opportunity set, then there are so many opportunities available to the investors like an investor has an opportunity to invest or consume equal amount of money after equal interval and save nothing, another opportunity for investor is to save all his money in first period and spend everything he saves in second period (Elton et al., 2007, p.5-6). Another option for investor is to spend all his income now and never think about future. Thus this opportunity set provides the investor with large number of opportunities. It also shows that if investor spends or consumes more in first period then he will live with less saving and hence with less spending or consumption in next period. Now it is up to investor to choose from these opportunities.

2.7.2 The indifference curve

According to the economic theory of choice an investor can choose among different opportunities by using curves known as “indifference curves” or “utilities curves” (Elton et al., 2007, p.5-6). These indifference curves show the investor preferences toward his saving in different periods of time. These curves are constructed in such a way that at any point on this curve an investor is supposed to be happy. Let’s explain this with the help of example; suppose there are two periods for consuming an investor’s saving period 1 and period 2, and there are different indifference curves like IC1, IC2 and IC3 ad so on. Now for these two periods of consumption investor will go higher indifference curve. This is because, if we keep period 1 consumption constant, then we can see that constant consumption in first period results in more consumption in period 2 and so on. From this example it is clear that if the investor consumes less in first period than he has more to consume in next coming periods so from above discussion we come to point the two things are important to reach the solution to
investment decision that are, a). Different choices that is available to investors called opportunity set and b). Investor taste and preferences, called as indifference curves or utility curves.

2.8 Portfolio analysis

2.8.1 Opportunity set under risk

As it is clear from above discussion everyone owns portfolio and has lot of opportunities to choose among available assets. So it is clear that an investor always holds more than one asset in his portfolio (Elton et al., 2007, p.46-48). This is because of various reasons the most important are risk and return factors that are associated with that portfolio of assets. So, usually an advice is given by financial analysts to the investors that they should hold more assets in their portfolio rather than single asset. This is because of the risk and returns of these assets in the portfolio. In the certain situation investor decision about that investment is certain. But in uncertain situation the returns of specific investment are not known with certainty. First of all let’s take a look how can we calculate the return and risk of portfolio. The important thing in this calculation is that risk of specific portfolio is more complex than that of single asset and this risk is depending on the returns of individual assets whether the returns are moving together or moving in different directions like some assets give positive return while other move in negative direction. When there is risk then the returns are not certain and the returns are associated with different possibilities or probabilities. Commonly there are two ways to get required information one is to calculate average and other is to calculate the dispersion around that average. It is not enough to calculate the average return it is also important to have how much this average return is away from actual return. And this deviation is called variance. And it is obtained by taking square of average deviation further more taking square of variance will result in standard deviation. It is normally considered good to use standard deviation instead of variance. Here we suppose that expected returns are normally distributed. In the case when these expected returns are not normally distributed than we use some complex tests.
2.8.2 Variance of combination of assets

The analysis helps us in choosing the assets among the risky assets. Investors are not bound to choose different assets but they are free to choose different combinations of available assets so that they can invest some money in one asset and some in other asset while making different combinations. The combination of assets provides that risk of assets associated with this portfolio is different from that of different single assets and similarly variance of a combination of assets can also be different from the variance of different single assets. Let’s understand this analysis with three extreme situations like good, average and bad. When we take these three extreme situations firstly, we come to know that if the two assets in different times have good and bad returns then the investment in these assets can decrease the variance of the portfolio to investing in single asset. If the good return is not linked with bad return of other asset then this decrease in variance will continue but not reach to zero. However, it is clear that variance of combination of assets is less than the variance of less risky assets. Secondly, analysis show that under these extreme situations the returns are also different for different. If an investor invests only in one asset and gets good return but the probability of getting this good return is less than the probability of getting good returns from the combination of two or more assets, and also decreases the variance. Thirdly, this analysis with extreme situations shows some characteristics of portfolio. In certain situation portfolio has same characteristics as that of single assets separately.

2.8.3 Characteristics of portfolios in general

“Return of the assets in portfolio is a weighted average of return of individual assets” (Elton et al., 2007, p.48-50). Similarly expected return of a specific portfolio is weighted average of expected return of individual assets. Variance of portfolio is measured as square deviation of return of assets in portfolio from the mean return. The covariance is use to calculate movement of return on assets. The covariance of portfolio is the product of two values of deviation of return from mean, which is variation of return from mean of assets 1 and variation of return from mean of asset 2. Covariance can be positive or it can be negative. Covariance can be large positive figure in the case when the returns from all assets in portfolio is positive or all the returns from all assets in portfolio is negative similarly covariance can be negative in the case when return from one asset is positive and return from other asset is negative. Covariance can be positive when there positive and negative variations occur at same time and it can be negative when these positive and negative variances occur at different times. And covariance can be zero when these positive and negative variations are not related to each other. Then comes correlation coefficient also called as correlation which is obtained by dividing the covariance with the product of standard deviation of two or more assets in portfolio. This correlation is set between the ranges of +1 to -1.

2.9 Special cases

As we know that the correlation coefficient of the assets move between +1 and -1. This shows that if correlation between assets is +1, than the assets in portfolio are moving together in perfectly positive direction. But if the correlation between assets is -1, then the assets in portfolio are moving in perfectly opposite direction, such as one moves
upward while other moves downward. To know more about the relation between assets and their co-movement in portfolio let’s take a look at following cases.

2.9.1 Case 1: Perfectly positive correlation

Let’s understand this case one with the help of following equation, if the correlation coefficient between the assets is +1 then the standard deviation of portfolio can be calculated with following equation. (Elton et al., 2007, p.68-75)

\[
\sigma = \sqrt{\sigma_1^2 + \sigma_2^2 + 2x_1x_2\sigma_1\sigma_2}
\]

Where

- \(x_1\) = proportion of asset 1 held in portfolio
- \(x_2\) = proportion of asset 2 held in portfolio
- \(\sigma_1\) = standard deviation of return on asset 1
- \(\sigma_2\) = standard deviation of return on assets 2
- \(\sigma\) = standard deviation of return on portfolio

After solving the above equation we get following equation.

\[
\sigma_p = [x_1\sigma_1 + x_2\sigma_2]^2
\]

Taking the square root we get.

\[
\sigma_p = x_1\sigma_1 + x_2\sigma_2
\]

Similarly the return can be calculated with following equation.

\[
R_p = x_1R_1 + x_2R_2
\]

As the correlation between these two assets is +1, so there is linear relationship between the risk and returns of both assets. As risk increases the return also increases and vice versa. The graph between the risk and return is simply a straight line. The risk cannot be diversified by buying both of these assets or buying only single assets.

2.9.2 Case 2: perfectly negative correlation

Again we will take above equation and explain the case where two assets that are moving along with one another but in different directions that is in opposite direction. (Elton et al., p.68-75) We can calculate the risk of portfolio as follow.

\[
\sigma_p = \sqrt{\sigma_1^2 + \sigma_2^2 - 2x_1x_2\sigma_1\sigma_2}
\]

Solving the equation we get two equations

\[
\sigma_p = [x_1\sigma_1 + x_2\sigma_2]^2
\]

Or
\[ \sigma_p = [-x_1 \sigma_1 + x_2 \sigma_2]^2 \]

It is difficult to take square root of negative digit. If we want to take square root of above two equations it is necessary that right hand side of equation should be positive. When we show these calculations in graph we will get two straight lines that are moving in opposite directions that is one is moving upward while other moving downward. When the correlation coefficient is -1 then the risk of the portfolio is less than the risk of portfolio when the correlation coefficient is +1. Similarly when the correlation coefficient is -1 then there are chances that investors can have two or more assets in his portfolio that give zero risk.

2.9.3 Case 3: No correlation, correlation coefficient zero

When we take correlation coefficient zero then the equation that is used to calculate the risk of portfolio is look like this. (Elton et al., 2007, p.76-80)

\[ \sigma_p = \sqrt{[x_1^2 \sigma_1^2 + x_2^2 \sigma_2^2]} \]

As there is no correlation between the returns and risk of the assets in this portfolio which shows that these two assets are independent from each other, from this an investor can minimize the risk by choosing different proportions of two or more assets in portfolio.

2.10 Efficient set or efficient frontier

I will like to further explain the risk and returns traits of single as well as multiple assets in portfolio. Here we talk about the combination of two or more risky assets in portfolio. The analysis helps us to find the possible risky assets that an investor can hold in his portfolio. While doing so we will find a portfolio that all investors like to hold because this portfolio gives good returns and less risk. This portfolio is called efficient frontier or efficient set. (Elton et. al., 2007, p.79-80)

We can plot a graph of returns and risk related to that return because we can calculate the returns and risk, but this is right only up to theory. In real world there are many other factors that are to be considered. These factors can cause more risk than expected. While keeping in mind all other factors when we plot a graph we can get diagram like following diagram.
As we discussed earlier that an investor likes to have more returns than getting less returns for a given level of risk similarly investor likes to bear less risk than more risk for a given level of risk. So, investor likes a portfolio that gives more returns for same level of risk or gives less risk for same level of returns. In the graph look at point C and E, which represent the portfolio C and E. It is clear that investor likes to have portfolio E because it gives more returns than portfolio C at the same level of risk. If we look at portfolio C and A, then investors will like to have portfolio A over C, because A has less risk then C at same level of returns. Similarly when we look at the point D and F, both have same returns but D has more risk than F. The point A and E are two extreme points that show satisfaction to investors as investors like to have maximum returns at same level of risk, so when we look at point C and E, E give maximum return than C at same level of risk or investor likes to have a portfolio that gives less risk at same level of return, so when we look at point A and C, both have same returns but A has less risk than C. So, the point E has maximum returns and A has minimum risk. Efficient set or frontier is the area between the points A and E.

2.11 Article review

2.11.1 Diversification: real estate and equity market

When we talk about investing in real estate they think that first comes in our mind is that whether this investment in real estate is secure investment along with other assets in portfolio, And whether adding the real estate in portfolio brings long term diversification or not and especially when other stocks are not performing good. When an investor makes a portfolio using different combination of assets then it is supposed that if an investor wants diversification then he must go for commercial real estate. It is not true theoretically. It is opposite to investors expectations and it is may be because of adverse traits of real estate like, lot size, transaction cost liquidity and information irregularity. (Knight, Lizieri & Satchell, 2005, p.309-323)
Previously research was base upon valuation or appraisal returns in order to find out the benefit of real estate when add to portfolio to diversify the risk of portfolio. And they made segment of both real estate and other stocks. Appraisal base indices can be explained as “smoothed”, (Knight et al., 2005, p.309-323) because of the attitude of valuer. Valuer adds new information to these indices when new information is available to them. Authors (Knight et al., 2005, p.309-323) is of the view point that when we consider single real estate then this smoothing can increase the risk. There is lot of questions that raises about the appraisal based valuation due to the difficulties faced by investors who invested in real estate. There are many other problems except large lot size, there are many issues related to liquidity mean that time period requires selling any assets. All these problems suggest that the appraisal based valuation method is not reliable method. Despite all the problems real estate investment is considered as alternative investment that may offer easily dividable, less transaction cost etc. the attitude of real estate is slightly moving away from the expected one. Companies usually do discounting on the value of their net assets. The authors (Knight et al., 2005, p.309-323) defined discounting as unpredictable and looking at performance they come to point that there is strong relation between real estate firm and equity market. Real estate index shows the returns distribution that is not normal. Real estate assets need to exhibit traits that are similar to that of other assets in order to get long and fat tail in distribution. Authors (Knight et al., 2005, p.309-323) suggest a mean absolute deviation as measure of risk. They (Knight et al., 2005, p.309-323) suggest maximum drawdown function. Many other use semi variance as a measure of risk.

However current research and literature argue that equities show asymmetric dependence. As current research use different measurements like conditional correlation technique, copula measure etc.

### 2.11.2 Asymmetric volatility, correlation and returns dynamics

In one of the studies researcher did analysis to find price differences in U.S.A. and U.K. according to the researchers during the previous studies researcher ignore the price difference between different markets and also the impact of this on the performance of real estate portfolio. (Michayluk, Wilson & Zurbruegg, 2006, p.109-131) Current real estate prices in the different market with different time period and any change in price due to any global news is now give consideration. It may be due to the reason that most of the investors consider real estate as it show traits that are different from those of other assets in market. The value of the property is also considered due to immoveable property of real estate.

According to Michayluk et al., (2006, p.109-131) in one research conducted for the period of 1980-1988 to check the real estate indirect role in mixed portfolio, They found that there is a benefit of real estate to hold in mixed portfolio and diversify the risk. They found very low positive correlation in their studies, which provides the evidence for diversifying the portfolio.

In another research done by Eichiltz (1996, p.56-62) to find out the correlation between the returns of real estate and both shares and bonds for nine countries, He found very small correlation between them. He suggested that this low correlation show that impact of local factor on property is more than impact of local factors on shares and bonds.
Very few numbers of researches had done to find out the impact of any news on property. However, these studies showed that any news whether national or international has very low impact on property market. Michayluk et al., (2006, p.109-131) comment that there is very low risk in REIT when compare with other type of investments.

### 2.11.3 Market efficiency and returns

Another research was done in which data from Hong Kong real estate and shares was used to found the movement of securities price due to any new information. It also showed that there were high returns and low risk and weak correlation between the returns of real estate and other assets (Fu & Ng, 2001, p.227-250). According to Fama (1991, p.1575-1617) the financial assets are considered efficient in the sense that the price of these assets is set according to any new information. So the prices of securities reflect all information. But in the case of real estate it is not true. Real estate has such characteristics that never allow real estate price to change quickly. It is hard to get information about the real estate at right time because there is no central transaction system for real estate. Corgel & deRoos (1999, p.279-296) explain the link between the risk and return of private real estate market, and they found that real estate returns have very less risk as compare to other risky securities. The correlation between the returns of real estate and stock market is very weak.

### 2.11.4 Global assets performance as risk adjusted tool

With growing world there is increase in interest to know more about the risk and return characteristics various securities especially across the globe. In one of the study researcher try to show the risk, return and correlation between different financial assets especially in capital market (Reilly & Wright, 2004 p.63-75). A research had done by Ibbotson, Siegel & Love, (1985, p.4-23), in which the authors included all important securities like shares, bonds real estate monetary metals and money market instruments to find the returns and correlation between them. They found that real estate generate excellent returns among all assets. Authors also check the correlation between all these assets and found that there is very less correlation between the shares and bonds, similarly real estate had very weak correlation not only with shares but also with bonds. Real estate had strong correlation with cash and metals. When they check the risk adjustment of these assets they found that the shares and bond across the world were not showing positive results but real estate and metal were performing very well.

### 2.11.5 Real estate risk and return

Whenever we talk about investment, choosing portfolio, looking at risk and returns all these things we normally use historical data. And we use that historical data and some time is difficult to get accurate historical data due to many reasons. And to get historical data about the risk and returns of real estate is quite difficult. In one of the studies that includes major real estate investors, researchers, large life insurance companies, real estate advisors, large pension funds etc. an attempt was made to check the expected inflation, returns , risk associated to that returns, and finally to find the correlation between the returns of real estate and returns from stock, and correlation with returns
from bonds. (Hartzell & Webb, 2001) From the survey it was found that inflation will increase in coming years. The returns expectations are high. Mean that return will increase in coming period. While founding the correlation they found that the correlation between the returns of real estate and stock returns is negative showed that the returns are moving in opposite directions. While checking the correlation between the returns of real estate and bond, they found that these two securities have no correlation. These findings showed that we can get diversification advantage by adding more and more real estate in our portfolio. As the diversification can be achieved if the correlation is zero or a little bit negative. From these studies it was suggested that if the investors want to enjoy the advantages of diversification then he should keep real estate in his portfolio.
Chapter 3- Method Section

In chapter 3 the methods and statistical tools that are used to answer the research question are going to be discussed. This chapter contains selection of study subject, methodological assumptions that explain about ontological assumptions, constructionism, epistemological assumptions, deductive and inductive, research design, research strategy and data collection.

3.1 Selection of study subject

As in today’s world everyone wants to invest and earn good returns with less risk. Also there are many options for investment available to investors like shares and real estate etc. The first thing is about the choice of investment, that an investor needs to take into consideration is where to invest meaning invest only in shares, or invest only in real estate or to invest in other securities. Should an investor choose a portfolio that is consisting of both shares and real estate? To choose a portfolio that contains both shares and real estate an investor needs to know the correlation between shares and real estate. This is because if the both assets have strong correlation then there will not be any diversification at all. Diversification can only be achieved if there is week or no correlation exists between securities. Now it’s investor’s choice to choose their investment priorities whether to invest only in shares or real estate. But if there is no correlation then it mean one asset will diversify the other so, the investors should choose optimal level of both assets in their portfolio. As I am looking my future in financial sector, it is hope from my side that this research paper about calculating the correlation between returns of shares and real estate helps both individual as well as institutional investors to choose portfolio.

Courses like corporate finance, investment, analysis of financial statements and valuation, Quantitative research methodology in social science and the most important analysis of financial data offered by Umea school of business provides me good base and understanding about quantitative research studies and encouragement to do this type of research. And the course research methodology in business administration provides guidance about research.

I am writing this research paper while keeping in mind the investors. For my research paper I am using stock index data as well as real estate index data for last 20 years, to check and calculate correlation between these two assets.

3.2 Methodological Assumption

When we talk about the methodological assumptions then there are two assumptions as we know that are 1. Ontological assumptions: (Bryman & Bell, 2007, p.11-20) that deal with reality. It can be explain like social entities have existence. And knowing the existence of these social entities deal with ontology and most important thing here is to understand whether these entities are just exist without any affect social particulars like an object or these entities have existence because of social factors that are affecting these entities. It can also be said that these entities came into being because of various actions of society. This concept can be explained further with two terms, objectivism and constructionism.
Objectivism and constructionism (Bryman & Bell, 2007, p.20-22) are two ontological concepts. As in real world there are objects that have existence mean that they are tangible in nature one can touch and feel real world things same is the view point of Objectivism when applying to social world. According to objectivism one can feel any firm, as tangible thing. This shows that all the firms have real existence as an object. All the firms have some standardized process according to specified rules and regulations, have employees working on various positions, have objective for existence and so on. Existence of firms as object is a reality.

Constructionism is another ontological concern that is opposite to the point that the firms and their culture are already defined. Mean that firms or organizations are not existing as objects as said before in objectivism but it came in existence by the peoples and their actions. According to the constructionism firm and its culture are constructed by the peoples who are working in these firms. Employees are building the firms and their cultures with continuous process.

2. Epistemological assumptions: that deals with knowing the reality. The basic concern of epistemology is the studying the social world with the help of real world. Epistemology deals how natural science procedures and principles can be apply in order to found the reality of social world. Like in natural science lab experiments done in order to found the reality but it is not the case in social science. It is not possible to conduct lab experiment to find reality of social science. So, Positivism is epistemological concept that provides the guidance when social science is treated as natural science. There is different point of view about positivism, like someone considers it as descriptive type. Mean that explaining the research idea, while other takes it as negative term that is used to explain data. Positivism is some think that is related to find reality of social theories through research and consider fundamentals of both deductive and inductive approaches. Also help to analysis the theories and developing laws based on those theories. It should be kept in mind that positivism is different from realism a term used natural science experiments.

As per objective it was an epistemological type of study in which an attempt made to know the reality in social science. Positivism used as epistemological approach that involves developing hypothesis or theory and then checking this hypothesis by collecting facts and figures and finally offer basis for developing law.

As the objective is to calculate the level of correlation between the returns of real estate index and stock exchange index, so, positivism is best choice. Knowing the level of correlation between them is social reality that can be found by first supposing hypothesis, gathering information in the form of facts and figures, checking these facts and figures and finally accepting or rejecting the hypothesis that provides basis for developing law.

3.3 Deduction and induction

Deductive and inductive theories are also called as scientific theories, (Bryman & Bell, 2007, p.4-15, p 55-62) and are mostly used in doing research. Deductive theory follows the pattern as

Theory ———> findings or observations
In *deductive approach*, studies are done on already known theories. On the basis of these theories hypotheses are developed and then collect data and at the end find the result and show observation and test hypothesis and confirm the theory. In *deductive theory* there is no development of new theory as a result of studies. While *inductive theory* is opposite to that of *inductive theory*. In *inductive studies* there is some sort of observation or finding. On the basis of these observation data is collected and finally develop a theory. Inductive studies follow the pattern as:

Observation or finding ➔ theory

There is another term used that is abduction which is combination of both induction and deduction. As in induction there is development of theory after doing observation and finding and in deduction there are observation and finding by following the specific theory. Some time it happened that researcher used both induction and deduction which is called abduction.

Here deductive approach used because in deductive approach researcher are going to confirm or check already existing theories. As theory is already exists that “no correlation is consider good”. It means that *deductive approach* is most suitable for this type of study. On the basis of this theory a hypothesis developed that “what is correlation level between the returns of Real estate price index and OMX Stockholm 30 index”. Data collected and different statistical tools used to find the results and observation and finally confirming the theory. *Deductive approach* used in this study as objective is not to develop new theory as in *inductive approach*.

### 3.4 Research Design

Different research designs are used for evaluation of studies. Like *experimental design*, *cross sectional design*, *longitudinal design*, *case study design* and *comparative design*. (Bryman & Bell, 2007, p.4-15) In *experimental design* researcher conducts experiments like scientists do experiment in lab, in *cross sectional design* two or more variables are studied at same time, in *case study* there is research on the base of single case similarly in *comparative design* there is comparative studies conducted while setting two cases as base. (Bryman & Bell, 2007, p.55-62)

The research design that used to find the correlation between the returns of real estate and stock exchange is *cross sectional design*. As it mentioned before that in *cross section design* two or more variables studied at the same time. So, same is case with this study there are two variables i.e. (Rr) Real estate returns and (Rs) stock returns.

### 3.5 Research Strategy

There are two main types of research strategies used to collect data that are qualitative and quantitative research strategy (Bryman & Bell, 2007, p.28-29). Qualitative strategies deal with the words and require the quality. Qualitative strategy is used to develop new as well as previously developed theories. Qualitative strategy is more commonly used to get deep understanding of any topic or case. It usually involves deep study of all the available material that is relevant to that specific case. Using the qualitative strategy data is collected by ethnography and participating in culture of specific region, by conducting interview, by focus group etc.
While in quantitative research strategy there are various quantitative methods that involve various calculations. As the name shows it deal with numbers. It is usually used to test or verify specific theory. Quantitative strategy uses different methods to collect data like, social surveys, structured interviews, using different sampling techniques, in which a sample from large number of objects is chosen.

In this research paper quantitative research strategy used, Since the objective is to find the correlation between the returns of real estate index and stock exchange index. Quantitative data is more helpful in order to generate more objective conclusion then subjective one. Courses like *quantitative research methodology in social science* and *analysis of financial data* helps a lot to conduct quantitative research study.

### 3.6 Data Collection Methods

Since, the objective of research is to find out the correlation between the returns of real estate price index and returns of stock exchange price index in Sweden. It needs both theoretical as well as empirical study. For empirical study historical real estate price index data and stock price index data for last 20 years required. Data is collected from data stream of Umea university library. And the source of collecting data of real estate price index is statistic Sweden. This statistical data is available at the home page of statistic Sweden ([www.scb.se](http://www.scb.se)). While the stock price index data is collected from data stream of Umea university library. I choose OMX Stockholm 30 (OMXS30) – price index randomly among other indices available. And I choose three types of real estate in Sweden i.e. one or two dwelling buildings, building for seasonal and secondary use, and multi dwelling buildings. The objective is to calculate the correlation between these three types of real estate price index with stock price index separately one by one.

Along with using the data stream to collect historical data, also search engine in Umea library used to find articles that are related to research question that is correlation between the returns of real estate and stock exchange. Different book from Umea university library used to find theories that are helpful in understanding investment decision, choosing the right combination of assets to invest, which correlation is best to choose etc.

### 3.7 Mathematical and Statistical Procedures

Statistic is all about *collecting data, organizing data, analyzing data, and finally presenting data* (Agesti & Finly, 2008, p.4-6). Two broad areas of statistics are *descriptive statistics* and *inferential statistics* (Agesti & Finly, 2008, p.4-6), in which graphs and numerical values presented and finally drawing a conclusion by using some specific method respectively. Defining the variables and then doing measurements on that variables is important because there is need to illustrate, make comparison and finally assess the variables. There are three main *data level* that are *nominal data* (a data other than numerical and in which there is no ordering of variables), *ordinal data* (a data in which an order is given to various variables e.g. if there are two variables like male and female than order is given like 1 for male and 2 for female) and *interval data* (a data that is mostly consist numerical data).

Numerical measures like *mean, median, quartile, dispersion, variance, standard deviation and inter quartile* are some of the measure used mostly in quantitative research studies (Ruppert, 2004, p.10-25). It can also be said that these measures are
used in finance. Than come correlation between the variables and for that purpose *Pearson correlation* is used. Correlation explains the movement direction of variables. *Multiple regression* than further explain the correlation of variables (Ruppert, 2004, p.10-25). *Multiple regressions* mostly used to check if there is correlation between variables and so on.

As the objective of study was to find correlation level between returns of real estate price index and stock price exchange, so firstly *Pearson correlation* used to find the correlation level between returns of both price indices. And then *regression analysis* used to further confirm the correlation. But before doing all this it will be useful to describe type of data, choice of statistical test used in this study and then methods.

### 3.8 Data type

As the purpose is to find the correlation between the returns of real estate price index and stock price index, and mentioned before that I choose three types of real estate i.e. One- or two dwelling buildings, Buildings for seasonal and secondary use and Multi-dwelling and commercial buildings; I take price indices for these three types of real estate for last 20 years (i.e. 1989-2008) on yearly bases. Similarly I collect stock price index (OMXS30) data for last 20 years (i.e. 1989-2008) on yearly bases. Finally calculate the correlation between these each type of real estate price index and stock price index.

As the purpose of study is to find, is there any correlation between the returns of real estate price index and stock price index. Hypothesis is that ``there is no correlation between the returns of real estate price index and stock price index`` mean that both move independently. Deductive approach used in studies because in deduction researchers try to check existing theories, same is in this studies.

### 3.9 Choosing statistical test

Most probably ``analyze relationship between two variables`` used. In which type of is interval and it is assumed that population is normally distributed. And will going to learn and use ``*Pearson rank correlation test*`` (Agosti & Finly, 2008, p.10-16).

Analyze relationship between two variables

![Diagram of Data Types](image-url)
Variables
There are two variables that are as Follow:

Rs = Returns on stock price index
Rr = Returns on real estate price index

3.10 Methods
To calculate the correlation between the returns of real estate price index and stock price index did simple calculations while using MS Excel and SPSS software.

First of all calculate the returns on stock prices by using the following formula.

Rs = ending year price – beginning year price / beginning year price...............................(1)
Rr = ending year price – beginning year price / beginning year price...............................(2)

Where

Rs = return on stock
Rr = return on real estate

Returns of stock for 20 years calculated by using this formula. Similarly by using the same formula calculate the returns of real estate. Then further calculate the average returns of both stock price returns and real estate price returns as follow.

\[ Rs^* = \frac{\sum R_s}{\text{number of year}} = \frac{R_{s1}+R_{s2}+R_{s3}+R_{s4} \ldots \ldots \ldots \ldots R_{s20}}{M} \] ...............................(3)
\[ Rr^* = \frac{\sum R_r}{\text{number of year}} = \frac{R_{r1}+R_{r2}+R_{r3}+R_{r4} \ldots \ldots \ldots \ldots R_{r20}}{M} \] ...............................(4)

Where

Rs* = expected return on stock
Rr* = expected return on real estate

After calculating the expected return it is necessary to find how much dispersion is there between the return and expected return of both real estate prices and stock prices. And this dispersion is checked by taking the differences between the return and average return i.e.

Dispersion = Rs – Rs*
Dispersion = Rr – Rr*

While checking this dispersion there might be problem that some of the outcome may be positive and some of the outcome may be negative. To overcome this problem we normally use square of any number this is because the square of any positive as well as negative number is positive. So we take square of (Rs - Rs*) and (Rr - Rr*) ². When we take average of square deviation then it is known as variance (Elton et al., 2007, p.144-146). After that I calculate the average of these square deviations as follow.

Variance of sock return = \[ \sigma^2_s = \frac{\sum (R_s - R_s)^2}{M} \] ...............................(5)
Variance of real estate return \( \sigma_r^2 = \frac{\Sigma (R_r - R_r^*)^2}{M} \) \hspace{1cm} (6)

Knowing the variance we can say that how much variation the returns are showing. Standard deviation can be calculated by taking the square root of these variances. Standard deviation is mostly used as substitute of variance (Elton et al., 2007, p.144-146). It also shows the dispersion of returns from the expected returns or mean returns.

Standard deviation \( \sigma_s = \sqrt{\text{variance of stock returns}} \) \hspace{1cm} (7)

Standard deviation \( \sigma_r = \sqrt{\text{variance of real estate returns}} \) \hspace{1cm} (8)

To calculate the correlation between the returns of real estate price index and stock price index we need to have standard deviation of both real estate returns and stock returns. Along with standard deviation of both we need covariance of both real estate returns and stock returns. So the covariance is calculated as.

Covariance \( (R_s, R_r) = \Sigma [(R_s-R_s^*) (R_r-R_r^*)] \)

Covariance shows the co-movement of returns of both real estate and stock away from expected return or mean returns.

Correlation is calculated by dividing the covariance \( (R_s, R_r) \) by standard deviations of both real estate and stock. So, correlation between returns of real estate and returns of stock price is calculated as

Correlation \( (R_s, R_r) = \rho = \frac{\text{covariance} (R_s, R_r)}{\sigma_s \sigma_r} \)

Firstly use simple calculation to calculate correlation between returns of both real estate price index and stock price index. By doing these calculations and using portfolio theory will help the investors to form efficient portfolio that can give them better returns with desire level of risk. So, knowing the correlation will definitely help in developing efficient portfolio. Secondly use SPSS software to calculate Pearson correlation that will further help to understand correlation.

### 3.11 Correlation and covariance

Variation of individual security described by variance but if there are two variables than covariance and correlation is more suitable (Ruppert, 2004, p.34-38). Covariance calculates the linear relationship between two variables and showed that how these two variables are jointly deviate from there mean (Ruppert, 2004, p.61-62). Covariance will be high with large deviation from mean and vice versa. Correlation tells how two variables are directly related (Ruppert, 2004, p.63-64). A correlation 0.25 consider week, 0.50 consider fairly strong, 0.95 consider quite strong and 1 considered strong relationship. And 0 correlations between two variables represent that two variables are not related to each other. And if there exists relationship between variables than one variable can be used to forecast another variable, regression is normally used for that purpose which discussed later in this chapter.

### 3.12 Confidence interval

Confidence interval can be defined as a "probability of including true constraint" (Ruppert, 2004, p.63-64) and it can be explained by \( \alpha = \text{alpha} \). For example if \( \alpha = 0.05 \), than it’s mean that there is 95% chances to include all parameter. In this study \( \alpha = 0.05 \).
Mean that 95% confidence that there is no correlation between the returns of real estate price index and stock price index and 5% chances that there exists some correlation between them.

### 3.13 Hypothesis

Null hypothesis = there is no correlation between returns of real estate price index and stock price index

Alternative hypothesis = there is correlation between returns of real estate price index and stock price index.

Normally while doing hypothesis there are two types of errors i.e. type one error and type two errors. (Ruppert, 2004, p.62-63) Type one error occurs when null hypothesis is not accepted although it is right similarly type two errors occur when null hypothesis is not rejected although it is wrong. So in this study after calculating correlation between returns of real estate price index and stock price index, it can be discussed about which type of error occurred.

Significance level is used to check the probability of occurrence of type one error. If the chance of occurrence of type one error is high than significance level value should be small and vice versa. (Anderson, Sweeney & Williams, 2008, p.340-341) So in this case, as stated before significance level represented by $\alpha = 0.05$

### 3.14 P value

It is already stated that $\alpha$ (alpha) can be used for accepting or rejecting the hypothesis. The next thing that comes in mind is that at what cost of $\alpha$ (alpha) researchers made their decision about accepting or rejecting the hypothesis. To answer this question p value used and p value described as smallest value of $\alpha$ (alpha) by which researchers can reject or accept the hypothesis (Ruppert, 2004, p.64-65). If p value is smaller than $\alpha$ (alpha) null hypothesis will be rejected and if the p value larger than $\alpha$ (alpha) null hypothesis will be accepted. P value in addition to deciding whether to accept or reject the hypothesis also helps to understand how accurate the decision is.

### 3.15 Pearson correlation

As the hypothesis is that there is no correlation between returns of real estate index and stock index returns and Pearson correlation used to test the hypothesis (Coakes, 2005, p.66-68). It is mostly used to find the correlation coefficient. It is used to describe the level to which two variable proportional to each other (statsoft.com, 2010). SPSS software help to calculate Pearson correlation and used Pearson correlation for each type of real estate and finally for all three types of real estate and stock index. To test the hypothesis we first define null hypothesis and alternative hypothesis as follow

Null hypothesis: `there is no correlation between returns of real estate index and stock index returns``

Alternative hypothesis: `there is correlation between returns of real estate index and stock index returns``. By using Pearson correlation the hypothesis was tested and discussed the findings in next chapter.
3.16 Regression analysis

Regression is well known statistical tool used more often. In it researchers defined their variables as *response variable* \(Y\) and *predictor variable* \(X\) (Ruppert, 2004, p.169-174). The purpose of the regression analysis is to find out relationship between the two main types of variables that are *response variable* \(Y\) and *predictor variable* \(X\). And mainly found whether *response variable* \(Y\) have some relationship with *predictor variable* \(X\) or not and after knowing the relationship did forecasting for *response variable* \(Y\).

Equation for regression analysis is as follow

\[ Y = \beta_0 + \beta_1 X + \varepsilon \]

Where

- \(Y\) = response variable
- \(\beta_0\) = intercept
- \(\beta_1\) = slope
- \(X\) = predicted variables
- \(\varepsilon\) = error

If in the equation above we put \(\beta_1, X\) and \(\varepsilon\) equal to zero than \(Y\) will be equal to \(\beta_0\) and can be said as probable value of \(Y\). similarly \(\beta_1, \beta_2, \beta_3, \ldots, \beta_n\) represent change in probable value as change take place in *predictor variable* \(X\). This is the case when there is only one *predictor variable* (Ruppert, 2004, p.174-180). But when we have more than one *predictor variables* than *multiple regression* used and equation become as follow

\[ Y = \beta_0 + \beta_1 X_1 + \ldots + \beta_n X_i + \varepsilon \]

So this equation can be used to find relationship between *response variable* and various *predictor variables*. In this research thesis returns on stock price index can be said as *response variable* \(Y\) and return on real estate price index can be said as *predictor variable* \(X\). As there are three type of real estate that are one or two dwelling buildings, seasonal or commercial buildings and multi dwelling buildings. So we can say that there are three *predictor variables* \((X_1, X_2,\text{ and } X_3)\). As per objective to know the correlation between the returns of stock price index and real estate price index it will be nice to know how returns on stock price index related to returns of three different types of real estate. So, regression analysis used to find how the returns of stock price index related to the returns of three types of real estate price index. Or it can be said that regression analysis used to found the relationship between OMX 30 price Index and three types of real estate i.e. one or two dwelling buildings, seasonal or commercial buildings and multi dwelling buildings.
Chapter 4- Empirical Observations And Findings:

In this chapter the observation and finding about the correlation between the returns of estate price index and stock price index will be shown by author.

4.1 Calculation of Returns

4.1.1 OMX Stockholm 30 index

First of all calculate the returns from price index of OMX Stockholm 30 index for last 20 years (1989-2008) by using the equation as described above. i.e. Rs = ending year price – beginning year price / beginning year price.

Table 1: Annual returns of OMXS 30 index

<table>
<thead>
<tr>
<th>YEARS</th>
<th>AVG INDEX</th>
<th>RETURNS (Rs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1989</td>
<td>201,0443162</td>
<td></td>
</tr>
<tr>
<td>1990</td>
<td>191,251029</td>
<td>– 0,048712082</td>
</tr>
<tr>
<td>1991</td>
<td>185,2812482</td>
<td>– 0,031214372</td>
</tr>
<tr>
<td>1992</td>
<td>164,483259</td>
<td>– 0,112250913</td>
</tr>
<tr>
<td>1993</td>
<td>224,60863</td>
<td>0,365540976</td>
</tr>
<tr>
<td>1994</td>
<td>283,8603573</td>
<td>0,263799869</td>
</tr>
<tr>
<td>1995</td>
<td>320,3429949</td>
<td>0,128523186</td>
</tr>
<tr>
<td>1996</td>
<td>389,0581686</td>
<td>0,214504999</td>
</tr>
<tr>
<td>1997</td>
<td>576,4690491</td>
<td>0,481704012</td>
</tr>
<tr>
<td>1998</td>
<td>693,3688265</td>
<td>0,20278587</td>
</tr>
<tr>
<td>1999</td>
<td>834,588263</td>
<td>0,203671453</td>
</tr>
<tr>
<td>2000</td>
<td>1293,192003</td>
<td>0,549496992</td>
</tr>
<tr>
<td>2001</td>
<td>869,8835738</td>
<td>– 0,327336102</td>
</tr>
<tr>
<td>2002</td>
<td>631,8878945</td>
<td>– 0,273594865</td>
</tr>
<tr>
<td>2003</td>
<td>545,8873878</td>
<td>– 0,136100893</td>
</tr>
<tr>
<td>2004</td>
<td>695,9077569</td>
<td>0,274819262</td>
</tr>
<tr>
<td>2005</td>
<td>828,7897559</td>
<td>0,190947719</td>
</tr>
<tr>
<td>2006</td>
<td>1013,669861</td>
<td>0,223072382</td>
</tr>
</tbody>
</table>
These are the returns that are calculated for OMX Stockholm 30 index by using simple formula. And these calculations are same and are useful in finding the correlation between the returns of all types of real estate in Sweden as well as individually for all three types of real estate that used for this studies.

From these returns calculate expected or mean return for OMX Stockholm 30 index by using simple average formula as follow.

\[ \text{Rs*} = \frac{\sum \text{Rs}}{\text{number of year}} = \text{Rs1} + \text{Rs2} + \text{Rs3} + \text{Rs4} \ldots \ldots \ldots \text{Rs20/M} \]

And the expected return calculated is

\[ \text{Expected (Rs*)} = 0.108893332 \]

4.1.2 Correlation between the returns of one or two dwelling building price index and OMX Stockholm 30 index:

Similarly as calculated the returns of stock exchange index from the price index of stock exchange than calculate the returns of one or two dwelling building from real estate price index for one or two dwelling building. And calculated following returns followed by expected returns or mean return.

### Table 2: Annual returns of one or two dwelling buildings

<table>
<thead>
<tr>
<th>YEARS</th>
<th>AVG REAL STATE PRICE (one or two dwelling building)</th>
<th>RETURNS (Rs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1989</td>
<td>181</td>
<td></td>
</tr>
<tr>
<td>1990</td>
<td>203</td>
<td>0.121546961</td>
</tr>
<tr>
<td>1991</td>
<td>217</td>
<td>0.068965517</td>
</tr>
<tr>
<td>1992</td>
<td>197</td>
<td>– 0.092165899</td>
</tr>
<tr>
<td>1993</td>
<td>175</td>
<td>– 0.111675127</td>
</tr>
<tr>
<td>1994</td>
<td>183</td>
<td>0.045714286</td>
</tr>
<tr>
<td>1995</td>
<td>184</td>
<td>0.005464481</td>
</tr>
<tr>
<td>1996</td>
<td>185</td>
<td>0.005434783</td>
</tr>
<tr>
<td>1997</td>
<td>198</td>
<td>0.07027027</td>
</tr>
<tr>
<td>1998</td>
<td>217</td>
<td>0.095959596</td>
</tr>
</tbody>
</table>
These are returns from these returns, than calculate expected or mean return by using the same simple average technique and find the expected or mean return that is as follow.

\[
\text{Expected Return (Rr*)} = 0.055958056
\]

Now after calculating the returns and from those returns the expected returns for both OMX Stockholm 30 index and one or two dwelling building, there are need to check how much variation these returns are showing from the expected return. And then calculate the deviation by using the following formula as mentioned above.

Variance of stock return = \( \sigma^2_s = \frac{\Sigma (R_s - R_s)^2}{M} \)

Variance of real estate return = \( \sigma^2_r = \frac{\Sigma (R_r - R_r^*)^2}{M} \)

Standard deviation = \( \sigma_s = \sqrt{\text{variance of stock returns}} \)

Standard deviation = \( \sigma_r = \sqrt{\text{variance of real estate returns}} \)

And calculate follow variance and standard deviation for both OMX Stockholm 30 index and one or two dwelling building as follow.

<table>
<thead>
<tr>
<th>Year</th>
<th>Stock</th>
<th>Variance (( \sigma^2 ))</th>
<th>Standard deviation(( \sigma ))</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td>237</td>
<td>0.060572</td>
<td>0.246114</td>
</tr>
<tr>
<td>2000</td>
<td>263</td>
<td>0.004017</td>
<td>0.063382</td>
</tr>
<tr>
<td>2001</td>
<td>284</td>
<td>0.066225166</td>
<td>0.096273292</td>
</tr>
<tr>
<td>2002</td>
<td>302</td>
<td>0.09631728</td>
<td>0.246114</td>
</tr>
<tr>
<td>2003</td>
<td>322</td>
<td>0.09631728</td>
<td>0.246114</td>
</tr>
<tr>
<td>2004</td>
<td>353</td>
<td>0.11369509</td>
<td>0.337162</td>
</tr>
<tr>
<td>2005</td>
<td>387</td>
<td>0.106728538</td>
<td>0.326803</td>
</tr>
<tr>
<td>2006</td>
<td>431</td>
<td>0.029350105</td>
<td>0.171209</td>
</tr>
<tr>
<td>2007</td>
<td>477</td>
<td>0.029350105</td>
<td>0.171209</td>
</tr>
<tr>
<td>2008</td>
<td>491</td>
<td>0.029350105</td>
<td>0.171209</td>
</tr>
</tbody>
</table>

And found that returns of OMX Stockholm 30 index on average showing standard deviation of \( \sigma = 0.246114 \), and one or two dwelling building show standard deviation of \( \sigma = 0.063382 \).

But to calculate the correlation between the returns of one or two dwelling building and OMX Stockholm 30 indexes there is need to find the covariance between returns of real
estate price index and stock price index. So, the covariance between the OMX Stockholm 30 index and one or two dwelling building is calculated by using the above mentioned formula as follow.

\[ \text{Covariance (Rs, Rr)} = \sum [(Rs-Rs^*) (Rr-Rr^*)] \]

\[ \text{Covariance (S,R)} = 0.001106672 \]

From this covariance, calculate the correlation between the returns of OMX Stockholm 30 index and one or two dwelling building by using above mentioned formula as follow

\[ \text{Correlation (Rs, Rr)} = \rho = \frac{\text{covariance (Rs, Rr)}}{\sigma^2s^* \sigma^2r} \]

\[ \text{correlation, } \rho (S, R) = 0.070944 \]

So, the correlation between the returns of OMX Stockholm 30 index and one or two dwelling building price index is approximately zero. Mean that very close to zero i.e. 0.070994.

### 4.1.3 Correlation between the returns of seasonal and secondary use buildings price index and OMX Stockholm 30 index

Returns of buildings for seasonal and secondary use are calculated followed by expected return are as follow

<table>
<thead>
<tr>
<th>YEARS</th>
<th>AVG REAL ESTATE PRICE(buildings for seasonal and secondary use)</th>
<th>RETURNS (Rs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1989</td>
<td>191</td>
<td></td>
</tr>
<tr>
<td>1990</td>
<td>216</td>
<td>0.130890052</td>
</tr>
<tr>
<td>1991</td>
<td>253</td>
<td>0.171296296</td>
</tr>
<tr>
<td>1992</td>
<td>225</td>
<td>– 0.110671937</td>
</tr>
<tr>
<td>1993</td>
<td>205</td>
<td>– 0.088888889</td>
</tr>
<tr>
<td>1994</td>
<td>215</td>
<td>0.048780488</td>
</tr>
<tr>
<td>1995</td>
<td>215</td>
<td>0</td>
</tr>
<tr>
<td>1996</td>
<td>219</td>
<td>0.018604651</td>
</tr>
<tr>
<td>1997</td>
<td>228</td>
<td>0.04109589</td>
</tr>
<tr>
<td>1998</td>
<td>248</td>
<td>0.087719298</td>
</tr>
<tr>
<td>1999</td>
<td>268</td>
<td>0.080645161</td>
</tr>
<tr>
<td>2000</td>
<td>306</td>
<td>0.141791045</td>
</tr>
<tr>
<td>Year</td>
<td>Buildings for seasonal and secondary use</td>
<td>Expected Return (Rr*)</td>
</tr>
<tr>
<td>------</td>
<td>------------------------------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>2001</td>
<td>335</td>
<td>0.094771242</td>
</tr>
<tr>
<td>2002</td>
<td>358</td>
<td>0.068656716</td>
</tr>
<tr>
<td>2003</td>
<td>383</td>
<td>0.069832402</td>
</tr>
<tr>
<td>2004</td>
<td>424</td>
<td>0.107049608</td>
</tr>
<tr>
<td>2005</td>
<td>470</td>
<td>0.108490566</td>
</tr>
<tr>
<td>2006</td>
<td>527</td>
<td>0.121276596</td>
</tr>
<tr>
<td>2007</td>
<td>588</td>
<td>0.115749526</td>
</tr>
<tr>
<td>2008</td>
<td>604</td>
<td>0.027210884</td>
</tr>
</tbody>
</table>

And the expected return of buildings for seasonal and secondary use is as follow

\[
\text{Expected Return (Rr*)} = 0.064963137
\]

Now the deviation the returns of buildings for seasonal and secondary use from their mean or expected return is as follow

<table>
<thead>
<tr>
<th>Stock</th>
<th>Buildings for seasonal and secondary use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variance ((\sigma^2)) =</td>
<td>0.060572</td>
</tr>
<tr>
<td>Standard deviation((\sigma)) =</td>
<td>0.246114</td>
</tr>
</tbody>
</table>

As we already know the returns, expected returns, variance and standard deviation of OMX Stockholm stock 30 index. Covariance between returns of OMX Stockholm 30 index and returns of seasonal and secondary use building price index calculated as follow.

\[
\text{Covariance (S, R)} = 0.000741049
\]

Finally the correlation between the returns of OMX Stockholm 30 index and returns of seasonal and secondary use building price index is calculated as.

\[
\text{correlation, } \rho(S, R) = 0.042402
\]

Again the correlation between the returns of OMX Stockholm 30 index and returns of seasonal and secondary use building price index is very small near to zero, Or we can say that zero correlation.
### 4.1.4 Correlation between the returns of multi dwelling and commercial buildings price index and OMX Stockholm 30 index

Returns and expected returns for multi dwelling and commercial buildings are given below.

**Table 4: Annual returns of multi dwelling and commercial buildings**

<table>
<thead>
<tr>
<th>YEARS</th>
<th>AVG REAL STATE PRICE (multi dwelling and commercial buildings)</th>
<th>RETURNS (Rs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1989</td>
<td>264</td>
<td></td>
</tr>
<tr>
<td>1990</td>
<td>314</td>
<td>0.190661479</td>
</tr>
<tr>
<td>1991</td>
<td>319</td>
<td>0.016339869</td>
</tr>
<tr>
<td>1992</td>
<td>277</td>
<td>-0.131832797</td>
</tr>
<tr>
<td>1993</td>
<td>238</td>
<td>-0.140740741</td>
</tr>
<tr>
<td>1994</td>
<td>265</td>
<td>0.115732759</td>
</tr>
<tr>
<td>1995</td>
<td>262</td>
<td>-0.012903226</td>
</tr>
<tr>
<td>1996</td>
<td>272</td>
<td>0.039215686</td>
</tr>
<tr>
<td>1997</td>
<td>291</td>
<td>0.06918239</td>
</tr>
<tr>
<td>1998</td>
<td>313</td>
<td>0.076470588</td>
</tr>
<tr>
<td>1999</td>
<td>341</td>
<td>0.087431694</td>
</tr>
<tr>
<td>2000</td>
<td>357</td>
<td>0.046482412</td>
</tr>
<tr>
<td>2001</td>
<td>373</td>
<td>0.045714286</td>
</tr>
<tr>
<td>2002</td>
<td>393</td>
<td>0.054644809</td>
</tr>
<tr>
<td>2003</td>
<td>408</td>
<td>0.03626943</td>
</tr>
<tr>
<td>2004</td>
<td>456</td>
<td>0.12</td>
</tr>
<tr>
<td>2005</td>
<td>480</td>
<td>0.051428571</td>
</tr>
<tr>
<td>2006</td>
<td>516</td>
<td>0.076086957</td>
</tr>
<tr>
<td>2007</td>
<td>602</td>
<td>0.166212121</td>
</tr>
</tbody>
</table>
Expected return of multi dwelling and commercial buildings is.

\[
\text{Expected Return (Rr*)} = 0.049469255
\]

Variance and standard deviation shown by the returns of multi dwelling and commercial buildings are as below.

<table>
<thead>
<tr>
<th>Stock</th>
<th>Multi dwelling and commercial building.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variance ((\sigma^2))</td>
<td>0.060572 \hspace{1cm} 0.006359</td>
</tr>
<tr>
<td>Standard deviation ((\sigma))</td>
<td>0.246114 \hspace{1cm} 0.079744</td>
</tr>
</tbody>
</table>

Covariance between the returns of multi dwelling and commercial building and OMX Stockholm 30 index followed by correlation between the returns of this type of real estate and stock exchange is as follow.

\[
\text{Covariance (S, R)} = 0.001406918
\]

And correlation

\[
\text{correlation, } \rho(S, R) = 0.071686
\]

Correlation between the returns of multi dwelling and commercial building and OMX Stockholm 30 index is 0.071686, which is very close to zero. So, there is also very little correlation between the returns of multi dwelling and commercial buildings.

### 4.1.5 Correlation between the returns of all three types of real estate and OMX Stockholm 30 index

Finally, correlation between the returns of all three types of buildings (one or two dwelling buildings, seasonal or secondary use building and multi dwelling and commercial buildings) and returns of OMX Stockholm 30 indexes calculated. First of all returns calculated from the average price of all three types of real estate. From these returns expected return calculated which is

\[
\text{Expected Return for three types (Rr*)} = 0.056087205
\]

Returns of all three types of real estate show variation and standard deviation from their expected returns as follow.

<table>
<thead>
<tr>
<th>Stock</th>
<th>All three types of real estate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variance ((\sigma^2))</td>
<td>0.060572 \hspace{1cm} 0.004677</td>
</tr>
<tr>
<td>Standard deviation ((\sigma))</td>
<td>0.246114 \hspace{1cm} 0.068386</td>
</tr>
</tbody>
</table>

Covariance shown by all three types and OMXS stock exchange is calculated as
Covariance (S, R all three types) = 0,001094074

At least the correlation between the returns of all three types of real estate and OMX Stockholm 30 indexes is calculated as

\[
\text{correlation, } \rho(S, R) = 0,065005
\]

It shows that there is approximately no correlation between the returns of all three types of real estate and OMX Stockholm 30 index.

**Table 5: with all results**

<table>
<thead>
<tr>
<th></th>
<th>Expected returns</th>
<th>variance</th>
<th>Standard deviation</th>
<th>Covariance</th>
<th>Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>OMX Stockholm 30 index</td>
<td>0,108893332</td>
<td>0,060572</td>
<td>0,246114</td>
<td>0,001106672</td>
<td></td>
</tr>
<tr>
<td>One or two dwelling building</td>
<td>0,055958056</td>
<td>0,004017</td>
<td>0,063382</td>
<td>0,001106672</td>
<td>0,070944</td>
</tr>
<tr>
<td>Buildings for secondary and seasonal use</td>
<td>0,064963137</td>
<td>0,005042</td>
<td>0,07101</td>
<td>0,000741049</td>
<td>0,042402</td>
</tr>
<tr>
<td>Multi dwelling buildings</td>
<td>0,049469255</td>
<td>0,006359</td>
<td>0,079744</td>
<td>0,001406918</td>
<td>0,071686</td>
</tr>
<tr>
<td>All three types of real estate and OMX 30 index</td>
<td>0,056087205</td>
<td>0,004677</td>
<td>0,068386</td>
<td>0,001094074</td>
<td>0,065005</td>
</tr>
</tbody>
</table>

**4.1.6 Hypothesis testing**

In order to confirm the above results and to show the results of hypothesis, mentioned in mathematical and statistical methods chapter, SPSS software used and calculate Pearson correlations. But before calculating correlation it will be interesting to know whether the returns of real estate index and returns of stock index have any linear relationship or not. To check the linear relationship, drawing scatter plots by using SPSS software is best choice. Scatter plots draw separately for each type of real estates and finally for all types of real estate and stock index. By looking at scatter plots (Appendix 1-2-3-4) drawn for each type of real estate it is clear that there is not any linear relationship between returns of real estate index and stock index.

Similarly, interpretation of correlation (Appendix 1-2-3-4) derived by using SPSS can also be examine and the output of the correlation verify the results of scatter plots that there is no correlation between the returns of real estate index and stock index.
After that to further confirm the correlation between the returns of stock price index and real estate price index regression analysis used that is also helpful in understanding how the returns of stock price index related to returns of real estate price index.

### 4.2 Regression analysis

As it is stated in chapter 3, that regression analysis used to check the relationship between returns of stock index (OMXS30) and returns of three types of real estate price index. Here result of regression analysis discussed to check the relationship of returns of stock price index and returns of real estate price index.

**Table 6: Regression analysis of three types of real estate price index and stock price index**

<table>
<thead>
<tr>
<th>Correlations</th>
<th>Stock Returns</th>
<th>One or two dwelling buildings</th>
<th>Building for seasonal use</th>
<th>Multi dwelling Buildings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Correlation</td>
<td>Stock Returns</td>
<td>1.000</td>
<td>.071</td>
<td>.042</td>
</tr>
<tr>
<td></td>
<td>One or two dwelling buildings</td>
<td>.071</td>
<td>1.000</td>
<td>.931</td>
</tr>
<tr>
<td></td>
<td>Building for seasonal use</td>
<td>.042</td>
<td>.931</td>
<td>1.000</td>
</tr>
<tr>
<td></td>
<td>Multi dwelling Buildings</td>
<td>.072</td>
<td>.872</td>
<td>.760</td>
</tr>
<tr>
<td>Sig.(1tailed)</td>
<td>Stock Returns</td>
<td>.386</td>
<td>.432</td>
<td>.385</td>
</tr>
<tr>
<td></td>
<td>One or two dwelling buildings</td>
<td>.386</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>Building for seasonal use</td>
<td>.432</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>Multi dwelling buildings</td>
<td>.385</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td>N</td>
<td>Stock Returns</td>
<td>19</td>
<td>19</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>One or two dwelling buildings</td>
<td>19</td>
<td>19</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>Building for seasonal use</td>
<td>19</td>
<td>19</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>Multi dwelling Buildings</td>
<td>19</td>
<td>19</td>
<td>19</td>
</tr>
</tbody>
</table>

This table simply described correlation between the returns of stock price index and returns of three types of real estate price index. It is a kind of repetition of above Pearson correlation.
This table explains about the simple straight line regression results. It can be noted from above tables that (returns of stock price index) intercept $\beta_0 = 0.98$, and other estimated coefficients (returns of three type of real estate) are $\beta_1 = 0.910$, $\beta_2 = -0.616$ and $\beta_3 = 0.007$ (Ruppert, 2004, p.169-175). Other important and interesting facts in this table are standard error, t value and P value.

Standard error described the deviation of result mean that expected estimators from the least square line a line that is used to minimize the distance of residual (Ruppert, 2004, p.169-175). So the standard error for (returns of stock price index) $\beta_0 = 0.87$ and for other coefficients (returns of real estate price index) $\beta_1 = 3.808$, $\beta_2 = 2.559$ and $\beta_3 = 1.696$ respectively.

T value is basically a ratio of standard error and estimated value and a tool to check the coefficient is zero.

And finally P value that is used to accept or reject the null hypothesis that is correlation is zero and correlation is not zero. P value of (returns of stock price index) intercept $\beta_0 = 0.281$ is smaller as compare to P value of other coefficients. So, it can be concluded that intercept is zero but the P value = 0.281 is larger than significance value so it can be said that intercept is zero that also showed that there is no correlation between the returns of stock price index and real estate price index. But the main thing is that intercept never explain more about the relationship for that it is important to understand the slop that describes relationship of returns of stock price index and real estate price index. P value of slops that is represented by (returns of real estate price index) $\beta_1 = 0.814$, $\beta_2 = 0.813$ and $\beta_3 = 0.997$ is larger than significance value which support the null hypothesis that there is no correlation between the returns of stock price index and real estate price index.

So, it can be said that there is no statistical significance relationship between returns of stock price index and real estate price index. So, the returns of both stock price index and real estate price index independent of each other.
4.2.1 Analysis of variance

As the name showed that it is all about the knowing the variation in one of the variables, response variable that is this thesis is returns on stock price index, if researchers know the other variable predictor variables that are three types of real estate. So in this research thesis it can be said that knowing the variation in returns of stock price index when other variable that are returns on three types of real estate price index is known.

In the table above there are different columns starting with sum of squares, it showed total variation that is sum of expected and non expected variation. Regression described sum of the variation that can be expected and that cannot be expected represented by residual. R square can be calculated by dividing the regression sum of square by its total sum of square (Ruppert, 2004, p.176-180)

\[ R^2 = \frac{\text{regression sum of square}}{\text{total sum of square}} \]

\[ R^2 = \frac{0.011}{1.151} = 0.00955 \text{ or } 0.955\% \]

\( R^2 \) can be explained as multiple correlations between response variable and predictor variables. It can be said that there is very small correlation between the returns of stock price index and returns of real estate price index that is approximately 1% correlation between them and 99% showed that there is no correlation between them.

F test used to verify the and check the null hypothesis it can be done by dividing the mean square regression by mean square residual (Ruppert, 2004, p.177-180)

P value provide the confirmation about the whether to accept or reject the null hypothesis. P value = 0.986 is totally supporting null hypothesis that there is no correlation between the returns of stock price index and returns of real estate price index.

As the objective of this research thesis was to found what is the level of correlation between the returns of stock price index and real estate price index? So, with the help of Pearson correlation and regression analysis it can be proved that there is strong
evidence about the no correlation between them and represent almost no correlation between them.

4.3 Findings

The objective of this research paper is to find correlation between the returns of real estate price index and stock price index in Sweden. And for that purpose three types of real estate used that include one or two dwelling buildings, seasonal or secondary use buildings and multi dwelling and commercial buildings and OMX Stockholm 30 price index. Historical prices index data is used that include data for last 20 years (1989-2008).

First of all the correlation between the returns of real estate price index and stock price index calculated individually. While calculating the correlation between the returns of one or two dwelling buildings price index and OMX Stockholm 30 price index it was found 0,070944 correlations between one or two dwelling building and OMX Stockholm 30 price index. This correlation is very near to zero we can consider this correlation as zero. So, the returns of one or two dwelling buildings price index and returns of 30 stock indexes are independent of each other. Similarly when calculated the correlation between other two types of real estate price index and OMX 30 price index and found that buildings for seasonal or secondary use and multi dwelling buildings have 0,042402 and 0,071686 correlation with returns of OMX Stockholm 30 index respectively. It is clear from the calculations that correlation between them is approximately zero. Mean that no correlation between the returns of all buildings for seasonal and secondary use, multi dwelling and commercial building and returns of OMX Stockholm 30 price index. So, the investor is totally free to choose among all three types of real estate for his portfolio along with shares. And it is not necessary for investors to have one or all three types of real estate in his portfolio. He is free in choosing among this real estate.

And finally when combined all three types of real estates and calculate the correlation between these three types of real estate’s price index and stock price index. And found 0,065005 correlations between all type of real estate (one or two dwelling buildings, buildings for seasonal and secondary use and multi dwelling buildings) price index and OMX Stockholm 30 price index. Additionally using regression analysis strengthen the hypothesis by providing more detailed confirmation about the relationship between the returns of stock price index and returns on real estate price index. And showed that there is only 0, 955% or 1% correlation exist between the returns of stock price index and returns of real estate price index which is very small correlation between them explaining further that there is 99% no correlation between the returns of stock price index and returns of real estate price index.

To prove the hypothesis, that there will not any correlation between the returns of real estate price index and stock index. So, approximately there is no correlation between them in my studies. Hence supporting the hypothesis that, `there is no correlation between the returns of stock price index and real estate price index`.
Chapter 5- Conclusion

5.1 Conclusion

Making an investment is all about the keeping in mind risk and returns associated with that investment. And there are various possible financial instruments in which one can invest money like T bills, bonds, shares, real estate and so on. Apart from T bills that are considered almost risk free all other financial instruments are considered having some sort of risk involved in it. Shares are considered more risky than all the financial instruments real estate considered less risky than shares and the bonds are consider less risky than real estate. But looking at returns associated with these investments we come to know that highly risky investments involved high returns and vice versa. We can say that T bills that are risk free will generate fewer returns and shares that are considered more risky will definitely generate high returns same is the case with other financial instruments. Now choice how much to invest either only in shares, bonds, real estate and other financial instruments depends upon the type of investor mean that if the investor is risk lover than he will definitely go for risky financial instruments. Similarly if he is risk neutral than will be ready to take fewer risk and if he is risk averse than definitely he will choose to invest only in risk free financial instruments that is T bills. Some time it is better to have different financial instruments in investment portfolio in order to avoid the risk and get better returns. Investor can have shares and bond in their portfolio; can have shares and real estate in their portfolio and so on. Here it was consider that having a stock and real estate in portfolio is good choice in order to diversify the risk. Because having no correlation between the returns of stock price and real estate is a sign of well diversification of risk. As the objective of this research thesis was to check the level of correlation between the return of stock price index and real estate price index. That really help to understand whether there is diversification after keeping these two securities in portfolio or there is no diversification at all.

As the research question is ´´what is correlation between returns of real estate price index and stock exchange index in Sweden? And the hypothesis was that there is no correlation between the returns of real estate price index and stock price index. So according to hypothesis as there should be no correlation between the returns of real estate price index and stock price index then it shows that the returns of both real estate price index and stock price are free in their movement mean that independent of each other. So to say one is moving in positive direction and other in negative direction. There is more diversification in the case of no correlation. So, the investors whether individual or institutional investors, they need to have optimal combination of both real estate and shares in their portfolio in order to get maximum diversification. And if there exists some correlation between the returns of real estate price index and stock price index then it mean that the returns of both are dependent on each other. Now the investors do not need to have both real estate and shares in their portfolio because in this case diversification cannot be achieved by having both real estate and shares in portfolio. Results of my studies shows that the there is no correlation between the returns of real estate price index and stock index. To check this level of correlation Pearson correlation and then regression analysis used as the Pearson correlation only explained level of correlation while regression analysis along with explaining the correlation also explain the variation between the response variable and predicted variables.
And it was found that the P value of slopes that is represented by (returns of real estate price index) $\beta_1 = 0.814$, $\beta_2 = 0.813$ and $\beta_3 = 0.997$ is larger than significance value which support the null hypothesis that there is no correlation between the returns of stock price index and real estate price index. So, it can be said that there is no statistical significance relationship between returns of stock price index and real estate price index. So the results from both Pearson correlation and regression analysis describe that there is very small or can be said that no correlation between returns of stock price index and real estate price index.

Both real estate and stock are independent of each other. Now investors should choose optimal level of both of the securities to diversify the portfolio. The results are very similar to those of previous studies done by other researchers that showed that putting the real estate into portfolio will diversified portfolio.

So finally it is concluded on the basis of the studies as well as from the previous studies that putting the real estate into portfolio will diversify the portfolio risk as there is very small or can be said that no correlation between the returns of real estate and stock exchange. Both the returns are independent of each other; returns of one can be used or helpful in diversifying the risk of other. So there is diversification while putting both stock and real estate in portfolio.

5.2 Further Research

Further research can be done by putting other types of real estate that include the agricultural real estate etc. and also by putting the OMX Stockholm 50 index. And if we want to know region wise correlation between the returns of regional real estate and stock index then it can also be found in further research.
Chapter 6- Credibility Criteria

In this chapter I will describe the criteria to check the quality of data, quality of research. This chapter contains reliability, validity and generalization.

6.1 Reliability

Reliability means that data or research show consistency or stability over time (Bryman & Bell, 2007, p.162-164). Consistency represent that data generate same results as generated by other researchers before. I believe that the results of my studies are reliable because the results are consistent to the previous researches and are showing the stability. And the data that is used to calculate the correlation between the returns of real estate price index and stock index is also reliable because I collect the data from reliable and well established data stream of Umeå University library. Further I also collect data from Statistics Sweden that is also a reliable source to collect the data. Reliability of results is confirmed by the MS Excel and is shown in appendix.

6.2 Validity

Validity can be described as data that is used to generate results should be of good quality. Mean that the data should support and help in finding the answer to the research question (Bryman & Bell, 2007, p.162-164). I use previous research articles that are relevant to hypothesis and also in accordance with to research question. And the tools that are used in MS Excel are also according to standard methods that are taught in courses like corporate finance and investment. So I can say that my study is a valid study.

6.3 Generalization

Generalization is about the becoming more general from specific (Google, 2009). In research studies generalization is done by using the sampling techniques. That helps to be more general then specific. In my studies I generalize the stock exchange in Sweden to OMX 30 Stockholm index and in real estate I generalize all types of real estate only to three types of real estates.
References

Books and Journals


Internet


Appendices

Appendix 1. Pearson Correlation between the returns of one or two dwelling building price index and OMX Stockholm stock 30index

Scatter plot

Correlations

<table>
<thead>
<tr>
<th></th>
<th>Rs</th>
<th>Rr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rs</td>
<td>Pearson Correlation</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Sig. (1-tailed)</td>
<td>.386</td>
</tr>
<tr>
<td>N</td>
<td>19</td>
<td>19</td>
</tr>
<tr>
<td>Rr</td>
<td>Pearson Correlation</td>
<td>.071</td>
</tr>
<tr>
<td></td>
<td>Sig. (1-tailed)</td>
<td>.386</td>
</tr>
<tr>
<td>N</td>
<td>19</td>
<td>19</td>
</tr>
</tbody>
</table>
Appendix 2. Correlation between the returns of seasonal and secondary use buildings price index and OMX Stockholm stock 30 index

<table>
<thead>
<tr>
<th></th>
<th>Rs</th>
<th>Rr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rs</td>
<td>Pearson Correlation</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Sig. (1-tailed)</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>19</td>
<td>19</td>
</tr>
<tr>
<td>Rr</td>
<td>Pearson Correlation</td>
<td>0.042</td>
</tr>
<tr>
<td></td>
<td>Sig. (1-tailed)</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>19</td>
<td>19</td>
</tr>
</tbody>
</table>
Appendix 3. Correlation between the returns of multi dwelling and commercial buildings price index and OMX Stockholm stock 30index

<table>
<thead>
<tr>
<th></th>
<th>Rs</th>
<th>Rr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rs</td>
<td>Pearson Correlation</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Sig. (1-tailed)</td>
<td>0.385</td>
</tr>
<tr>
<td>N</td>
<td>19</td>
<td>19</td>
</tr>
<tr>
<td>Rr</td>
<td>Pearson Correlation</td>
<td>0.072</td>
</tr>
<tr>
<td></td>
<td>Sig. (1-tailed)</td>
<td>0.385</td>
</tr>
<tr>
<td>N</td>
<td>19</td>
<td>19</td>
</tr>
</tbody>
</table>
Appendix 4. Correlation between the returns of all above three types of real estate and OMX Stockholm stock 30index

<table>
<thead>
<tr>
<th>Correlations</th>
<th>Rs</th>
<th>Rr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rs</td>
<td>Pearson Correlation</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Sig. (1-tailed)</td>
<td></td>
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<tr>
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<td>.396</td>
</tr>
<tr>
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<td>19</td>
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</tbody>
</table>
Appendix 5. Regression analysis:

### Descriptive Statistics

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>N</th>
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</thead>
<tbody>
<tr>
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<td>.25286</td>
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<tr>
<td>One or two dwelling buildings</td>
<td>.0560</td>
<td>.06512</td>
<td>19</td>
</tr>
<tr>
<td>Building for seasonal use</td>
<td>.0650</td>
<td>.07296</td>
<td>19</td>
</tr>
<tr>
<td>Multi dwelling buildings</td>
<td>.0495</td>
<td>.08193</td>
<td>19</td>
</tr>
</tbody>
</table>

### Correlations

<table>
<thead>
<tr>
<th></th>
<th>Stock Returns</th>
<th>One or two dwelling buildings</th>
<th>Building for seasonal use</th>
<th>Multi dwelling buildings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pearson Correlation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stock Returns</td>
<td>1.000</td>
<td>.071</td>
<td>.042</td>
<td>.072</td>
</tr>
<tr>
<td>One or two dwelling buildings</td>
<td>.071</td>
<td>1.000</td>
<td>.931</td>
<td>.872</td>
</tr>
<tr>
<td>Building for seasonal use</td>
<td>.042</td>
<td>.931</td>
<td>1.000</td>
<td>.760</td>
</tr>
<tr>
<td>Multi dwelling buildings</td>
<td>.072</td>
<td>.872</td>
<td>.760</td>
<td>1.000</td>
</tr>
<tr>
<td><strong>Sig. (1-tailed)</strong></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Stock Returns</td>
<td>.386</td>
<td></td>
<td>.432</td>
<td>.385</td>
</tr>
<tr>
<td>One or two dwelling buildings</td>
<td>.386</td>
<td>.</td>
<td></td>
<td>.000</td>
</tr>
<tr>
<td>Building for seasonal use</td>
<td>.432</td>
<td>.000</td>
<td>.</td>
<td>.000</td>
</tr>
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<td>Multi dwelling buildings</td>
<td>.385</td>
<td>.000</td>
<td>.000</td>
<td>.</td>
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<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stock Returns</td>
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<td>19</td>
<td>19</td>
<td>19</td>
</tr>
<tr>
<td>One or two dwelling buildings</td>
<td>19</td>
<td>19</td>
<td>19</td>
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<tr>
<td>Building for seasonal use</td>
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<td>19</td>
<td>19</td>
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<tr>
<td>Multi dwelling buildings</td>
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</table>
### Variables Entered/Removed

<table>
<thead>
<tr>
<th>Model</th>
<th>Variables Entered</th>
<th>Variables Removed</th>
<th>Method</th>
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<tr>
<td>1</td>
<td>Multi dwelling buildings, Building for seasonal use, One or two dwelling buildings</td>
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a. All requested variables entered.
b. Dependent Variable: Stock Returns

### Model Summary

<table>
<thead>
<tr>
<th>Model</th>
<th>R</th>
<th>R Square</th>
<th>Adjusted R Square</th>
<th>Std. Error of the Estimate</th>
<th>Change Statistics</th>
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a. Predictors: (Constant), Multi dwelling buildings, Building for seasonal use, One or two dwelling buildings

b. Dependent Variable: Stock Returns

### ANOVA

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<tr>
<th>Model</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
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<td>Regression</td>
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a. Predictors: (Constant), Multi dwelling buildings, Building for seasonal use, One or two dwelling buildings

b. Dependent Variable: Stock Returns
### Coefficients

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<td>B</td>
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a. Dependent Variable: Stock Returns

### ANOVA

<table>
<thead>
<tr>
<th>Model</th>
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<th>F</th>
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<td>Total</td>
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<td>18</td>
<td></td>
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a. Predictors: (Constant), Multi dwelling buildings, Building for seasonal use, One or two dwelling buildings
b. Dependent Variable: Stock Returns

### Residuals Statistics

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
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<tbody>
<tr>
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a. Dependent Variable: Stock Returns
Chart

Scatterplot

Dependent Variable: Stock Returns

Regression Standardized Residual

Regression Standardized Predicted Value