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## Risk and return for single family housing in Sweden

Is the average investor compensated for the risk taken when buying a single family house?

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### ABSTRACT

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This thesis investigates the relationship between risk and return in the single family housing market in Sweden for the time period 1981-2005. It compares the risk adjusted return of the single family housing market to the Swedish stock market. The risk adjusted return is compared on a five and 10 year time horizon of investment. Additionally, it is investigated whether metropolitan and non-metropolitan areas differ in respect to risk, return and risk adjusted return. We find that there is a positive relationship between risk and return in the Swedish single family housing market for the time period. However, the risk adjusted return is lower for the single family housing market than that of the Swedish stock market. It is also found that the risk adjusted return in the single family housing market is higher for a longer time horizon of an investment. Finally, it is established that metropolitan areas have a higher risk, return and risk adjusted return than non-metropolitan areas in the single family housing market.

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## 1 INTRODUCTION

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Housing is a subject that affects most people. It is a central part of most individuals' economic environment and often constitutes a large part of the individual's economic budget. Housing can be divided into different categories. Firstly, owning or renting, secondly, living as a single family or as multiple families in one property. A single family house is a residential structure designed to include only one dwelling. Basically, the stereotypical family house. At the end of 2005, over 3.7 million people aged between 16-74 lived in single family housing<sup>1</sup> in Sweden. Hence, a majority of the population aged between 16-74 lived in a single family house. As such, the category single family housing should have the largest amount of investors.

The real estate market is a topic that has gathered much interest from the media and the general public. Given the nature of real estate, housing has a dual role of both consumption and investment. From the beginning of year 2000 until the end of 2006 the nominal general price increase of single-family houses in Sweden has been 86%<sup>2</sup>. It is often mentioned in media that the price level is rapidly increasing. There is however also a risk in this financial investment. This risk is also mentioned frequently in media, but in terms of a possible upcoming bust in the market, such as the real estate market crisis in the end of the 80's and early 90's. Despite the strong interest from both the general public and the media, there seems to be little academic research on the actual risk and the analysis on the return in comparison to the risk.

The return, or perhaps more importantly, the level of risk and the cost of obtaining the return is a crucial question for the investor.

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<sup>1</sup> Statistics Sweden (Bostads- och byggnadsstatistik årsbok 2007)

<sup>2</sup> Statistics Sweden (Property Price Index)

## **1.1 PURPOSE AND RESEARCH PROBLEM**

Inspired by the study conducted by Cannon, Miller and Pandher<sup>3</sup>, which investigates and concludes a positive correlation between return and volatility in the U.S. metropolitan housing market, we are interested if this holds true also in the Swedish real estate market. Furthermore, we would like to look at whether risk is reflected in the returns, but also if it is sufficiently compensated by looking at the risk adjusted return. By looking at the risk adjusted return for single family housing and comparing it with the risk adjusted return of the stock market, the investor should be able to more accurately determine the profitability of the investment.

## **1.2 CONTRIBUTION**

To our knowledge, our study is the only attempt to investigate the risk and return on the Swedish single-family housing market using the volatility as explanatory variable. We hope to shed light on some factors affecting the profitability of investing in this market.

## **1.3 OUTLINE**

First we present the theoretical framework summarizing the basic theory on factors affecting investments in real estate and financial instruments. Secondly, we present previous findings within the field from both the Swedish as well as the U.S. market. Thereafter, we continue with presenting our hypotheses followed by a presentation of the data and the methodology. Finally, we provide the analysis together with a robustness test and conclusions, followed by a discussion about further studies that can be conducted.

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<sup>3</sup> Cannon, Miller and Pandher (2006)

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## 2 THEORETICAL FRAMEWORK

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*Presented below, are the measurements of the amount of risk within both real estate and the stock market. Then the factors affecting return in real estate, which is followed by the methods of measuring the price development within real estate.*

### 2.1 RISK

Risk can be defined as the deviation from the expected return of an asset.<sup>4</sup> The volatility is a measure of this deviation. Furthermore, the risk can be divided into two components, systematic risk and idiosyncratic risk. The first component, the systematic risk, is a non-diversifiable risk which stems from the market risk. The market risk, or the systematic risk, is the variance of the market return. The second component, the idiosyncratic risk, is a diversifiable risk which is due to an individual asset's unique circumstances. Hence by buying a single real estate property, the buyer takes on both market risk plus the individual asset's unique risk.

### 2.2 CROSS SECTIONAL REGRESSIONS ON VOLATILITY

#### 2.2.1 CAPM

The Capital Asset Pricing Model (CAPM) is a set of predictions concerning equilibrium expected returns on risky assets.<sup>5</sup> The systematic risk factor, or beta, is calculated by taking the covariance between the asset's return and the market's return and dividing it by the market's variance.

Hence:

$$\beta_i = \frac{Cov(r_i, r_M)}{\sigma_M^2} \quad (1)$$

Furthermore, CAPM prices only the systematic risk, which should function when a portfolio consists of several assets. However, a normal individual buying a single-family house does not have the opportunity to diversify his investment in the same way as he could when choosing his portfolio on the stock market. Buying a single-family house normally represents a large portion

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<sup>4</sup> Bodie, Kane and Marcus (2002)

<sup>5</sup> Ibid

of the individual's wealth and investing capacity. Furthermore, an average individual does not hold houses that he or she does not use for living. Hence, the level of diversification is very limited.

We therefore think that a CAPM model is not the most appropriate approach to measure the risk and return relationship when it comes to single-family houses. Instead, we will use the normal volatility<sup>6</sup> measure and compare if return is higher when a higher degree of volatility is present. We thus use the following model in order to see what the relationship between return and volatility has been during the time period 1982-2005 on single-family houses in Sweden:

$$r_i = \alpha_0 + \alpha_1 Vol_i + \varepsilon_i \quad (2)$$

Assume  $r_i$  represents the average annual return for the single family houses in region  $i = 1, \dots, n (n = 4)$ . In order to investigate the role of volatility ( $Vol$ ) on returns on the property investment, returns are decomposed using the cross sectional regression. Where  $Vol$  is the return volatility for the mean priced house in each region  $i$  over the years 1980-2005 and  $\varepsilon_i$  is the standard Gaussian error.

### 2.2.2 Sharpe Ratio

In order to compare two different investment opportunities in a satisfactory manner, the Sharpe ratio is often used.<sup>7</sup> The Sharpe ratio is a reward to variability ratio which measures the reward, defined as return, in consideration to the risk, defined as volatility.

$$S = \frac{E[R - R_f]}{\sqrt{Var[R - R_f]}} = \frac{E[R - R_f]}{\sigma} \quad (3)$$

$S$  = Sharpe ratio

$E$  = Expected return

$R$  = Return on asset

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<sup>6</sup> The standard deviation of the change in value of a financial instrument with a specific time horizon

<sup>7</sup> Bodie, Kane and Marcus (2002)

$R_f$  = Return on risk free asset

$\sigma$  = Standard deviation of the asset

Hence, the Sharpe ratio indicates how well an investor is compensated for the risk taken. We are aware that the Sharpe ratio has its limitations when it comes to measuring the compensation of risk when the market is declining. For instance if two assets both lost 5% in value but at different risk levels, which was best to invest in beforehand?

### 2.2.3 Factors affecting the return of an investment in real estate

Looking at an investment in a single family house it consists of different constituents:

- Capital return - being the increase or decrease in the property's value over the investment horizon.
- The benefit of not having to pay the opportunity cost of renting an equivalent house
- Operating, maintenance cost and depreciation of the property asset
- Property tax
- Transaction costs

The capital return on a single-family house can be expressed as:

$$C(\text{ret}_{t,T}) = \sqrt[T-t]{\frac{P_T}{P_t}} - 1 \quad (4)$$

When the time period is one year,  $(T-t) = 1$  and hence equation (1) becomes:

$$C(\text{ret}_{t,T}) = \sqrt[T-t]{\frac{P_T}{P_t}} - 1 = \sqrt[1]{\frac{P_T}{P_t}} - 1 = \left(\frac{P_T}{P_t}\right)^{\frac{1}{1}} - 1 = \frac{P_T}{P_t} - 1 \quad (5)$$

The benefit of not having to pay the opportunity cost of renting an equivalent house can be expressed as:

$$\text{Opportunity Cost}_t = OC_t = P_t \times oc_t \quad (6)$$

The maintenance and depreciation costs are expressed as:

$$\text{Maintenance Cost}_t = MC_t = P_t \times mc_t \quad (7)$$

$$Depreciation_t = P_t \times \delta_t \quad (8)$$

$$Net\ Rent_t = OC_t - MC_t - Depreciation_t = P_t(oc_t - mc_t - \delta_t) = P_t \times nr_t \quad (9)$$

$$Property\ tax_t = Assessed\ Value_t \times tax\ rate_t \quad (10)$$

For the equations above, the costs expressed in small letters, for instance  $oc_t$ , represents the costs in percentage of price.

The total yearly return on the investment can be calculated by using equations 4-10:

$$\begin{aligned} ret_t &= C(ret_t) + OC_t - MC_t - Depreciation_t - Property\ tax_t = \\ &= \frac{P_T}{P_t} - 1 + P_t(oc_t - mc_t - \delta_t) - Assessed\ Value_t \times tax\ rate_t = \\ &\frac{P_T}{P_t} - 1 + P_t \times nr_t - Assessed\ Value_t \times tax\ rate_t \end{aligned} \quad (11)$$

#### 2.2.4 Property price index

During the time period investigated there have been several readjustments to the assessed value<sup>8</sup> of the property stock in Sweden. These have been set in 1981, 1990, 1996 and 2003.<sup>9</sup> Using the assessed values, Statistics Sweden (SCB) divides the properties into different categories which then are used with a weighting system constructed by SCB. Using these two components, SCB calculates the property price index to show the price development in Sweden. An Achilles' heel with the property price index is that it requires a certain amount of transactions in each category group for the results to be reliable. This implies that the property price index, though good as a measure of the price development in Sweden, cannot be conducted with reliable results on municipality level due to the lack of sufficient transactions within each category group.

#### 2.2.5 Average prices of properties

Using the average prices of properties sold during a time period in order to see the price increase over the time period is not a good measure. The reason for this is that the real estate market is a heterogeneous market and the properties transacted over time periods can differ substantially in

<sup>8</sup> Assessed value = The value set for the property by the tax authorities (generally 75% of market value)

<sup>9</sup> SCB (Hur mäter man prisutvecklingen på småhus?)

for instance standard and size. Therefore the comparability of properties transacted during different time periods may be quite limited. In order to increase the comparability another parameter must be added. Such a parameter could be the assessed value of the property.

### 2.2.6 Transaction Price/Assessed Value (K/T)

The K/T measure is simply the transaction price divided by the assessed value. Due to the fact that the assessed value is taking into account factors such as standard and size, the K/T measure is adjusted for the possible differences between different properties. Hence, with the K/T measure it is possible to evaluate the price development of properties even if the transacted properties over time have different characteristics.

In order to illustrate we use an example:

K/T value within municipality	Assessed value of property	Assumed value of property
2	1,000,000	$2 \times 1,000,000 = 2,000,000$

If the K/T value in a municipality is 2, the average transaction in the municipality has a transaction price twice that of the assessed value of that specific property. Using this information, a house owner can assume that his property has a value twice that of the assessed value for his property.

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### 3 PREVIOUS FINDINGS

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Real estate can be seen as both an investment in an asset class as well as consumption good. Following the line of reasoning in economics, an asset with higher risk should also yield a higher return. This has been proven to hold also within real estate, at least in the U.S. market.

Cannon, Miller and Pandher conducted a study on the metropolitan areas in the U.S. market in 1995 through 2003.<sup>10</sup> They used a panel data set comprising of 7,234 ZIP codes falling in 155 urban metropolitan statistical areas. Their study shows that higher volatility is rewarded by higher return, which is in conformance with the general risk-return hypothesis. Furthermore, they find that housing returns increase by 2.48% annually for a 10% rise in volatility.

Another approach is to estimate the beta coefficient for an asset and use the CAPM in its plain form, or a modified version, and describe the return due to the amount of risk undertaken, represented by the beta. According to CAPM, an asset class with higher systematic risk is expected to generate a higher return. However, for the Swedish real estate market, there have not been any significant results proving that a risk premia is present. Ahlberg and Lindensjö conducted a study in 2005 covering the Swedish house price indices from 1981 through 1999 using a CAPM approach.<sup>11</sup> Their study could not find significant results of a risk premia in the Swedish housing market. Hence, it seems that the Swedish real estate market's return is not well explained using CAPM. Instead, we would like to investigate whether the return in the single family housing market can be explained by volatility in Sweden, as it has successfully been done by Cannon et. al. in the U.S.

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<sup>10</sup> Cannon, Miller and Pandher (2006)

<sup>11</sup> Ahlberg and Lindensjö (2005)

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## 4 HYPOTHESES

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*We have divided our hypotheses into four different categories: is there a relationship between risk and return, if so, is the risk appropriately rewarded, does the risk-reward relationship depend on time horizon of investment, and finally, is the risk-return relationship different for metropolitan/non-metropolitan areas. Last in this section, a table is presented summarizing the hypotheses.*

### 4.1 RISK AND RETURN RELATIONSHIP IN THE SINGLE FAMILY HOUSING MARKET

When investing, the rational investor requires a higher return for a higher risk. This should hold true also for house owners, who have invested in their home. Do single-family houses show greater return for higher risk? We state the following first hypothesis:

*H1: There is a positive relationship between risk and return in the Swedish single family housing market*

### 4.2 RISK ADJUSTED RETURN ON THE SINGLE FAMILY HOUSING MARKET COMPARED TO THE STOCK MARKET

According to normal economic theory, the risk adjusted return for any investment should be the same. Thus the risk adjusted return of single family housing should be equivalent to that of the stock market. Hence our second hypothesis will be:

*H2: The risk adjusted return for the single family housing market is equal to that of the Swedish stock market*

### 4.3 THE EFFECT OF THE TIME HORIZON

Investors have different time horizons for their investments depending on factors such as age, mobility and family conditions. Therefore, we are interested in whether the time horizon of investment affects the risk and return relationship. If there were no transaction costs, we would expect there to be no difference in the risk and return relationship depending on the time horizon of the investment. However, we assume that these transaction costs occur. If the transaction cost can be spread out over a longer time period, the effect on the yearly return diminishes, making the single family housing investment better off. Furthermore, having a longer time horizon for the investment should lead to a lower risk, making the investment more

profitable. Hence, we expect to find a positive relation between the return and a longer time horizon, while we expect a negative relation between the risk and a longer time horizon of investment for single family housing. Thus it leads us to the following hypothesis:

*H3: The length of the time horizon of the investment affects the risk and return relationship positively for the single family housing in Sweden*

#### **4.4 RISK AND RETURN IN METROPOLITAN AREAS**

##### **4.4.1 Risk**

As mentioned earlier, single family housing property value constitutes of two components, land and a building. Assuming a building can be moved, it should be valued at approximately the same price regardless location. Land however, cannot be moved or created, and the supply is therefore in-elastic. Making the land value more dependent on demand and changes in demand will lead to large fluctuations in price. Furthermore, since land cannot be moved, its value is dependent on location.

Assuming that land is more scarce in metropolitan areas, the land value should also be higher in metropolitan areas. *Ceteris paribus*, this should lead to land value making out a larger portion of the property's value in metropolitan areas compared to non-metropolitan areas. From this and given the expected volatile nature of land, the properties' value in metropolitan areas should relatively be more volatile compared to non-metropolitan areas.

##### **4.4.2 Return**

Following the reasoning above, the higher expected risk of an investment in single family housing in metropolitan areas, should yield higher returns compared to non-metropolitan areas.

##### **4.4.3 Risk adjusted return**

Finally, we expect that the risk adjusted returns should be equal in metropolitan and non-metropolitan areas. From the above reasoning, we state the following three hypotheses:

*H4: The risk of an investment in single family housing is higher in metropolitan areas*

*H5: The return of an investment in single family housing is higher in metropolitan areas*

*H6: The risk adjusted return of an investment in single family housing is equal in metropolitan and non-metropolitan areas*

To conclude, we present our six hypotheses in the following table:

*Table 1.*

<b><i>Hypotheses</i></b>	
<i>H1</i>	<i>There is a positive relationship between risk and return in the Swedish single family housing market</i>
<i>H2</i>	<i>The risk adjusted return for the single family housing market is equal to that of the Swedish stock market</i>
<i>H3</i>	<i>The length of the time horizon of the investment affects the risk and return relationship positively for the single family housing in Sweden</i>
<i>H4</i>	<i>The risk for an investment is lower in metropolitan areas</i>
<i>H5</i>	<i>The price increases are higher in the metropolitan areas</i>
<i>H6</i>	<i>The risk adjusted return is higher in metropolitan areas</i>

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## 5 DATA

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*The data sets collected are presented below together with the source of the data.*

### 5.1 OMXSPI AND OMXBGI

We have gathered daily data for the Swedish Stock Exchange which includes the dividend payouts. This data is only available from 1995-12-29 until 2005-12-30 using the OMXBGI. Therefore, we also gathered daily data for the rest of the time period from 1981 using the OMXSPI, which does not include dividend payouts, in order to get a full coverage of our sample period.

### 5.2 RISK FREE RATE

The risk free rate in Sweden has been collected from the Central Bank of Sweden for the time period 1981-2005. Due to the fact that the interest used by the Central Bank has changed over the time period, we have been forced to gather three different types of interest rates. First we gathered the discount rate for the time period 1981-01-01 to 1987-01-30, secondly we gathered the marginal rate from 1987-01-30 until 1994-06-01 and finally we gathered the repo rate from 1994-06-01 until 2005-12-31.

### 5.3 K/T

For the entire time period data for K/T values on municipality level has been available from Statistics Sweden.

### 5.4 ASSESSED VALUES

Unfortunately, the assessed values on municipality level for the time period previous to 2003 has not been accessible from Statistics Sweden or any other data source. Instead, the assessed values had to be collected on county level, available from Statistics Sweden for the entire time period.

### 5.5 PROPERTY PRICE INDEX

The property price index for Sweden has been gathered from Statistics Sweden for the time period 1981-2005.

## **5.6 AVERAGE USEFUL FLOOR SPACE**

The average useful floor space per single family housing unit has been gathered from Statistics Sweden.

## **5.7 MAINTENANCE COST FOR CO-OPERATIVES**

Due to lack of data on the maintenance cost of single-family housing, data has been gathered for the average maintenance cost for co-operatives as a substitute for the time period 1996-2005. This data was available from Statistics Sweden.

## **5.8 AVERAGE RENT FEE**

The average rent fee in Sweden was collected from Statistics Sweden covering the years 1996-2005.

## **5.9 RELIABILITY OF DATA**

We believe that the data from Statistics Sweden and the Central Bank of Sweden is reliable as these are institutions with no private interests. Furthermore, we also believe that the primary data collected from OMX meets any requirements of reliability, since this is a company which specifically deals with the trust of its data presented.

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## 6 METHODOLOGY

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*Firstly we present the assumptions that are made. Secondly, the method of sampling and how the K/T values are linked are presented. Thereafter, the methods applied in the analysis are presented.*

### 6.1 ASSUMPTIONS

#### 6.1.1 Time of investment

It is assumed that all investments will be made in the beginning of a year and all disinvestments will occur at the end of a year.

#### 6.1.2 Rent

As stated in *section 2.2.3*, owning a house and living in it reduces the cost for the investor of living in terms that he does not have to pay a rent to a landlord. During the 10 year time period 1996-2005 the average rent over the average property value for single family houses had a median value of 5.5% which we assume to be the rent portion of the properties throughout our time period.<sup>12</sup>

Owning a house and using the benefit of living in it constitutes a value for the investor in form of the opportunity cost of renting an equivalent home. A tenant has to pay rent to his landlord, while an owner of a home does not. Hence we price the benefit by quantifying the value of renting an equivalent home. This value should thus be included when calculating the return on the investment.

#### 6.1.3 Financing of asset

We assume that the investor will not borrow capital in order to make his investment.

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<sup>12</sup> See Appendix 13.1

## 6.1.4 Tax

### 6.1.4.1 Property tax

There was a tax reform in Sweden in 1990 which led to that the legislation of real estate tax changed substantially from the one before.<sup>13</sup> After 1990, the tax on housing became a fixed percentage at 1.0% of the assessed value<sup>14</sup>. Previously, the tax on housing was constructed such that both the tax rate and the amount of the assessed value to be taxed were positively correlated with the owner's income. According to Peter Englund, professor of Banking and Insurance, the median property owner was taxed on 2% of the assessed value, and had a marginal tax rate of 50% during the time period of 1981-1989. Hence, our estimate for the effective real estate tax during the time period 1981-1989 on the assessed value is 1.0%. Hence, according to our assumptions, the median household's tax pressure has not changed during our sample period. Additionally, Swedish legislation has made new built houses exempt from property tax the first five years and the following five the property is to fifty percent exempt from property tax. Looking at the years between 1991-2005 the median percentage of the single-family house stock made up of houses younger than six years was 1.57% and houses older than five but younger than 11 years was 1.34%<sup>15</sup>. Since more than 97% of the single family house stock is not tax exempt, we decided to assume that all single family housing is treated in the same way regarding property tax, i.e. is liable for property tax.

### 6.1.4.2 Tax shield

If an investor borrows money in order to make the investment, a tax shield occurs. This tax shield is the same regardless if the investment is made in a property or in stocks. We have not taken the tax shield in consideration when comparing the return on the stock market and the real estate market.

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<sup>13</sup> Swedish law, SFS (1990:650)

<sup>14</sup> Swedish law, SFS (1984:1052)

<sup>15</sup> See Appendix 13.3

### 6.1.4.3 Capital gains tax

The tax on real estate capital gains compared to stock capital gains has differed historically. As an example, after 1989 the part of a capital gain on property that is taxed amounts to 70%, whereas the capital gain tax on equity is based on 100% of the capital gain. A big difference is that it has been possible for a house owner to avoid capital gains tax by investing again in another real estate property, of equal or greater value. Thus, the investor can effectively for a long period of time avoid being taxed on the capital gain, as long as the capital gain is re-invested into another property.<sup>16</sup> This opportunity has however not been possible within the stock market. Given these discrepancies, the differences on pre and after tax returns can be substantial. Depending under what circumstance the investor has invested, the after tax scenario can differ. By this we mean, factors such as age, mobility and family conditions. For example, a young person investing in a house is likely to buy a larger house and thus probably also more valuable house, when starting a family. However, when an old person is moving he might invest in a smaller and thus probably also less expensive house. Under these circumstances, the young investor is able to enroll the capital gain into the new investment, whereas the old person cannot do so.

Ceteris paribus, the after tax return for the young and old investor differs substantially, while they have exactly the same pre tax return. Due to this discrepancy we choose to look at the pre tax return on housing. In order to be able to compare the investment in the real estate single-family house market with the stock market, we have to be consequent and use the pre tax measure for the stock market return. We leave it up to the investor to calculate the after tax scenario (capital gain) according to their own individual tax circumstances.

### 6.1.5 Transaction costs

When making an investment, certain transaction costs occur. For instance, when buying a property a real estate agent often takes out a fee from the seller and the buyer has to pay a fee in order to be the rightful owner of the property, i.e. registration of title. Hence, the seller pays a

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<sup>16</sup> Poterba (1984)

transaction fee to the real estate agent, while the buyer pays a fee in form of a stamp duty. The Swedish legislation<sup>17</sup> imposes a stamp duty of 1.5%, which we assume has been the constant stamp duty through the time period 1981-2005. Similarly there are transaction costs for investing in the stock market. Usually a brokerage fee is paid when buying or selling a financial instrument. We assume that when making the investment in real estate, the investor pays 1.5% of the acquisition price in stamp duty. When exiting the investment, the investor pays 3% of the selling price to the real estate agent. Furthermore, we assume that when investing in the stock market, the investor pays 0.5% of the transaction price both when investing and exiting.<sup>18</sup>

### 6.1.6 Maintenance and operating costs

We believe there are two main scenarios when investing in single-family housing. Either the investor will use it for his own living or sublet the house to a tenant. We assume that the maintenance costs will be carried by the owner of the property. Maintenance costs can be such things as painting, insuring etc. Regardless of whether the investor decides to buy a house to live in, to rent a house or to rent an apartment, we assume he has to pay the operating costs himself. Hence, we see the operating costs as a cost that should not be linked with the type of investment the investor decides to make and therefore we exclude operating cost from our analysis.

The median operating cost of a single-family house during the time period 2000-2005 was 1.12%.<sup>19</sup> Based on this, we assume that the maintenance cost during the time period 1981-2005 was 1%.

### 6.1.7 Depreciation

A single family house property consists of two components, land and a building. We assume that the average property has a value distribution of fifty percent to each of the components. Land does not depreciate, as do houses. We assume that a normal house, if maintained, should last 100 years. We therefore assume that the depreciation rate of the house is 1% yearly. Hence, the actual depreciation of the property should be 0.5% yearly.

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<sup>17</sup> Swedish law, SFS (1984:404)

<sup>18</sup> Nordea (Carina Ene-dotter)

<sup>19</sup> See Appendix 13.2

### 6.1.8 Net Rent

Since we assume that the opportunity cost of renting, maintenance cost and depreciation are constant portions of the single family house price ( $P_t$ ) we also assume that the net rent ( $nr_t$ ) is constant. Using an opportunity cost of renting at 5.5%, a maintenance cost of 1.0% and a depreciation rate of 0.5% yearly we end up with a net rent of 4.0%:

$$ac_t = \overline{ac} = 5.5\%$$

$$mc_t = \overline{mc} = 0.5\%$$

$$\delta_t = \overline{\delta} = 1.0\%$$

$$\therefore nr_t = \overline{nr} = 5.5\% - 0.5\% - 1.0\% = 4.0\%$$

The net rent of 4.0% for the Swedish real estate market can be assumed reasonable, since it has been used previously within this field of study.<sup>20</sup>

### 6.1.9 Dividend payout

For the 10 year time period 1995-12-29 until 2005-12-30, the average yearly dividend payout has been collected comparing the OMXBGI and the OMXSPI. The average yearly dividend amounted to 2.07%. For the time period 1982-1995 we assume there was a constant yearly dividend payout policy equivalent to 2.0%.

### 6.1.10 Metropolitan areas

We assume that the following counties are to be considered metropolitan areas, Stockholms län, Uppsala län, Skåne län and Västra Götaland län. This assumption is made from the fact that the four largest cities in Sweden are located in these counties.<sup>21</sup> Furthermore, we assume that all municipalities within these counties are metropolitan areas.

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<sup>20</sup> Englund, Hwang and Quigley (2002)

<sup>21</sup> SCB (Folkmängden per tätort 2005)

### 6.1.11 Summary of assumptions

*Table 2.*

Assumptions	
Time of investment	Investments at year beginning and divestments at year end
Rent	5.5% throughout time-period
Interest rate	Cost of borrowing is the same for the two types of investments
Liquidity	The same amount of capital can be borrowed for the two types of investments
Tax	
- <i>Property tax</i>	1% on the assessed value
- <i>Tax shield</i>	Not taken into consideration
- <i>Capital gains tax</i>	Pre-tax measure is used (i.e. cap gains tax excluded)
Transaction costs	Single family housing: 1.5% stamp duty paid at investment and 3% agency fee paid at divestment.
	Stock market: 0.5% fee at both investment and divestment
Maintenance and operating costs	1% of true value for single family housing
Depreciation	0.5% yearly depreciation
Net rent	4%
Dividend payout	2%
Metropolitan areas	Stockholms län, Uppsala län, Skåne län and Västra Götaland län

## 6.2 METHOD OF SAMPLING

In the total data collected, all municipalities existing in Sweden in 2005 are included. However, for reliability reasons, municipalities with at least one year of less than 30 transactions have been dropped. Thus by keeping data from municipalities with at least 30 sales per year, the sample for each municipality can be assumed to be diversified. From this we assume that the idiosyncratic risk component becomes negligible. Furthermore, the municipalities that did not exist throughout the entire time period of 1981-2005 were dropped. 238 municipalities out of 290 remain in the sample.

### 6.3 LINKING THE K/T

Figure 1

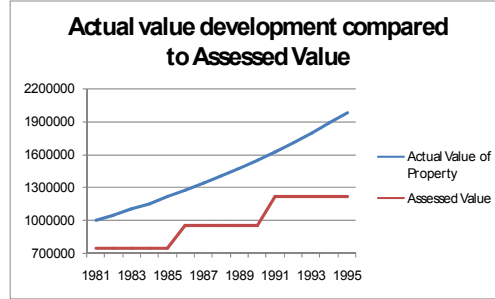
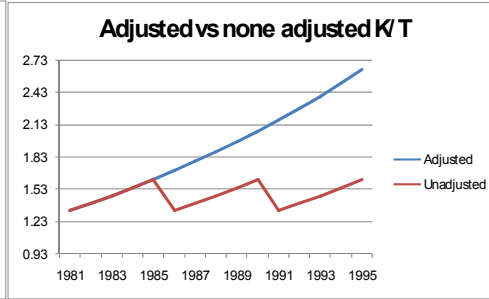


Figure 2.



In *figure 1* above, the actual price development of a property and its assessed value is shown. To describe the property value development, the K/T value cannot be used without adjustments. The K/T values indicate the increase in property value for the time period with the same assessed value. However, when the assessed value is revised, the K/T values will have a tendency to show a “zig-zag” movement since the denominator has changed, as illustrated in *figure 2*. In order to compare over periods of different assessed values for the same property, the K/T values must be adjusted using the same assessed value in the denominator. The assessed value used as base is the assessed value for the property in 1981. The linking is conducted using the following equation:

$$Z^*_{t,j} = Z_{t,j} \times \left( \frac{AV_{t,j}}{AV_{1981,j}} \right) \quad (12)$$

Where

$Z^*$  = Adjusted K/T value

$Z$  = K/T value

$AV$  = Assessed Value

$t$  = Year

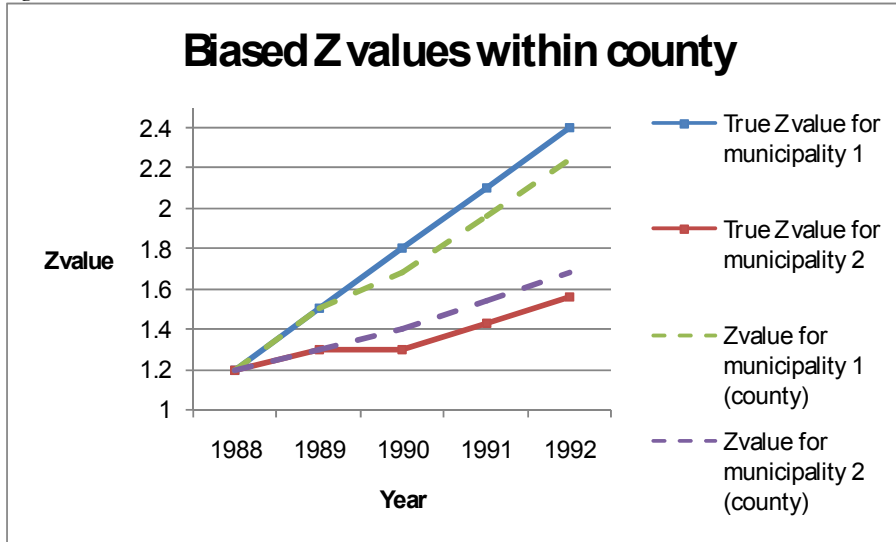
$j$  = region

### 6.4 ESTIMATION OF ASSESSED VALUES

As stated previously, the average assessed values on municipality level were not available. Therefore, an estimation using the county level has been made. Each municipality has been given the same average assessed value as the county it belongs to. This leads to certain limitations since

it is likely that the municipalities within the county differ and thus the assessed value on the county level for each municipality might lead to potentially different results than the actual development.

Figure 3.



Assume two different municipalities within the same county that have a different price development of single family housing, illustrated by the solid lines in *figure 3* above. The assessed values for the municipalities are readjusted in 1990, based on the price development for each municipality. The municipality with a better price development over the last assessed value period will have a relatively higher increase in assessed value compared to the municipality with a poorer price development. However, as mentioned before, the municipality assessed values are lacking and instead the county level of assessed value has been used. The county level assessed value is a form of average of the municipalities within the county. This leads to that the price development for each municipality within the county is converged toward each other, as illustrated by the dotted lines in the figure. However, this should only affect the data every time there is a re-adjustment of the assessed values. This occurs four times over the sample period.

## 6.5 CALCULATING THE RETURN ON THE REAL ESTATE INVESTMENT

In order to get an estimation of the prices for each municipality throughout the time period, we use the adjusted K/T value ( $Z_t^*$ ). Using equation (11) we can replace  $P_t$  with  $Z_t^*$ , obtaining:

$$\begin{aligned}
ret_t &= C(ret_t) + OC_t - MC_t - Depreciation_t - Property tax_t = \\
&= \frac{Z_T^*}{Z_t^*} - 1 + Z_t^* (oc_t - mc_t - \delta_t) - Assessed Value_t \times tax rate_t = \\
&\frac{Z_T^*}{Z_t^*} - 1 + Z_t^* \times nr_t - Assessed Value_t \times tax rate_t
\end{aligned} \tag{13}$$

To calculate the return of the investment we use the yearly returns calculated according to equation (10) in order to build an index.

$$\begin{aligned}
Index(1981)_j &= 100 \\
Index(T)_j &= 100 \times \left[ (1 + ret_{t,j}) + (1 + ret_{t+1,j}) + \dots + (1 + ret_{T,j}) \right]
\end{aligned} \tag{14}$$

Where

$$t = 1982$$

$$j = region$$

From this the return on the investment in the real estate market, can be calculated. However, from the indices presented above, adjustments must be made for transaction costs.

$$Yearly\ return\ on\ investment = \sqrt[(x-k)]{\left[ \frac{Index(T=x)_j}{Index(T=k)_j} \times (1 - ma) \times (1 - s) \right]} - 1 \tag{15}$$

Where

$$x = Time\ of\ exit$$

$$k = Time\ of\ investment$$

$$ma = Real\ estate\ agent\ fee$$

$$s = Duty\ stamp$$

For calculating the risk of the investment, the unbiased estimator of the population standard deviation has been used.

$$\sigma = \sqrt{\frac{1}{n-1} \sum_{i=1}^n (y_i - \bar{y})^2} \tag{16}$$

However, this measure for risk is not flawless, for instance in periods of constantly high returns, the standard deviation can become large, even though the investment has generated very high returns. It can be discussed whether fluctuations in really high returns represent risk.

## 6.6 CALCULATING THE RETURN ON THE STOCK MARKET INVESTMENT

For calculating the index of the stock market a similar method has been used, as with the real estate investment.

$$\begin{aligned} Index(1981)_j &= 100 \\ Index(T) &= 100 \times [(1 + ret_t) + (1 + ret_{t+1}) + \dots + (1 + ret_T)] \end{aligned} \quad (17)$$

Where

$$t = 1982$$

From this the return on the investment in the stock market, can be calculated. However, from the indices presented above, adjustments must be made for transaction costs.

$$Yearly\ return\ on\ investment = \sqrt[x-k]{\left[ \frac{Index(T=x)}{Index(T=k)} \times (1 - tc_k) \times (1 - tc_x) \right]} - 1 \quad (18)$$

Where

$x =$  Time of exit

$k =$  Time of investment

$tc_x =$  Courtage on exiting

$tc_k =$  Courtage on investing

Assuming that  $tc_x = tc_k = \bar{tc}$  the equation can be rewritten as:

$$Yearly\ return\ on\ investment = \sqrt[x-k]{\left[ \frac{Index(T=x)}{Index(T=k)} \times (1 - \bar{tc})^2 \right]} - 1 \quad (19)$$

Similarly, as for the risk measure of the real estate investment, the unbiased estimator of the population standard deviation has been used for the stock market investment.

$$\sigma = \sqrt{\frac{1}{n-1} \sum_{i=1}^n (y_i - \bar{y})^2} \quad (20)$$

As stated previously, this measure for risk is not flawless. It contains the same drawbacks as the risk measure used for the real estate investment.

## 6.7 RISK ADJUSTED RETURN

In order to estimate the risk adjusted return, the Sharpe ratio has been used. The Sharpe ratio has been mentioned in the theory segment and will be used as described accordingly.

## 6.8 TIME HORIZON OF INVESTMENT

The sample data covers 25 years, hence the yearly return can be calculated for 24 years. To investigate differences between time horizons, two different time horizons have been used. These are:

- 10 year time horizon
- 5 year time horizon

For the two time horizons, the number of investment opportunities varies. For the 10 year time horizon, there are 15 investment opportunities (1982,1983,...,1995,1996) and for the 5 year time horizon, there are 20 investment opportunities. The yearly return for each time horizon and investment opportunity has been calculated for each municipality. Thereafter, the average of the yearly returns for each time horizon has been calculated, and is assumed to be the expected return for the municipality if an investor holds a property over the time horizon. Furthermore, the standard deviation of the yearly returns for each time horizon has been calculated for each municipality.

## 6.9 COMPARING RISK ADJUSTED RETURN WITHIN THE REAL ESTATE MARKET

The counties are ranked after their Sharpe ratios for each time horizon. This was not conducted for the municipality level, due to the overwhelming amount of data and thus the difficulty of presenting it in a meaningful manner. To add to this, we investigate the differences between metropolitan and non-metropolitan areas within Sweden, on municipality level. This was conducted by testing whether there were any significant differences in the Sharpe ratios between metropolitan and non-metropolitan municipalities.

### **6.10 COMPARING RISK ADJUSTED RETURN BETWEEN THE REAL ESTATE MARKET AND THE STOCK MARKET**

Using the calculated Sharpe ratios, it has been analyzed whether the municipalities have outperformed the risk adjusted return for the stock market during the same time horizon of investment.

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## 7 ANALYSIS

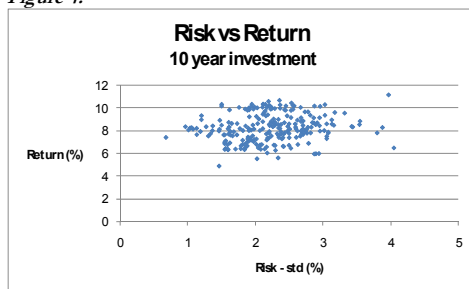
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The empirical analysis is presented below. Each hypothesis is analyzed and discussed separately and in the same order as they were listed in table 1.

### 7.1 RISK AND RETURN RELATIONSHIP IN THE SINGLE FAMILY HOUSING MARKET

The risk and return relationship for a 10 year investment in the Swedish single family housing market is plotted in *figure 4*. The observations in the figure are the 238 municipalities kept in the sample. The correlation between risk and return seems to be slightly positive, but to be certain more statistical calculations must be computed.

*Figure 4.*



The data sample consists of municipalities with differing amounts of transactions per year. The transactions per year for each municipality range between 30 and 1610 in the kept sample. Thus, it can be assumed that heteroscedasticity<sup>22</sup> is present in our data. Therefore, the OLS regression was conducted using the robust standard errors, presented in *table 2* below:

*Table 2.*

Investment Horizon (years)	10	5
Adjusted R <sup>2</sup>	0.024	0.485
Standard error	0.012	0.010
Observations	238	238
Intercept coefficient	0.075	0.045
Standard error intercept coefficient	0.003	0.003
P-value of intercept	0.000	0.000
Std coefficient	0.330	0.742
Standard error std coefficient	0.127	0.052
P value of std	0.010	0.000
Lower end of 95% confidence interval for std coefficient	0.080	0.640
Reject H <sub>0</sub>	NO	NO

<sup>22</sup> Conditional variances of dependent variable are not constant

This table shows that for the 10 year time horizon the correlation between risk and return is positive and has a coefficient of 0.330. Hence for a 10% increase in risk, the return increases by 3.30%. This is statistically significant at the 95% level since the p-value is less than 0.05. The relationship is positive also for the five year time horizon and is statistically significant at the 95% level. Having a 10% increase in risk leads to an increase in the yearly return of 7.42%. The large discrepancy between the risk and return relationship coefficients may possibly in part be explained by the varying intercepts. The intercept for the 10 year horizon lies close to the risk free interest rate which had an average of 8.15% for the equivalent time horizon. However, for the 5 year investment, the intercept coefficient was estimated to be 4.50% while the risk free rate for the 5 year time horizon averaged at 7.75%. In theory, the estimates for the intercept coefficient should equal that of the risk free rate. Since the estimates of the intercepts for both time horizons are lower than the risk free rate, it could be interpreted that the investor has not been sufficiently compensated.

For both time horizons the lower end of the 95% confidence interval for the risk and return relationship is positive. Hence it is likely that the risk return relationship for the single family housing in Sweden is indeed positive. However, it is worth mentioning that the intercept coefficients, which are both significant at the 95% level, differ from the risk free rate computed from the Central Bank of Sweden for each respective time period. This, together with the fact of the low adjusted  $R^2$  for the 10 year time horizon, one should be cautious interpreting the data. However from the above results, we can conclude:

*We accept H1 stating there is a positive relationship between risk and return in the Swedish single family housing market.*

## 7.2 RISK ADJUSTED RETURN ON THE SINGLE FAMILY HOUSING MARKET COMPARED TO THE STOCK MARKET

The Sharpe ratio for the municipalities has been compared to the Sharpe ratio of the OMX for the respective time horizons. The hypothesis that the difference between the municipality single family housing Sharpe ratio and the OMX is equal to zero has been tested against the alternative hypothesis that they are different. Hence;

$$H_0 = \text{Sharpe ratio}_{RE} = \text{Sharpe ratio}_{OMX}$$

$$H_1 = \text{Sharpe ratio}_{RE} \neq \text{Sharpe ratio}_{OMX}$$

As the number of observations are 238, thus larger than 30, the central limit theorem is applicable and the difference between the two Sharpe ratios should be normally distributed. The results are presented below in *table 3*:

*Table 3.*

Time Horizon	10 years	5 years
d	-2.629	-0.556
std	0.590	0.266
n	238	238
$t_{obs}$	-68.728	-32.273
$t_{crit}$	-1.960	-1.960
Reject $H_0$	YES	YES

The negative  $t_{obs}$  indicate that the single family housing Sharpe ratio is worse than the OMX for both time periods and the results are significant at the 95% level since  $|t_{obs}| > |t_{crit}|$ .<sup>23</sup> Thus we can reject the null hypothesis and favor the alternative hypothesis that they are different.<sup>24</sup> This leads us to conclude:

*H2: We reject the hypothesis that the risk adjusted return for single family housing market is equal to that of the Swedish stock market. Instead the alternative hypothesis that the risk adjusted return for the single family housing in Sweden is worse than that of the stock market.*

<sup>23</sup> Newbold (1995)

<sup>24</sup> The data has also been tested excluding the negative Sharpe ratios, as the appropriateness of negative Sharpe ratios can be questioned. This gave similar results, where the adjusted return for the single family housing in Sweden underperformed that of the OMX.

### 7.3 THE EFFECT OF TIME HORIZON

The risk adjusted return in single family housing may be dependent of the time horizon of the investment. In the analysis, the 10 and 5 year time horizons have been compared on municipality level. The null hypothesis being that Sharpe ratio of the 10 year investment is greater than that of the 5 year. Hence:

$$H_0 = \text{Sharpe ratio}_{10} > \text{Sharpe ratio}_5$$

$$H_1 = \text{Sharpe ratio}_{10} \leq \text{Sharpe ratio}_5$$

Since the appropriateness of negative Sharpe ratio values can be questioned, the municipalities with negative Sharpe ratios during both time horizons have been dropped. From this, 153 municipalities remain for the comparison. *Table 4* below presents the difference between the Sharpe ratio of the two time horizons. The results show that there seems to be a positive effect of investing in the 10 year time horizon compared to the 5 year time horizon. Thus we cannot reject the null hypothesis of the 10 year investment horizon being superior to that of the 5 year horizon.

*Table 4.*

Increasing from 5 to 10 year time horizon	
mean (10)	0.349
mean (5)	0.241
std(10)	0.400
std(5)	0.152
n	153
$Z_{\text{obs}}$	1.807
$Z_{\text{crit}}$	-1.645
Reject $H_0$	<b>NO</b>

This leads us to conclude:

*H3: The length of the time horizon affects the risk and return relationship positively when increasing the time horizon from 5 to 10 years.*

Accepting the *H3* hypothesis, might seem contradictory to the return risk relationship coefficients obtained in *section 7.1*. However, the large differences in the estimated coefficients in the regression in *section 7.1*, are to a large extent a result of the two estimated intercepts obtained

for the 5 and the 10 year horizons. However, using the Sharpe ratio the intercept is the risk free rate per definition. Therefore, the analysis using the Sharpe ratio should give a better comparison regarding the two investment horizons.

#### 7.4 RISK AND RETURN IN METROPOLITAN AREAS

Regarding the metropolitan areas the amount of municipalities are 101 and the number of non-metropolitan municipalities are thus 137 in the sample. Since the number of observations exceeds 30, the central limit theorem is applicable for the following analyses.

##### 7.4.1 Risk

The null hypothesis being that the difference is zero and the alternative being that the metropolitan areas have a different risk compared to non-metropolitan areas. Hence:

$$H_0 = Risk_{Metro} = Risk_{Non-metro} = \sigma_{metro} = \sigma_{non-metro}$$

$$H_1 = \sigma_{metro} \neq \sigma_{non-metro}$$

The results from this are presented in *tables 5 and 6* below:

*Table 5.*

Risk in metro vs non-metro, 10 yrs	
mean(metro)	0.025
mean(non-metro)	0.020
std(metro)	0.005
std(non-metro)	0.006
n(metro)	101
n(non-metro)	137
$Z_{obs}$	6.741
$Z_{crit}$	$\pm 1.96$
Reject $H_0$	<b>YES</b>

*Table 6.*

Risk in metro vs non-metro, 5 yrs	
mean(metro)	0.062
mean(non-metro)	0.045
std(metro)	0.010
std(non-metro)	0.010
n(metro)	101
n(non-metro)	137
$Z_{obs}$	13.676
$Z_{crit}$	$\pm 1.96$
Reject $H_0$	<b>YES</b>

It can be seen from both time horizons that the  $Z_{obs}$  is positive and greater than  $Z_{crit}$ , hence we reject the null hypothesis of the risk being equal in the two different regions. The risk in the metropolitan areas is significantly higher compared to the non-metropolitan areas at the 95% significance level for both time horizons. We thus conclude:

*We accept the H4 hypothesis of the risk being different (higher) in metropolitan areas compared to non-metropolitan areas.*

### 7.4.2 Return

The null hypothesis being that the difference is zero and the alternative being that the metropolitan areas had a higher return. Hence:

$$H_0 = \text{Return}_{\text{Metro}} = \text{Return}_{\text{Non-metro}}$$

$$H_1 = \text{Return}_{\text{Metro}} \neq \text{Return}_{\text{Non-metro}}$$

The results from this are presented in *tables 7 and 8* below:

*Table 7.*

Return in metro vs non-metro, 10 yrs	
mean(metro)	0.092
mean(non-metro)	0.075
std(metro)	0.008
std(non-metro)	0.009
n(metro)	101
n(non-metro)	137
$Z_{\text{obs}}$	15.004
$Z_{\text{crit}}$	$\pm 1.645$
Reject $H_0$	<b>YES</b>

*Table 8.*

Return in metro vs non-metro, 5 yrs	
mean(metro)	0.096
mean(non-metro)	0.075
std(metro)	0.009
std(non-metro)	0.009
n(metro)	101
n(non-metro)	137
$Z_{\text{obs}}$	17.740
$Z_{\text{crit}}$	$\pm 1.645$
Reject $H_0$	<b>YES</b>

It can be seen from both time horizons that the  $Z_{\text{obs}}$  is positive and greater than  $Z_{\text{crit}}$ , hence we reject the null hypothesis of the return being equal in the two different regions. The return in the metropolitan areas is significantly higher compared to the non-metropolitan areas at the 95% significance level for both time horizons. We thus conclude:

*We accept the  $H_5$  hypothesis of higher return in metropolitan areas for both time horizons.*

### 7.4.3 Risk adjusted return

The null hypothesis being that the two areas have the same risk adjusted returns and the alternative being that they have different risk adjusted returns. Hence:

$$H_0 = \text{Sharpe ratio}_{\text{metro}} = \text{Sharpe ratio}_{\text{non-metro}}$$

$$H_1 = \text{Sharpe ratio}_{\text{metro}} \neq \text{Sharpe ratio}_{\text{non-metro}}$$

The results from this are presented in *tables 9 and 10* below:

*Table 9.*

<b>Risk in metro vs non-metro, 10 yrs</b>	
mean(metro)	0.472
mean(non-metro)	-0.318
std(metro)	0.391
std(non-metro)	0.477
n(metro)	101
n(non-metro)	137
Zobs	14.022
Zcrit	±1.96
Reject H0	<b>YES</b>

*Table 10.*

<b>Risk in metro vs non-metro, 5 yrs</b>	
mean(metro)	0.299
mean(non-metro)	-0.081
std(metro)	0.135
std(non-metro)	0.219
n(metro)	101
n(non-metro)	137
Zobs	16.468
Zcrit	±1.96
Reject H0	<b>YES</b>

It can be seen from both time horizons that the  $Z_{obs}$  is positive and greater than  $Z_{crit}$ , hence we reject the null hypothesis of the risk adjusted return being equal in the two different regions. The risk adjusted return in the metropolitan areas is significantly higher compared to the non-metropolitan areas at the 95% significance level for both time horizons. We thus conclude:

*We reject the H6 hypothesis that the risk adjusted return in metropolitan areas is equal to that in non-metropolitan areas. The risk adjusted return in metropolitan areas is higher than in non-metropolitan areas.*

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## 8 ROBUSTNESS TEST

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### 8.1 NON-STATIONARITY

In order to get reliable results, the data must be controlled for non-stationarity. This is because non-stationary data can lead to spurious results.<sup>25</sup> Furthermore, non-stationarity often gives rise to very high levels of adjusted  $R^2$  measures, even when the explanatory power is low. Therefore, an augmented Dickey-Fuller test is performed on each variable, return and risk, presented in *tables 11 and 12* below. However, our regressions are not performed on time series, but rather on municipalities. As can be seen from the tables below, the null hypothesis of unit roots can be rejected at the 1% significance level for all time horizons of investment and the data can be concluded to be stationary. This implies no further modifications need to be performed on the data for single family housing.

*Table 11.*

Risk		
Time horizon of investment	test statistic, $z_{\text{obs}}$	p-value
10 years	-9.070	0.000
5 years	-7.013	0.000

*Table 12.*

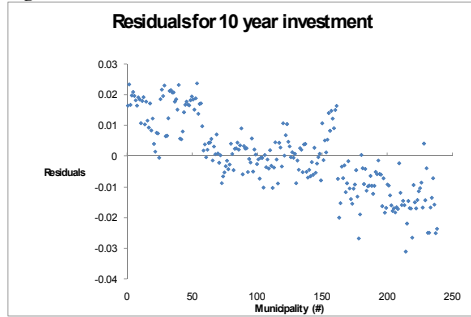
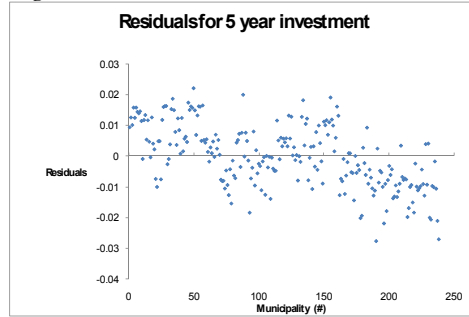
Return		
Time horizon of investment	test statistic, $z_{\text{obs}}$	p-value
10 years	-4.207	0.001
5 years	-3.464	0.003

### 8.2 EXAMINATION OF RESIDUALS

In order to check if the model contains specification errors we have plotted the residuals against the municipalities. Since the Sharpe ratio in metropolitan areas was greater than that of non-metropolitan areas we expect that metropolitan municipalities have a positive residual, whereas the non-metropolitan municipalities have a negative residual. The *figures 5 and 6* below present the residuals for each municipality, showing a trend of decreasing residual values. The first municipality numbers are sorted according to metropolitan and non-metropolitan areas. The first 101 municipalities represent metropolitan areas, and the following 137 represent non-metropolitan areas. Indicating that our theory of non-metropolitan areas having more negative residuals than metropolitan areas.

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<sup>25</sup> Gujarati (2003)

*Figure 5.**Figure 6.*

Hence, there seems to be a pattern in the residuals, indicating that there might be a specification error in the model. This is not surprising since we have concluded that the risk adjusted return for single family housing is higher in metropolitan areas than non-metropolitan areas. It is therefore not preferable to use a single model to explain the single family housing return using volatility as a measure, but rather it might be more efficient to use a model for metropolitan areas, and a different model for non-metropolitan areas. However, we leave this for further research.

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## 9 LIMITATIONS

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We would like to ask the reader to be cautious regarding the high risk-return relationship indicated by our 5 year time horizon results. The 7.42% increase in return for an increase of volatility by 10% seems high when compared to the obtained value for the U.S. market of 2.48% and our estimate for the 10 year time horizon of 3.30%. Furthermore, the positive impact on the risk adjusted return when increasing the time horizon from 5 to 10 years indicate that the estimated risk and return relationship for the five year time horizon of 7.42% may be inaccurate.

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## 10 CONCLUSION

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We ask the reader to be cautious regarding the results, especially for the 5 year investment, due to the possible limitations mentioned previously.

From the analysis we are able to conclude that when looking at a sample period of 25 years, 1981-2005, our results indicate that there is a positive relationship between risk and return in the Swedish single family housing market. For a 5 year investment, an increase in volatility by 10% leads to an increase in return by 7.42%. While for a 10 year investment, an increase in volatility by 10% leads to an increase in return by 3.30%. This can be compared to the results obtained in the U.S metropolitan market by Cannon et. al. where an increase in volatility by 10% leads to an increase in return by 2.48%.

Furthermore, we are also able to find significant results that the Swedish single family housing market has underperformed, on a risk adjusted basis, compared to the Swedish stock market.

Increasing the length of the investment horizon for single family housing in Sweden has a positive impact on the risk adjusted return when the investment horizon is increased from 5 to 10 years.

We find that the risk of investing in single family housing in metropolitan areas is higher than that of the non-metropolitan areas. We also find that the return is higher for metropolitan areas. Finally, we conclude that the risk adjusted return is higher in metropolitan areas than in non-metropolitan areas.

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## 11 FURTHER STUDIES

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We are aware of the fact that using the assessed value on county level instead of municipality level limits the accuracy of our results. Therefore, it would be interesting to see if our conclusions hold true if a study was conducted using assessed values on municipality level. Furthermore, using a more extensive sample period, it would be possible to conduct the analysis on longer investment horizons. This would be preferable, as it is possible that many investors have longer time horizons than 10 years.

In addition, we are aware that our classification of metropolitan and non-metropolitan areas is not ideal. The picture is not black and white, but rather, many municipalities might show tendencies of both criteria. Therefore, investigating using other classification methods could depict a more accurate picture. For instance, the number of inhabitants per municipality might be a better classification method. Since there are improvements that can be made within this field, we welcome further studies on the subject.

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**OMX**

*OMXSBPI* and *OMXSBGI*

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**13 APPENDIX**


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**13.1 MEDIAN RENT/PROPERTY VALUE CALCULATION**

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Average rent per month	3,785	3,890	3,914	3,938	3,981	4,027	4,161	4,279	4,405	4,520
Average rent per year	45,420	46,680	46,968	47,256	47,772	48,324	49,932	51,348	52,860	54,240
Property Price Index	185	198	217	237	263	284	302	322	353	387
Average Assessed Value	441,060	472,053	517,351	565,033	627,020	677,086	720,000	762,000	765,612	769,974
Average Property Value	588,079	629,404	689,801	753,377	836,026	902,781	960,000	1,016,000	1,020,816	1,026,632
Rent/Property Value	7.723%	7.417%	6.809%	6.273%	5.714%	5.353%	5.201%	5.054%	5.178%	5.283%
Median Rent/Property Value (1996-2005)	5.533%									

Source: Statistics Sweden (Bostads- och byggnadsstatistik årsbok 2001-2007)

**13.2 MAINTENANCE AND REPAIR COST**

	2000	2001	2002	2003	2004	2005
Average useful floor space per dwelling	122					
Maintenance and repair cost per square meter	76	85	84	84	94	96
Maintenance and repair cost per dwelling	9272	10370	10248	10248	11468	11712
Maintenance and repair cost/property value	1.11%	1.15%	1.07%	1.01%	1.12%	1.14%
Median maintenance and repair cost/property value (2000-2005)	1.12%					

Source: Statistics Sweden (Bostads- och byggnadsstatistik årsbok 2001-2007)

Statistics Sweden (Rikets fastigheter 2003, del 2)

**13.3 NEW BUILT HOUSES (PORTION OF TOTAL STOCK)**

	Number of existing properties	Newly produced	Demolished	Newly produced (%)	Newly produced (0-5) (median)	produced (6-10) (median)	Newly produced (0-10) (median)
<b>Median value</b>					1.57%	1.34%	2.24%
1991	1,874,233	28,685		1.53%			
1992	1,902,821	19,532	9,056	1.03%			
1993	1,922,254	9,400	10,033	0.49%			
1994	1,931,599	5,246	4,099	0.27%			
1995	1,936,766	3,726	1,441	0.19%	3.51%		
1996	1,940,439	3,695	-22	0.19%	2.17%		
1997	1,944,096	3,868	-211	0.20%	1.34%		
1998	1,947,890	4,280	-486	0.22%	1.07%		
1999	1,952,114	5,061	-837	0.26%	1.06%	3.51%	
2000	1,957,095	5,579	-598	0.29%	1.15%	2.17%	
2001	1,962,580	7,884	-2,399	0.40%	1.36%	1.34%	
2002	1,974,071	8,014	3,477	0.41%	1.57%	1.07%	
2003	1,985,561	8,143	3,348	0.41%	1.76%	1.06%	
2004	1,997,072	11,578	-67	0.58%	2.08%	1.15%	
2005	2,007,097	10,076	-51	0.50%	2.30%	1.36%	

Source: Statistics Sweden (Bostads- och byggnadsstatistik årsbok 2001-2007)