Stockholm School of Economics
Master's Thesis in Finance

Housing Price Insurance

A Study of the Willingness to Pay

Torbjörn Bäckmark*
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Abstract

The purpose of this study is to empirically identify factors that affect the willingness to pay for housing price insurance. Applying a Tobit model to data from a market survey performed in Uppsala 2007, this study shows that the willingness to pay for housing price insurance is negatively correlated with homeowners equity in their house, household income and the horizon for the investment in the house and that the willingness to pay is positively correlated with the respondents level of risk aversion. For a household with mean characteristics in the sample the willingness to pay is around 150 SEK/MSEK housing per month. A rough estimate of the cost of insurance based on the valuation of a traditional sell option on historical data shows a likely cost of insurance ranging from about 750 SEK/MSEK housing per month for the one year horizon down to zero cost for 8 years and longer horizons. A respondent with mean characteristics stated that he would be likely to live in his new home in 5-10 years and the stated willingness to pay cover the estimated cost of insurance at about 6 years and longer horizons.

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*19850@student.hhs.se

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1. Introduction

This thesis studies the possibility to construct contracts that enables people to avoid exposure to housing price risk. The gain from reducing housing price risk is not homogenous and this study tries to find which characteristics affect the willingness to pay for housing price insurance and how they affect it.

Purchasing a home is for most people the greatest investment during their lifetime. The decision to buy a home is often based on changes in the family situation. Over the lifetime we typically have an increased need for housing, both in terms of size and quality. The first home could be a small rental apartment or condominium then a typical housing career could go through larger condominiums, and for some people possibly through townhouses to villas. A typical Swedish male moves 11 times during his lifetime and in the nineties in Sweden 1.2 million people moved every year and out of them 400 000 moved across a municipality border (Statistics Sweden (2003)). One way to describe this is to talk in terms of housing consumption. This housing journey is made mostly because of changes in our need of housing. At the same time the home is the dominating asset in the investment portfolio of a homeowner household. In fact that asset typically comprises several hundred percent of net wealth of the household at a young age and first after a career of owning different homes and having amortized the mortgages the investment in the home is going down to about 100 % of net wealth at the age of 50 years old (Englund et al (2002)).

Hence, the home is one very important asset in the homeowners investment portfolio. As with most investments there are risks to consider when making an investment in the home. But how is the typical homeowners total investment portfolio composed? According to Markowitz (1952) the choice of securities in an investment portfolio should not be made to maximize expected return only. The investor should instead invest in a portfolio which maximizes expected return at an acceptable risk level, that is, the investment portfolio should have acceptable low variance. The risky portfolios with minimal variance for an expected return forms the efficient frontier of risky assets. Rational investors choose a portfolio from this efficient frontier thereby making a risk return trade-off that maximizes their utility which is a function also depending on their level of risk aversion (Bodie et al (2008)). Investment in several securities with low correlation reduces the total portfolio variance. For most ranges of expected return and standard deviation this implies that the best choice of investments is a diversified portfolio. A study of housing as one of the assets in an investment portfolio by Goetzmann (1993) shows that housing has low correlation with other assets and indicates that the optimal level of housing in an investment portfolio is about 50 % of the net wealth for the minimum variance portfolio. With the Markowitz investment perspective in mind it is easy to argue that homeowners tend to have a too large exposure against housing price risk in their investment portfolio due to the large investment in their home.

Over time housing prices vary, both the national price level for example relatively to household income, as well as the relative prices of, for example, a house in Stockholm compared to a house in the country side. Figure 1 shows that the housing purchase power, as measured by the Swedbank Boindex (Housing Index), went down about 40 % over the years from 2005 to 2008, and then up again almost 50 % in less than a year in 2009 (Swedbank Boindex (2010)). Figure 2 shows the price development for condominiums in Stockholm; as can be seen, the price index has increased 16,5 % over the last year (Valueguard Index Sweden AB (2010)). The figures illustrate the fact that if you have to move and buy or sell a condominium or a house at some specific point in time, you clearly face a large housing price risk. Depending on the timing of the deal and short time variations in housing prices the outcome could be very different and that will have great effects on the individual. With heavy leverage a large part of the total wealth could be lost. In extreme cases it could become difficult to move if the value of the home no longer covers the mortgage.

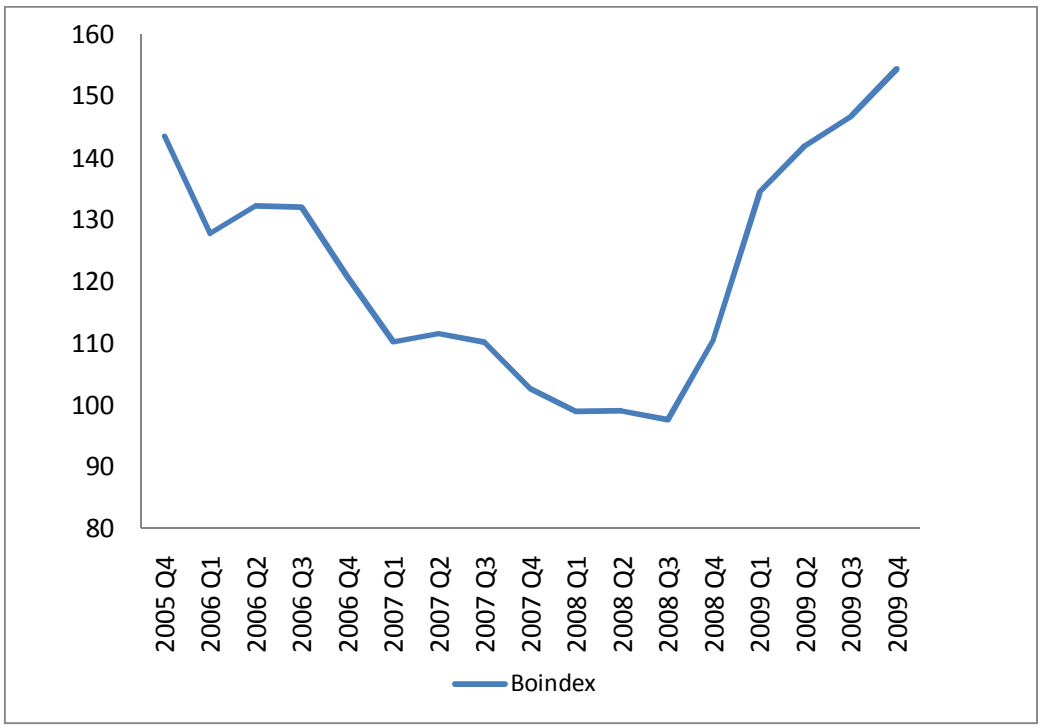

Figure 1. Housing purchase power.

The figure shows the Boindex (Housing Index) of Swedbank. It shows housing purchase power. As can be seen it went down about 40 % from 2005 to 2008 and then up again almost 50 % in less than a year in 2009 (Source: Swedbank (2010)).

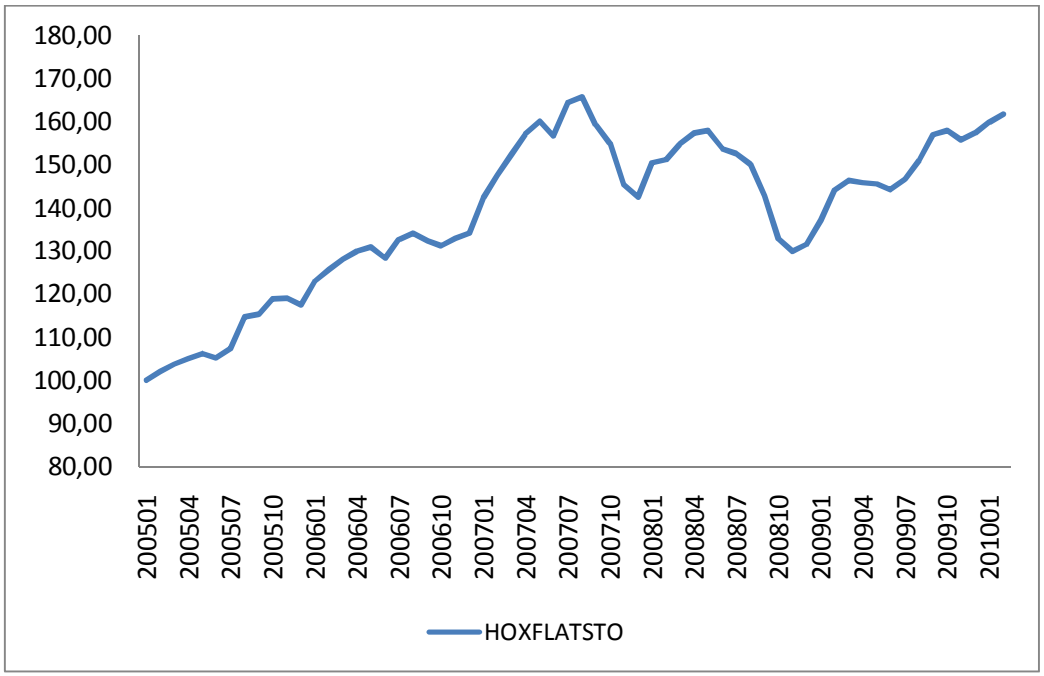

Figure 2. Condominium price development in Stockholm.

This figure shows price development for condominiums in Stockholm as measured by the index HOXFLATSTO by Valueguard Index Sweden AB. The price index increased 16.5 % over the last year (Source: Valueguard Index Sweden AB (2010)).

There is a current debate whether a housing price bubble is building up again on the housing market. The historically low interest rate and the increased mortgage lending to the public have led to a rapid increase in the housing purchase power during the last year. At the Executive Board's monetary meeting at the Riksbank on February 10, Stefan Ingves highlighted the problem with a divided capital market with high lending to households and low lending to companies, and he warned that the development of the housing market needs to be closely monitored (Sveriges Riksbank (2010)). Another indication of an overheated market is the statement by the National Housing Credit Guarantee Board (2010) that the housing market is overvalued by 20 %, and that it will adjust in the near future. The alleged reason is that housing wealth in relation to private consumption is historically high, in the last 10 years it has increased with more than 50 %, and that this measure in the long run should increase with the growth in consumption of about 2 % per year only. If the interest rate rises or disposable income falls, the housing prices will probably fall, and with heavy leverage some households will be highly vulnerable to this risk. The point here is not to try to predict a future downturn in the housing market, only to argue that a significant fall in housing prices is likely enough that one should expect a demand for some form of insurance.

It is thus not surprising that attempts have been made to introduce instruments that could reduce homeowner exposure to this risk. One instrument that could be used to accomplish that is the housing price insurance, through which an insurance company offers to guarantee the price of a house up to some level for a premium; a later section will provide more details on such insurances. There have also been attempts in several countries to introduce different kinds of housing price derivatives, but so far without great success (Englund (2009), Iacoviello and Ortalo-Magné (2003)).

To summarize: on the one hand, the purchasing of a home is one of the main investments in most individuals' life. It is by no means a risk-free investment, and consumers often show a significant degree of risk-aversion when making much smaller purchases, such as when insuring acquisitions of home electronics. But at the same time, the attempts to provide insurances for housing purchases have more or less failed. This raises the fundamental question of what does the demand for such products actually look like? The purpose of this thesis is to shed some light on this issue by trying to empirically identify factors that affect the willingness to pay for housing price insurance, and to measure the quantitative significance of these factors. To my knowledge this is the first empirical study of the willingness to pay for housing price insurance. In the following reasoning in this thesis there is an underlying assumption that presumably house buyers are rational in the sense that those who would gain more from insurance are willing to pay more for it. I am not sure that this will always be the case though since it is probably not common knowledge on how to think about these risks.

The study applies a Tobit model to data from a market survey performed in Uppsala 2007. It shows that the willingness to pay for housing price insurance is negatively correlated with the homeowners equity in the house, the household income and the expected horizon for the investment in the house, and that the willingness to pay for insurance is positively correlated with the respondents level of risk aversion. For a household with mean characteristics in the sample, the willingness to pay for insurance is 150 SEK/MSEK housing per month for households that demands insurance. A rough estimate of the cost of insurance using historical data is ranging from 750 SEK/MSEK housing per month for the one year horizon down to zero cost for 8 years and longer horizons.

The rest of the thesis is organized in the following way. The next section, Theoretical framework, walks through some previous research which motivates the hypotheses that will be used. The Theoretical framework section also presents some contract forms that have been suggested in the literature to relax the risk exposure towards the housing market. The following sections present the hypotheses, the dataset and the methodology used. After that follows empirical findings and analysis and discussions. The thesis ends with conclusions. For practical reasons the term house will be used to represent a single unit of housing; the house could in practice represent a single family house or a condominium.

2. Theoretical framework

For the presumable home buyer the investment decision is made having some kind of prediction of the future expected economical situation of the household in mind. The total wealth as well as predicted cash-flows in and out of the household are important variables to consider when making a budget for the house deal. There are two different kinds of risks to consider, first the cash flow risk associated with higher living costs for example due to increased rent. The second risk is the housing price risk which is the risk of losing money when selling the house in the future. It is this second risk that is discussed in this thesis.

With more total wealth and higher expected future income the sensitivity to housing price risk is reduced. A high future income makes it possible to amortize more on the mortgage and easier to save money to accumulate capital. This cushions the impact from losses on the housing investment. Englund et al (2002) shows in a mean-variance efficiency study that poor households theoretically would gain more from the possibility to hedge against housing price risk. Poor meaning in this case a heavy leveraged homeowner for which the home make up to 400 % of their net wealth. Their study showed that the gain from hedging is less for average and rich homeowners, were average homeowners having 200 % of their net wealth in the home and rich homeowners having 100%.

Another aspect of the price risk is the price risk associated with the probability of moving to another town. Sinai and Souleles (2009) argue that it is the sale price net the subsequent purchase price and not only the pure sale price that matters for the housing risk. That is, if selling the house and moving to a house in another town where the prices covariates with the prices in the home town the price risk are not as high as the ownership in the first house is a hedge for price variations in the subsequent one. What is important here then is if the prices in the current location covariates with prices in other towns to which the speculator could move with high probability in the future. Sinai and Souleles show that in U.S. people tend to move between pair of towns with high covariance and that mobile households are one percentage point more likely to choose to own the house than to rent it.

Jansson (2008) shows that the optimal level of owner-occupied housing is a diminishing function of unemployment housing price covariance. For most households labor income is the most important source of income and for homeowner households the home is the greatest asset. If there is a large covariance between risk of unemployment and housing prices the households are even more exposed to the unemployment risk. Such higher covariance would typically appear in small towns with few large employers. If an unemployment shock appears at such location the housing prices are affected too through the reduction in demand on the housing market. Homeowners who lose their employment are hit twice losing value in their home simultaneously.

A further aspect of the housing risk problem is the risk associated with future consumption of housing. Housing is not a substitutable good. Everybody needs a place to live and we know that we will have a future consumption need of housing too. This need can be satisfied by renting or by owning a house. Sinai and Souleles (2005) shows that by owning it is possible to avoid the unpredictability of renting costs, homeownership with long term fixed mortgage rate is more predictable. The market rent tends to vary with the prices of the real estate market. With no investment in housing you are heavily exposed against future variations in the market rent, possibly having to reduce other consumption to pay the increased rent. One can think of this as the future housing need being a short position in the housing market and the current ownership of a home being the perfect hedge. The reasoning on choice between homeownership and renting requires off course a well functioning rental market for housing. In Stockholm the rental market is limited by regulated rent levels and instead of clearing the market at a market rent there is a deficit of rental apartments (Ellingsen and Englund (2003)). Tenants in Stockholm are favored by the regulated rents and are probably not as exposed to future variations in the rent level as they would have been with market rents.

The risks of housing price falls are important not only to the individual homeowner, Case and Quigley (2008) describes three different channels through which a downturn in housing prices affects the economy as a whole. The first effect is the wealth effect. When the value of household assets fall this leads to less spending on consumption. This is because the reduction of the house value affects the household balance sheet, and therefore the household is likely to change its behavior when it comes to choices of consumption and saving. The second effect of reduced housing prices is the income effect. Falling house prices leads directly to fewer sales and loss of income for brokers, mortgage lenders and others. Also, falling prices leads to less new construction and hence reduced income also to the construction industry as a whole. The third effect is the financial markets effect by which other parts of the economy is affected through the financial markets if the housing prices fall. This effect was visible in the subprime crisis when uncertainties concerning bad mortgage backed securities spread out over the world. Uncertainty drained liquidity from the financial markets and the crisis eventually lead to an increased downturn in the real economy too. Hence an introduction of housing price insurance on the market may have desirable external effects on the macro economy.

2.1 Contract forms

There has been some research on how to relax the homeowner exposure towards the housing market and some different ideas for contract forms can be considered (Englund (2009)). The goal would be to try to somehow reduce the homeowners investment in his house. One first basic thing to consider for the individual presumable home owner would be to choose a cheaper house in the first place and that way limiting the size of the investment to what would be an appropriate share of housing in the total investment portfolio. For most people that is not a realistic approach since such limitations in the choice of house would eliminate the possibility to buy the size and quality of house needed for consumption purposes according to the family situation and other factors. Assume instead that the choice of house is already made according to these factors and consider some other possibilities.

2.1.1 Shared home ownership

Theoretically it would already today be possible for a homeowner to reduce his investment in the own home by selling a part of the house to somebody else, possibly not living there. However the demand for such a share in a house is probably limited and if a contract was signed it would give rise to some obvious problems in the area of moral hazard and asymmetric information. What would happen for example if the homeowner does not maintain the house in an appropriate manner? Another issue would be if the part holding a share in the house without living there would like to sell his share. Could he then force the person living in the house to move and sell the house in the market or does that person have to buy out his share? How should they agree on a price? With low liquidity in the market some friction in this area can easily be imagined. For this kind of solution to work there is a need for a detailed contract to be worked out. Caplin et al (1997) has suggested a solution for shared home ownership called Partnership Markets where institutional investors would provide some of the equity for the house in exchange for a share of the future selling price. This would make opportunities also for people outside of the housing market to buy shares and hence increase their exposure in the residential real estate market. Hence this seems like an intuitively good solution to the overinvestment problem. But still even with detailed contracts worked out this solution will always be troubled by the asymmetric information and moral hazard problems.

2.1.2 Shared-Equity Mortgages

Traditionally homeowners rely on pure debt when financing their home. The so called Shared-Equity Mortgages, SEMs, makes it possible for the homeowner to share some of the housing price risk with investors. Just as corporations, homeowners can this way finance their investment through a mix of equity and debt (Caplin et al (2007)). The earliest SEMs were called Shared-Appreciation Mortgages, SAMs, and these contracts is constructed to give the borrower interest-free loans in exchange for a share in the appreciation on the house when the contract is terminated. For example a contract with a two to one

appreciation-sharing ratio would mean that the borrower takes a mortgage for 20 % of the home value and pays 40 % of the appreciation as interest when the loan is terminated. This contract means risk sharing for the homeowner since the mortgage will be interest free if the value of the house falls. On the other hand the terms of the contract is not very favorable for the homeowner in times when house prices rise a lot since the effective interest rate can turn out to be very high.

2.1.3 Index derivatives

Another instrument to consider is derivatives with a housing price index as base. With futures, options or swaps traded in a fully functional market any house owner could theoretically tailor his own solution by buying standardized derivatives that hedge his positions in the same way as is possible on the derivatives markets for stocks. Case et al (1993) argues that if such markets where in effect institutional investors could then choose to put a major part of their investments in there and their clients would gain from diversification. That would make it possible for people without houses, for example renters, to that way increase their exposure in the housing market. Remember that some research implied that an optimal portfolio should include about 50 % investment in the housing market (Goetzmann (1993)). This means that renters would gain from diversification too if they could increase their investment using such derivatives. For most people it would probably be too advanced to trade such contracts in a market place. But that last problem could be resolved by intermediate actors in the financial markets who could create some kind of house savings funds where people could save money in funds tied to a housing price index.

2.1.4 Insurance contracts

The insurance contract is a fourth instrument that could be used for this purpose (Case et al (1993)). With an insurance covering the losses from a sale the homeowner exposure for housing price risk would be eliminated. An insurance contract could be formed to cover losses from a house having the insurance company taking on the specific risk for that house, or it could be connected to some housing price index and cover only losses as derived from that index development during the same period. With a credible housing price index as base the later solution would be less exposed to moral hazard and asymmetric information issues and therefore probably cheaper. As with other insurances if it was to be connected to the specific house the possibility occur for the house owner to try to take advantage of asymmetric information and for example reduce maintenance facing a sale with the insurance contract so to speak in the money. Knowing that the sale would anyhow result in losses that will be covered by the insurance company the homeowner has no incentive to make an effort to increase the sales price in the coming sales process as he would have done without the insurance. Also, it would be important for the insurance company to make a credible valuation of the house. Otherwise the house buyer could drive the house price beyond the fair market price armed with a housing price insurance, knowing that even if he buys at

overprice he will get his money back from the insurance. Another problem is that of adverse selection; Homeowners who have bought houses and have private information on that their house for some reason is more likely to lose in value has more incentives to buy insurance. This will mean an increased cost for the insurance company and hence for the insurance contracts.

The effect of moral hazard can be remedied to some extent by introducing conditions to fulfill for the insurance to be payed out and to use a deductive as is common practice for insurance contracts. The insurance company could for example use a deductive of 5 % meaning that the contract would not cover the first 5 % of the losses and therefore some incentive is left for the homeowner to make the extra effort as he would have done without insurance. The main drawback for the solution with insurance for the specific house is the increased costs for the insurance contract due to asymmetric information.

On the other hand an insurance contract covering losses as derived from an index only leaves the homeowner with the residual risk specific to that house. It is probably not very encouraging for the individual with housing price insurance if it turns out that a big loss on his sale is not covered by the insurance anyway only because the loss was due to price risk specific to his house. In the homeowners perspective it could be even more important to cover the house specific risk since in many cases he will move on to another house and then it is the relative price between the current living and the next that matters. Having to realize losses on a house from a price fall not correlated to the rest of the housing market would mean not only that the loss would not be covered by the index based insurance but also that the loss is realized in a time when the other houses in the market has become even more expensive and hence if searching for another home the situation would be cumbersome.

In the survey that is treated in this thesis one important question was posed as “If you buy a new home - how much would you be willing to pay per month to not having to worry about price falls in the housing market?”. This question does not define exactly which form of contract that is considered. However a question formulated like that asking for a price implies an insurance contract. An investment in a index derivative for example a sell option could be covered with the same question but that seems a little complicated and probably people answered the survey having some kind of insurance contract in mind.

3. Hypotheses

Below, in Table 1, is a summary of suggested factors that would affect the willingness to pay (WTP) for housing price insurance. The sign column contains guesses of the sign of the affect of the factor on the WTP and there is a short motivation.

Table 1. Suggested factors that would affect the willingness to pay for housing price insurance

The table shows suggested factors that would affect the willingness to pay for housing price insurance. It contains guesses of the sign of the effect and a motivation.

Factor	Sign	Motivation
Wealth	-	Increased wealth works as self insurance.
Income	-	Increased income works as self insurance.
Equity	-	Increased equity in the house cushions losses from housing price falls.
Diversification	-	Increased diversification in the total investment portfolio reduces exposure against housing price risk.
Horizon	-	A long horizon on the investment decrease risks due to short time price variations.
Forecast	-	A negative forecast for the housing price market development increase incentive to buy insurance.
Age	+	Because of a smaller future short position in the housing market at higher age the incentive to buy insurance should increase.
Marital Status	-	With a partner in the household the risk of losing labor should decrease since two persons in the household means some diversification of the labor market risk and health related risks.
Children	+	Children in the household would mean increased responsibility to provide for the household and increased costs in the budget.
Moving probability	+	With a high probability of moving to another town the value from insurance would increase. Especially if the prices in the town to move to does not covariate much with the current town.
Unemployment risk	+	With a high risk of unemployment the value from insurance increase. Especially so in towns with high unemployment risk / housing price covariance.
Risk aversion	+	For people with extreme risk aversion the value of insurance would be higher.

The first factors concern the wealth of the household. With large enough wealth a household will be self insured. For a poor household on the other hand a realized loss from a sold house could mean disaster for the economy. With increased wealth or increased income the WTP for insurance is expected to decrease. The same argument goes for the equity in the home. For some people with most of their wealth invested in the house the home equity is probably a good proxy for the total wealth. Increased equity in the house cushions losses and with increased equity in the house the WTP is expected to decrease.

When looking at the total investment portfolio households with well diversified portfolios are less exposed to house price risk. Therefore WTP for housing price insurance is expected to decrease for households with well diversified total investment portfolios. For the house as for any investment a longer investment horizon would imply less exposure to pricing risks due to temporary price variations. If you live in your own house and do not plan to move for a long time these price variations has no impact on the household economy. If on the other hand you know that you have to move soon the pricing risk of the individual house is great, hence the WTP is expected to decrease with the investment horizon.

The household face several risks. Some of these risks could be hedged to some extent within the family depending on the family situation. A married couple with two labor incomes is less exposed to risks of losing income due to unemployment or health issues. Therefore WTP for housing price insurance is expected to be lower for married couples. Children in the family could have some hedging effect too when growing up but it is supposed that the increased responsibility to provide for children will take the overhand and WTP is expected to be higher for households with children.

The risks in the housing market are twofold. We have the investment risk resulting from transactions in the housing market. The other risk is the consumption risk resulting from the fact that we know that we have to pay for future housing. Looking at this with a lifecycle perspective we know that at young age we have a lot of future housing consumption to hedge, a typical person would demand more and more housing, both in size and quality up to some age. First after retirement maybe the housing consumption would possibly diminish. With this increasing need of housing in front of us at young age we have so to speak a large short position on the housing market and we can hedge that position by owning more than otherwise optimal in the current own living. The need for this kind of hedge diminishes as we get older. Therefore the WTP for housing insurance is expected to be an increasing function in age.

A homeowner with high probability of moving to another town is more exposed to housing price risk. That is especially so if the housing prices in the town to move to does not covariate much with the housing prices in the current location. Therefore WTP is expected to increase with increased probability to move to another town.

Homeowners with high risk of losing their employment and living in towns with high unemployment housing price covariation are more exposed to housing price and hence WTP is expected to be increasing in unemployment risk.

Finally WTP is expected to be an increasing function of the level of risk aversion of the household. The utility for the household from insurance depend not only on the absolute risk reduction, the function does also include the risk aversion of the household.

This thesis uses a dataset with answers from a survey that does not include questions to reveal all the factors above. Below is a list of hypotheses for the factors that will be possible to test empirically with the dataset at hand. The formal statistical tests will be made trying to reject a null hypothesis stating that the corresponding factor does not affect the willingness to pay in favor for the alternative hypothesis stating that the factor does affect the willingness to pay for insurance.

Null hypotheses:

- H_{01}: Homeowners **income** does not affect the willingness to pay for insurance.
- H_{02}: Homeowners **equity** does not affect the willingness to pay for insurance.
- H_{03}: Homeowners **horizon** does not affect the willingness to pay for insurance.
- H_{04}: Homeowners **age** does not affect the willingness to pay for insurance.
- H_{05}: Homeowners **marital status** does not affect the willingness to pay for insurance.
- H_{06}: Homeowners **children** do not affect the willingness to pay for insurance.
- H_{07}: Homeowners **forecast** does not affect the willingness to pay for insurance.
- H_{08}: Homeowners **risk aversion** does not affect the willingness to pay for insurance.

Alternative hypotheses:

- H_{11}: Homeowners with small **income** are willing to pay more for insurance.
- H_{12}: Homeowners with small **equity** in their own home are willing to pay more for insurance.
- H_{13}: Homeowners with short **horizon** are willing to pay more for insurance.
- H_{14}: Homeowners at high **age** are willing to pay more for insurance.
- H_{15}: Married homeowners (**marital status)** are willing to pay less for insurance.
- H_{16}: Homeowners with **children** are willing to pay more for insurance.
- H_{17}: Homeowners with a negative **forecast** for the housing prices are willing to pay more for insurance.
- H_{18}: Homeowners with high **risk aversion** are willing to pay more for insurance.

4. Data

The dataset used in this thesis is the outcome from a market survey performed in Uppsala 2007 for Valueguard. The survey consisted of an e-mail questionnaire with 30 questions and it was directed to a registry of speculators on the housing market. The survey was sent to 9000 e-mail addresses among which a lot belonged to inactive members. Out of the persons logging in to the site 30 days before the survey the answering frequency was about 25 %. The total number of answers is 1207 and out of them 1117 has completed the questionnaire. The purpose of this survey was to probe for the interest for housing price insurance.

4.1 Variables

4.1.1 WTP

The dependent variable willingness to pay per price unit of housing (WTP) is calculated from the answers of two questions in the questionnaire *"If you buy a new home - how much would you be willing to pay per month to not having to worry about price falls in the housing market?"* and "*If you buy a new home – how much do you think it will cost?"*. Hence the WTP per price unit and month is calculated as the answer on the first question divided with the second and gives a variable in the form of willingness to pay for insurance per month and MSEK of housing expressed in KSEK. There is some weakness in this estimate since the question as such does not reveal the form of the contract that should make the homeowner not having to worry about a price fall in the housing market. It is only put in general, what would the speculator be willing to pay per month not to worry. Neither does the question specify how much a contract would cover, however I assume that the speculators answered this question having their specific prospect new home in mind.

4.1.2 Income

The Income question is posed as *"How large is the income of your households before tax?"* and the answers are divided in 10 categories, taking on values 1-10, representing incomes ranging from below 10 000 SEK per month to above 80 000 SEK per month.

4.1.3 Equity

Equity is derived from questions on how much the new home would cost and how much mortgage the speculator think she would need to buy the new home. It is expressed as a fraction of the total value of the house and is ranging from 0.1 to 1.

4.1.4 Horizon

Horizon is taken as the answer on the question *"If you buy a new home – how long do you think you will live there?"*. The answers are given in three categories, 1-3, representing answers "less than 5 years", "5-10 years" and "more than 10 years".

4.1.5 Age

Age is given in 6 categories, 1-6, representing answers "below 25 years", "25-34 years", "35-44 years", "45-54 years", "55-64 years" and "65 years and above".

4.1.6 Marital status

Marital status is a dummy variable taken as the answer on a question on the family situation. It takes the value "1" if the answer was "married or cohabitant" otherwise it takes the value "0".

4.1.7 Children

Children is a dummy variable taken from the question *"Do you have children living in your household?"*. It takes the value "1" if there are one or more children living in the household and "0" otherwise.

4.1.8 Forecast

Forecast is taken as the answer on the question *"How do you think the following will develop: … Housing prices in the Uppsala area during the upcoming two years"*. The answers are given in five categories "fall a lot", "fall little", "unchanged", "raise little" and "raise a lot".

4.1.9 Worries

The Worries variable is constructed to be a kind of proxy for risk aversion. This variable is derived from four different questions on worries for different things relating to the house deal. The questions were posed as below:

"Suppose that you just bought a new home. How strong worry do you think you would feel for the following things (on a scale ranging from 1-5):

1. That housing cost will be too high.

2. To lose money on a future sale (if the price falls).

3. That the housing prices will fall so the value of the house diminishes.

4. To be sitting with the house and not being able to sell it."

The Worries variable is constructed as the average on the answers given on the questions above. The answers on these individual questions seem correlated and they are taken together as a measure of risk aversion. It should be noted that housing price insurance would not cover high housing cost, but against the three others worries a housing price insurance would help.

Table 2 shows some summary statistics for the variables that will be used in this thesis.

Table 2. Summary statistics

The table shows summary statistics for the initial data set.

Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
WTP	1207	0.0569	0.1436	0	3
Income	1078	6.5649	2.2575	1	10
Equity	745	0.3918	0.2752	.1	1
Horizon	734	2.2316	0.7575	1	3
Age	1169	2.9530	1.2843	1	6
Marital status	1207	0.6694	0.4706	0	1
Children	1207	0.3853	0.4869	0	1
Forecast	1099	3.3057	1.0159	1	5
Worries	746	2.8056	0.9863	1	5

5. Methodology

The first part of the analysis will be to examine the data and take care of outliers. After that there will be some analysis based on the correlation between the dependent and the explanatory variables as well as the correlation among the explanatory variables. As an initial model for the willingness to pay I propose the following model:

$$WTP = \alpha_0 + \beta_0 * Income + \beta_1 * Equity + \beta_2 * Horizon + \beta_3 * Age + \beta_4 * Marital\ Status + \beta_5 * Children + \beta_6 * Forecast + \beta_7 * Residual\ Worries + u_0 \quad (1)$$

When it comes to the risk aversion parameter a proxy for this, Worries, is calculated from the answers on questions regarding worries for different kinds of risks associated with the house market. A rational house buyer with a normal level of risk aversion would express worries that relate to the risks in the market. Hence, the worries estimate for these individuals should itself theoretically be explained by the other explanatory variables. If using this proxy directly as an explanatory variable in the model there would be a problem with multicollinearity. Instead worries are modeled as the dependent variable in a separate regression and residuals from a prediction using estimated parameters from this separate regression are placed in the original model. That last explanatory variable shows residual worries and this will have a positive value when the respondent expressed more worries than what would be estimated by the model with their other answers. If the coefficient for this variable turns out positive this would mean that willingness to pay is higher for extra worrisome and hence more risk adverse households.

$$Worries = \alpha_{10} + \beta_{10} * Income + \beta_{11} * Equity + \beta_{12} * Horizon + \beta_{13} * Age + \beta_{14} * Marital\ Status + \beta_{15} * Children + \beta_{16} * Forecast + u_1 \quad (2)$$

$$Residal\ Worries = Worries - \widehat{Worries} \quad (3)$$

The goal for this thesis is to estimate parameters a_0, β_0- β_7 and to find if this is an appropriate model for the willingness to pay for housing insurance and to use the resulting model with the estimated parameters to simulate the willingness to pay for housing price insurance.

When people filled in the questionnaire not everyone was interested in housing price insurance. There was another question asking whether the speculator would be interested in an insurance which protect against losses if he would sell his home after a price fall. Some speculators answered no on this question and these speculators did not then state the willingness to pay as a price in the next question. Hence for

these speculators there are explanatory variables but no observations on the dependent variable in the population.

Trying to solve this problem using a regular OLS turns out not to be a feasible solution (Breen (1996)). The first naïve approach would be to discard all observations where no willingness to pay have been stated and run an OLS regression in the subset of the population that have stated a willingness to pay. This would mean not only that observations are thrown away, and some variability is lost, but furthermore that the resulting estimates would be biased and inconsistent (Gujarati (2003)) because they are based on a non-randomly selected subset of the population. That is true even within the population with willingness to pay. Another approach could be to assign the value of zero for the willingness to pay for those who have not stated such value. Again, this would give biased estimates of the parameters for the population.

The obstacle lies in the fact that for the part of the original full sample that are not interested in housing price insurance there are no observations on their willingness to pay. This type of sample, where information on the regressand is available only for some observations is called a censored sample. One way to tackle this kind of problem is to use the Tobit model developed by James Tobin (1958) and Amemiya (1973). Tobit is short for Tobins probit. This model is useful for exactly this kind of situation, where the dependent variable of the regression has a lower or upper limit and for some part of the sample it assumes the limit value while for the rest of the sample it varies over a wide range of values.

The Tobit model is defined by

$$y_i = \begin{cases} y_i^* & if \quad y_i^* > 0 \\ 0 & if \quad y_i^* \leq 0 \end{cases} \qquad \text{(i = 1,2, …, N)} \qquad (4)$$

where y_i^* is a latent variable:

$$y_i^* = x_i'\beta + u_i\,, \;\; u_i \sim N(0, \sigma^2)$$

Hence there is an underlying function y* for which parameters will be estimated, for the whole population. Observations of the explanatory variables exists for the full sample, but for one part of the sample, the one where y* <= 0 there are no observations from the regressand. This part of the sample has been censored. In the Tobit model the parameters are estimated with a maximum likelihood method.

The β estimated with the Tobit model defines the estimated underlying function, y*. In a regular OLS the estimated β shows the effect of a unit change in the corresponding explanatory variable on the dependent variable, holding all other variables constant. Using the Tobit β is only meaningful when interested in the underlying variable. The expected value of the underlying variable is shown in equation 5, and the marginal effect of a unit change in variable x_j, the partial derivative, is given in equation 6.

$$E(y^*_i|x_i) = x'_i\beta \tag{5}$$

$$\frac{\partial E(y^*)}{\partial x_j} = \beta_j \tag{6}$$

However in most cases when it comes to Tobit models what is interesting is how a unit change in one of the explanatory variables changes the expected realized outcome from the censored function, y. The expected value of the realized variable can be expressed as in equation 7 (Breen (1996)).

$$E(y_i|x_i) = P(y_i > 0|x_i)\, E(y_i|y_i > 0, x_i) \tag{7}$$

McDonald and Moffitt (1980) describes how the total effect from changes in the explanatory variables can be decomposed into two parts; (1) the change in the values being above the limit weighted with the probability of being above the limit and (2) the change in probability weighted with the expected value of y above the limit (equation 8).

$$\frac{\partial E(y)}{\partial x_j} = P(y > 0) * \frac{\partial E(y|y>0)}{\partial x_j} + E(y|y > 0) * \frac{\partial P(y>0)}{\partial x_j} \tag{8}$$

The partial derivatives can be expressed analytically in terms of the standardized normal distribution function, Φ(z), and the standard normal density function, φ(z), as in equations 9-11. In this context z denotes a particular value of $x_i'\beta/\sigma$.

$$\frac{\partial P(y>0)}{\partial x_j} = \varphi(z)\frac{\beta_j}{\sigma} \tag{9}$$

$$\frac{\partial E(y)}{\partial x_j} = \Phi(z)\beta_j \tag{10}$$

$$\frac{\partial E(y|y>0)}{\partial x_j} = \beta_j\left[1 - z\,\frac{\varphi(z)}{\Phi(z)} - \left(\frac{\varphi(z)}{\Phi(z)}\right)^2\right] \tag{11}$$

The partial derivatives will be estimated with Stata holding the other variables constant at the mean value of the sample, and the estimates will be used to simulate marginal effects from changes in the explanatory variables with the estimated model.

An estimate of the price at which it would be possible for an insurance company to offer an insurance contract will be calculated using historical data from a housing price index, FASTPI, by Statistics Sweden (2010). The probability and size of the losses will be estimated with rolling imaginary housing deals with different horizons. With the historical probability and size of a loss calculated the cost of an insurance contract that fully covers the losses, as a traditional sell option, would be at least as big as the riskless negative cash flow with the same value.

6. Empirical Findings and Analysis

The first step will be to remove outliers. By examining the data I find that most of the observations of the derived WTP are situated between 0 and 0.5 with the mean value as low as 0.0569, that is a willingness to pay for insurance of 57 SEK/MSEK housing per month. However there are three observations above 1, the most extreme as high as 3, representing a willingness to pay of 3000 SEK/MSEK housing per month. Looking closer at that observation it turns out that this respondent stated a willingness to pay of 600-999 SEK per month not to having to worry for price falls on the housing market. At the same time she stated that if she bought a new home it would cost less than 300 000 SEK and that she would probably borrow about half the amount. This value stands out as an outlier among the other observations. Since this respondent was looking for a cheap home, maybe one explanation for the extreme willingness to pay could be that this answer was not given with her specific prospect new home in mind. The three observations with WTP above 1 were excluded from the further analysis on this dataset.

Table 3 below shows a correlation matrix for the dependent and explanatory variables from the dataset with the significance level in italics below each correlation coefficient.

Table 3. Correlation matrix

The table shows a correlation matrix for the dependent and explanatory variables from the dataset with the significance level in italics below each correlation coefficient. There are significant negative correlations between WTP and Income, Equity, Horizon, Marital status and forecast. There are strong correlation also between Marital status and Income and between Age and Equity.

	WTP	Income	Equity	Horizon	Age	Marital status	Children	Forecast	Worries
WTP	1								
Income	**-0.0949** *(0.0018)*	1							
Equity	**-0.0943** *(0.0100)*	**0.1250** *(0.0009)*	1						
Horizon	**-0.1747** *(0.0000)*	**0.2176** *(0.0000)*	**0.2646** *(0.0000)*	1					
Age	**-0.0237** *(0.4186)*	**0.2496** *(0.0000)*	**0.5138** *(0.0000)*	**0.3462** *(0.0000)*	1				
Marital status	**-0.1025** *(0.0004)*	**0.5945** *(0.0000)*	**0.1015** *(0.0056)*	**0.2859** *(0.0000)*	**0.0851** *(0.0036)*	1			
Children	**-0.0114** *(0.6919)*	**0.2552** *(0.0000)*	**-0.1034** *(0.0047)*	**0.2077** *(0.0000)*	**-0.0315** *(0.2822)*	**0.2704** *(0.0000)*	1		
Forecast	**-0.0624** *(0.0386)*	**-0.0285** *(0.3608)*	**0.0491** *(0.1882)*	**-0.0218** *(0.5622)*	**-0.0699** *(0.0205)*	**-0.0062** *(0.8368)*	**-0.0733** *(0.0150)*	1	
Worries	**0.1544** *(0.0000)*	**-0.0866** *(0.0223)*	**-0.2833** *(0.0000)*	**-0.1920** *(0.0000)*	**-0.2207** *(0.0000)*	**-0.0905** *(0.0134)*	**0.0043** *(0.9065)*	**-0.2016** *(0.0000)*	1

There are significant negative correlations between WTP and Income, Equity, Horizon, Marital status and Forecast. And there is a significant positive correlation between WTP and Worries. That is all intuitive and according to the hypotheses. However for Age and Children the correlations are not significant. Note however that there are strong correlations also between Marital status and Income and between Age and Equity. Using these parameters as explanatory variables in a multiple regression model would imply problems with multicollinearity since this suggests possible linear relationships between variables.

An initial Tobit regression gives insignificant results for the explanatory variables Income, Age, Marital status and Children as shown in table 4 below. With the initial regression as a starting point a series of regressions is performed removing some of the insignificant variables. Since the explanatory variables Age and Marital status showed strong correlation with other explanatory variables I choose to remove them. Children turned out insignificant also with the other variables removed.

Table 4. Estimates initial Tobit regression

The table shows estimates from the initial Tobit regression. Equity and Horizon are the only significant coefficients.

				Log likelihood	=	-69.14
				Number of obs	=	652
				LR chi2(7)	=	50.87
				Prob > chi2	=	0.0000
WTP	**Coef.**	**Std. Err.**	**T**	**P > |t|**	**[95 % Conf.**	**Interval.]**
Income	-.0044	.0042	-1.04	0.297	-.0127	.0039
Equity	-.0959	.0329	-2.92	0.004	-.1604	-.0313
Horizon	-.0284	.0113	-2.52	0.012	-.0506	-.0063
Age	-.0060	.0074	-0.82	0.413	-.0206	.0085
Marital status	-.0310	.0201	-1.54	0.124	-.0705	.0086
Children	-.0153	.0163	-0.94	0.349	-.0473	.0167
Forecast	-.0130	.0074	-1.76	0.079	-.0274	.0015
Constant	.2466	.0391	6.30	0.000	.1697	.3234
Sigma	.1783	.0068			.1649	.1917

Obs. summary:

260 left-censored observations at wtp<=0
392 uncensored observations
0 right-censored observations

Next step is to estimate the residual worries in its own regression. For this a regular OLS is used. Initially all the explanatory variables from the previous model was used. The variables that turned out insignificant in the initial regression were removed and a reduced model with Equity, Horizon, Age and Forecast as explanatory variables appeared. The estimates from the regression using this reduced model are shown below in table 5.

Table 5. Estimates from the OLS for Worries, reduced model

The table shows final estimates from the OLS regression with Worries as dependent variable.

				Number of obs	=	633
				F(4, 628)	=	29.71
				Prob > F	=	0.0000
				R-squared	=	0.1591
Worries	**Coef.**	**Std. Err.**	**t**	**P > |t|**	**[95 % Conf.**	**Interval.]**
Equity	-.7018	.1544	-4.55	0.000	-1.0050	-.3986
Horizon	-.1545	.0507	-3.05	0.002	-.2540	-.0551
Age	-.0927	.0339	-2.73	0.006	-.1593	-.0261
Forecast	-.2117	.0350	-6.04	0.000	-.2805	-.1429
Constant	4.3690	.1668	26.19	0.000	4.0413	4.6966

According to this estimated model, the Worries depend on Equity, Horizon and Forecast with a negative sign. This is intuitive; with more equity, a longer horizon or a more positive forecast there is less reason to worry. Age turned out significant with a negative sign, which is against the hypothesis stated initially for the WTP.

This estimated model for Worries is used to predict Worries and the predicted values are drawn from the original observed Worries to get the residuals. These are called Worres and are used as the last explanatory variable in the original model. Again the insignificant variables are removed from the model.

Table 6. Estimates final Tobit regression

The table shows estimates from the final Tobit regression. The coefficients for Income, Equity, Horizon and Worres are significant at the 5 % level.

Log likelihood	=	-28.26	
Number of obs	=	633	
LR chi2(5)	=	65.31	
Prob > chi2	=	0.0000	

WTP	**Coef.**	**Std. Err.**	**T**	**P > |t|**	**[95 % Conf.**	**Interval.]**
Income	-.0068	.0032	-2.10	0.036	-.0131	-.0004
Equity	-.1259	.0274	-4.60	0.000	-.1797	-.0722
Horizon	-.0333	.0096	-3.45	0.001	-.0522	-.0143
Worres	.0269	.0079	3.43	0.001	.0115	.0424
Constant	.1986	.0271	7.32	0.000	.1453	.2519
Sigma	.1618	.0063			.1494	.1742

Obs. summary:

252 left-censored observations at wtp<=0
381 uncensored observations
0 right-censored observations

The estimated model for the underlying function becomes

$$WTP = 0.199 - 0.007 * Income - 0.126 * Equity - 0.033 * Horizon + 0.027 * Worres \quad (12)$$

According to this estimated model the null hypotheses that Income (H_{01}), Equity (H_{02}), Horizon (H_{03}) and Risk aversion (H_{08}) does not affect the willingness to pay are rejected in favor for the respective alternative hypotheses (H_{11}, H_{12}, H_{13} and H_{18}). The null hypotheses that Age (H_{04}), Marital status (H_{05}), Children (H_{06}) and Forecast (H_{07}) does not affect the willingness to pay could not be rejected at the 5% level. However the Forecast variable was close to significant with a p-value of 7 % and with the expected negative sign. As a measure of explanatory power a R^2 value is calculated correlating the predicted to the observed values and it is found to be 8 %.

Table 7. Rejected null hypotheses according to the final Tobit regression model

The table presents which null hypotheses that can be rejected according to the final Tobit regression model.

Hypothesis		**Status**
H_{01}:	Homeowners **income** does not affect the willingness to pay for insurance.	Rejected
H_{02}:	Homeowners **equity** does not affect the willingness to pay for insurance.	Rejected
H_{03}:	Homeowners **horizon** does not affect the willingness to pay for insurance.	Rejected
H_{04}:	Homeowners **age** does not affect the willingness to pay for insurance.	Not rejected
H_{05}:	Homeowners **marital status** does not affect the wtp for insurance.	Not rejected
H_{06}:	Homeowners **children** do not affect the willingness to pay for insurance.	Not rejected
H_{07}:	Homeowners **forecast** does not affect the willingness to pay for insurance.	Not rejected
H_{08}:	Homeowners **risk aversion** does not affect the willingness to pay for insurance.	Rejected

Next step is to estimate the marginal effects of a unit change in the explanatory variable to the expected realized values. This is done numerically in Stata, holding the other explanatory variables constant at the sample mean.

$$E(WTP) = P(WTP > 0)\, E(WTP|WTP > 0) \quad (13)$$

The expected value of the truncated variable WTP turns out to be 0.081. That means that in the estimation sample the expected willingness to pay for insurance is 81 SEK/MSEK housing per month. This figure can be decomposed into the probability of having a WTP > 0 and the expected value of WTP conditional on being larger than 0. The probability of WTP > 0 is 0.58 and the expected value of WTP conditional on being larger than 0 is 0.141. That means that according to the estimated model 58 % among households with mean characteristics of the sample will demand insurance and in this group the average WTP is 141 SEK/MSEK housing per month. 42 % of the group will be censored and not state a willingness to pay. Recomposing these figures we find that 0.58 * 141 + 0.42 * 0 = 81.

Further the marginal effects of a unit change in the parameters will be investigated. That is the partial derivatives. This is done numerically in Stata and the results are displayed in table 8 below.

Table 8. Predicted values and marginal effects

The table shows predicted values and the marginal effects of a unit change for the explanatory variables on the expected value of WTP and on the expected value of WTP decomposed to the expected value of WTP conditional on being > 0 and on the probability of WTP > 0.

Variable	**E(WTP)**	**E(WTP | WTP > 0)**	**Pr(WTP > 0)**
	.0813	.1411	.5761
	δy/δx	**δy/δx**	**δy/δx**
Income	-.0039	-.0028	-.0164
Equity	-.0725	-.0513	-.3048
Horizon	-.0192	-.0135	-.0805
Worres	.0155	.0110	.0652

The marginal effects, taken as the partial derivative for the respective explanatory variable holding the others constant at the sample mean tells us how a unit change in the variable affects the expected value according to the estimated model. The first column shows the effect to the total expected value for the censored variable, the second shows the decomposed part for the change in the expected value conditional on not being censored and the third shows the decomposed effect on the probability of not being censored.

For example looking at the first variable in the first row, Income, a unit increase according to this would result in a reduced expected value of the censored variable WTP of -0.0039. Next column tells us that the

expected value conditional on WTP > 0, would be reduced by -0.0028 and the third column shows that the probability of WTP > 0 would decrease with -0.0164. The income variable was ranging from 1-10 representing different income groups, an increase of 1 would mean for example an increase from a household income before tax of 30 000 – 39 999 SEK to 40 000 – 49 000 SEK. This increase would according to the model give a decreased WTP of about 4 SEK/MSEK housing per month for the total censored value. The decrease in expected value in the group with WTP > 0 being about 3 SEK and the probability of being in that group being reduced with about 1.6 %. The expected willingness to pay in the sample was 81 SEK and the reduction of 3.9 SEK would give a new expected WTP at 77 SEK. The expected WTP for households with sample mean characteristics with WTP > 0 was 141 and the reduction here would be 3 SEK to 138 SEK and the probability of being in that group was 58 % reduced with 1.6 to about 56 %. This example is shown in table 9 below.

Table 9. Marginal effects from a unit change in income

This table shows an example of the marginal effects of a unit change in income on expected value of WTP and on the right the marginal effects on expected WTP decomposed to the probability of WTP > 0 and the expected value of WTP conditional on being > 0.

E(WTP)	**=**	**P(WTP > 0)**	*****	**E(WTP | WTP > 0)**
Sample mean values				
81	=	0.58	*	141
Marginal effect due to a unit change in income				
-4		-0.016		-3
Resulting value after a unit change in income				
77	=	0.56	*	138

With the same logic we can look at the other variables too. The Equity was expressed as the fraction of the house not financed with mortgage. Hence a unit change in Equity means a change from no equity to 100 % equity in the home. That change would give a decreased willingness to pay of 51 SEK for the group with above zero willingness to pay and 30 % reduced probability of being in this group. For the total censored variable the expected value decrease with 72 SEK/MSEK housing per month.

A unit change in Horizon, that is a 5 years longer horizon on the housing investment, gives a decreased willingness to pay of 13 SEK/MSEK housing per month for the group with above zero willingness to pay and a reduced probability of being in this group with 8 %. For the total censored variable the expected value decrease with 19 SEK/MSEK housing per month.

The last explanatory variable that turned out significant in the model is the variable for residual worries. A unit increase in the residual worries gives an increased willingness to pay in the above zero group with 11 SEK/MSEK housing per month. The probability of being in this group increases with 7 %. For the total censored variable the expected value increases with 16 SEK/MSEK housing per month.

The price of insurance is estimated using historical data, calculating the probability and size of losses on housing deals in a housing price index using different horizons (Appendix). The estimated monthly cost of insurance is ranging from about 750 SEK/MSEK housing per month for the one year horizon down to zero cost for horizons of 8 years and above. The respondents with a greater than zero willingness to pay stated an average willingness to pay of around 150 SEK/MSEK housing per month which covers the cost of insurance for horizons of about 6 years and longer.

6.2 Discussion

The survey used was not tailored for this study. Because of that, in this study some of the variables were constructed as proxies for the straight forward questions you would have wanted to perfectly match the aim of this thesis. The main things here are that the terms for the product were all implicit. The survey did not specify the insurance contract as the product that would make the speculators not having to worry about price falls. Also the connection to the prospect new home is a bit weak. Hence the respondents in the survey may have answered these questions having different things in mind. Some of them reasoning with their specific prospect new home in mind and thinking of how much they would be willing to pay to protect that house from a price fall after a future sell. Others might have been thinking in general about the maximum amount they could put aside to insure their future home maybe considering also more expensive houses than the one specified as the object of interest right now.

There are some reasons to why you may not need the housing price insurance. One argument is that you are already protected through the political system. You can argue that the Swedish political system would not allow a situation where a lot of households became bankrupted at the same time because of falling housing prices. A big part of the population own houses and condominiums and have large mortgages. The later is especially true for young people. If the housing prices turn down too much it would have great effects for the economy of the whole country.

It is in the interest of the politicians and everybody that this does not happen. Hence, if the market turns down the political system tends to defend the housing prices, for example through the monetary policy with lowered interest rates from the central bank, which dampens price falls. Also through expansive financial politics, for example possibly through unfinanced tax reductions or increased allowances, aimed

at reducing the downturn in the market and thereby also the housing price fall. If a crisis would occur you could imagine other kind of rescue packages too. Some Swedish citizens may so to speak rely on that the system will somehow take care of them in worst case. This prediction may be true or false, but if people expect these effects they can look at that as a kind of insurance against general downturns in the market and with this wisdom at hand they might not want to pay once again for a second insurance.

7. Conclusions

With the estimated model it is possible to reject the null hypotheses that Income, Equity, Horizon and Risk aversion does not affect the willingness to pay. For these four factors the model shows significant coefficients with the expected signs. The willingness to pay for housing price insurance in this sample is negatively correlated with the household income, the equity in the house and the horizon for the investment in the house. The WTP is positively correlated with the respondents risk aversion. The model has an explanatory power as expressed by the R^2-value of only 8 %. That is not surprising since there is some uncertainty in the questions in the survey and this study goes beyond the original purpose of the market survey.

For a household with mean characteristics in the sample the WTP is around 150 SEK/MSEK housing per month for households that demand insurance. A rough estimate of the cost of insurance based on the valuation of a traditional sell option on historical data shows a likely cost of insurance ranging from about 750 SEK/MSEK housing per month for the one year horizon down to zero cost for 8 years and longer horizons. A respondent with mean characteristics stated that he would be likely to live in his new home in 5-10 years and the stated willingness to pay cover the estimated cost of insurance at about 6 years and longer horizons.

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Appendix

This is an estimation of the cost of housing price insurance. This simple model uses rolling housing investments with different horizon over historical housing prices according to the housing price index FASTPI (Statistics Sweden (2010)) for the county of Stockholm to find the expected costs of the losses and estimate the size of the riskless cash flow with equivalent expected value.

		Horizon							
year	index (FASTPI Sthlms län)	8 years	7 years	6 years	5 years	4 years	3 years	2 years	1 years
1975	53								
1976	62								17%
1977	71							34%	15%
1978	83						57%	34%	17%
1979	94					77%	52%	32%	13%
1980	100				89%	61%	41%	20%	6%
1981	100			89%	61%	41%	20%	6%	0%
1982	101		91%	63%	42%	22%	7%	1%	1%
1983	103	94%	66%	45%	24%	10%	3%	3%	2%
1984	106	71%	49%	28%	13%	6%	6%	5%	3%
1985	111	56%	34%	18%	11%	11%	10%	8%	5%
1986	121	46%	29%	21%	21%	20%	17%	14%	9%
1987	147	56%	47%	47%	46%	43%	39%	32%	21%
1988	187	87%	87%	85%	82%	76%	68%	55%	27%
1989	222	122%	120%	116%	109%	100%	83%	51%	19%
1990	246	144%	139%	132%	122%	103%	67%	32%	11%
1991	254	147%	140%	129%	110%	73%	36%	14%	3%
1992	216	104%	95%	79%	47%	16%	*-3%*	*-12%*	*-15%*
1993	183	65%	51%	24%	*-2%*	*-18%*	*-26%*	*-28%*	*-15%*
1994	201	66%	37%	7%	*-9%*	*-18%*	*-21%*	*-7%*	10%
1995	204	39%	9%	*-8%*	*-17%*	*-20%*	*-6%*	11%	1%
1996	205	10%	*-8%*	*-17%*	*-19%*	*-5%*	12%	2%	0%
1997	230	4%	*-7%*	*-9%*	6%	26%	14%	13%	12%
1998	265	8%	4%	23%	45%	32%	30%	29%	15%
1999	303	19%	40%	66%	51%	49%	48%	32%	14%
2000	365	69%	99%	82%	79%	78%	59%	38%	20%
2001	402	120%	100%	97%	96%	75%	52%	33%	10%
2002	426	112%	109%	108%	85%	61%	41%	17%	6%
2003	436	114%	113%	90%	65%	44%	19%	8%	2%
2004	468	128%	103%	77%	54%	28%	16%	10%	7%
2005	502	118%	89%	66%	38%	25%	18%	15%	7%
2006	565	113%	86%	55%	41%	33%	30%	21%	13%
2007	647	114%	77%	61%	52%	48%	38%	29%	15%
2008	662	81%	65%	55%	52%	41%	32%	17%	2%
2009	682	70%	60%	56%	46%	36%	21%	5%	3%
Average return:		81%	69%	58%	48%	38%	28%	17%	8%

Average loss:	0%	-7,1%	-11,4%	-12,0%	-15,2%	-13,7%	-15,7%	-15,1%	
periods	27	28	29	30	31	32	33	34	
periods with loss	0	2	3	4	4	4	3	2	
P (probability)	0,00	0,07	0,10	0,13	0,13	0,13	0,09	0,06	
P*Average loss:	**0,00%**	**-0,51%**	**-1,18%**	**-1,60%**	**-1,96%**	**-1,71%**	**-1,43%**	**-0,89%**	
yearly cost	0,00%	-0,07%	-0,20%	-0,32%	-0,49%	-0,57%	-0,71%	-0,89%	
monthly cost	0	-60	-164	-266	-408	-475	-595	-741	[SEK/MSEK housing per month]

The cost of a riskless negative cash flow with the same expected value as the losses according to this model is 0,89 % of the house value for a one year horizon. For a four year horizon it is almost 2 %. For horizons of 8 years or longer no period with losses occurred during this period.

When the cost is divided to a monthly cost over the horizons it ranges from about 750 SEK/MSEK housing per month for the one year horizon down to zero cost for 8 years and longer horizons.