

A case for risk management in  
the Swedish housing market  
*Studying the demand for market value insurance products in  
the Swedish metropolitan residential real estate market*

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**Abstract**

This thesis builds on the discussions by Robert Shiller and Peter Englund, among others, proposing outlines for an insurance policy on the market value of homes. The aim of the thesis is to examine if risk is perceived in the current housing market, if there is a demand for managing part of this risk, and how one could go about when constructing a market value insurance policy. A securitization of the insurance policies into a Market Insurance Backed Security (MIBS) is further proposed, which facilitates risk transfer to investors. 70% of our sample find there to be at least some risk in the housing market and the interest for the insurance is found to be significantly different from zero. The securitization method could set further research on a new path, ultimately enabling households to manage risk in an insurance scheme and through investments in MIBS.

JEL Classification: R39, G41, G22, G11

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# 1. Introduction

This thesis tries to establish how households view their housing-related risk exposure and their willingness to handle this risk. An insurance policy is created, and the demand for such a product is investigated. The economic rationale to handle the risk exposure within the housing market has been established among academics for long (Case, Shiller & Weiss, 1993) (Case & Weiss, 1999)(Goetzmann, 1993). What has not yet been examined exhaustively is the households' point of view. We find that approximately 70% of the sample perceive some, or a great deal, of risk in the housing market. Having to realize losses is, on average, perceived as the greatest risk. Further, we find support for potential buyers exhibiting demand for the insurance policy that would allow housing risk management. The generalizability of the findings is, however, limited. A proposal of how to practically construct a market value insurance is given and the basis is outlined. This thesis differs from previous research (Case *et al.* 1993)(Englund, 2009) by proposing a securitization of the insurance policies, instead of focusing on a derivatives market. This is a novel way of approaching the method by which risk could be transferred from the policy writer, as it does not utilize neither a property index, nor a liquid derivatives market. The proposed product, henceforth referred to as Market Insurance Backed Security (MIBS), is subsequently offered to external investors with the possible extension of being traded on a secondary market.

Housing is one of the key components in individuals' wealth portfolios (Campbell, 2006). Even though, traditionally, investment decisions are separated from consumption decisions, this argument cannot be made in the case of housing, as it serves a dual purpose. Englund (2009) argues that the leveraged home-equity investment should be viewed as part of the asset base. He further argues that for many homeowners, the asset portfolio has a substantial weight towards the housing market as a consequence of their home-ownership (Englund, 2009). It is suggested that an optimal amount of 15-70% of ones portfolio should be invested in a *diversified* bundle of real estate securities (Englund, 2009)(Englund, Hwang & Quigley, 2002).

In accordance with Modern Portfolio Theory (MPT), the possibility to diversify part of the idiosyncratic risk (held in the form of home-equity), should be sought after by risk averse investors. This is currently only achievable by purchasing more of other financial assets, after accumulation of additional capital. Yao and Zhang (2005) have

found that "*when owning a house, investors reduce the equity<sup>1</sup> proportion in their net worth (bonds, stocks, and home equity), reflecting the substitution effect of home equity for risky stocks*"<sup>2</sup>. As first suggested by Markowitz (1952), the effects of diversification work through two channels: firstly, reducing the weights of individual assets, and secondly, when returns of different assets have low or negative correlation. The argument for diversification is, thus, further amplified by the weak correlation between real estate returns and other asset classes (Englund, 2009).

In *Irrational exuberance* (2015), Shiller argues that it is generally assumed that individual households are unaware of their risk exposure to the real estate market. He further argues that housing finance has been virtually immune to innovation, due to a variety of reasons such as the limited accessibility of financial patents and the incentive structure benefiting the current status quo (Shiller, 2014). A viable investment alternative is, thus, not yet accessible.

A prerequisite for demanding a risk solution, is that there is some perceived risk in the housing market, which is the first main focus of this thesis. In a qualitative study based on 150 households in the UK, it was investigated how homeowners view their risk exposure. It was further examined if there is an appetite for reducing this risk. Approximately 75% of the homeowners did not consider diversifying their portfolios by investing elsewhere, in order to reduce their overexposure to the housing market. Close to half of this group did not consider investing elsewhere, since they viewed the investment as being close to risk-free. Further, the equity investment in their housing was considered to be a financial buffer, should their financial position be altered (Smith, Searle & Cook, 2008).

Residential real estate has a stochastic return, with periods of substantial increases and falls. This is exemplified by *e.g.* the 4% increase in home prices in Sweden during the beginning of 2017 to Aug. 2017, followed by a 9% decrease to December 2017 (*cf.* Figure 4 Appendix A). Holding the opinion that investing in a home is close to risk-free, is to neglect the probability of a declining housing market, as well as not considering how leverage affects the position. This indicates that many households might not recognize the risk that they carry.

A study on financial literacy among young adults, found that 24% of their respon-

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<sup>1</sup>Here equity refers to stocks.

<sup>2</sup>These relations were studied in a case where investors are indifferent between owning and renting a home.

dents had basic financial literacy, while 69% claimed to have high financial knowledge (de Bassa Scheresberg & Lusardi, 2014). It is further suggested that financial illiteracy is widespread in countries with well-developed and functioning markets, *i.a.* Sweden, Germany and Japan. Furthermore suggesting that an overconfidence is present in older groups, believing they had good financial knowledge while scoring below average (Lusardi & Mitchell, 2011). Cox, Brounen and Neuteboom (2015) concluded that households with higher financial knowledge have a better understanding of risks associated with different types of mortgages, as well as accompanying tax-benefits related to certain mortgage products (*e.g.* deferred amortization mortgages). As these studies suggest, the assumption of the individual household as the optimal agent for financial decision making, could be questioned. This has previously been argued for by *e.g.* Thaler and Sunstein (2003), even in countries with well-developed markets. As a consequence of widespread financial illiteracy, a risk management solution might be met with skepticism and rejection, even though it has, on aggregate, large societal gains. Especially so, when considering the large weight homeowners have towards housing in their wealth portfolios.

If one reviews the inflation adjusted residential real estate returns, the real return between the end of the 19 century and year 2000 was 0% per annum (Shiller, 2015). Viewed simply as an investment, this would imply a negative return in real terms, as the nominal profit is taxable if realized. The feeling, however, could be that the investment has generated some wealth. Englund (2009) suggests that, when considering the property's full return, one additionally has to take the consumption of housing into account. Consuming housing, can be viewed as a dividend payment to the homeowner (Case & Shiller, 2003). This complicates the payoff calculations, as the market price of housing consumption cannot be observed in today's regulated rent market.

The view that housing is a risk-free investment (Smith *et al.*, 2008) could be explained by *the money illusion*, *i.e* the "*tendency to think in terms of nominal rather than real monetary values*". Further, it is argued that basing purchasing or sales decision on past nominal values is a form of money illusion, even in the absence of inflation. This manifests in the reluctance of selling a house at a nominal loss (Shafir, Diamond & Tversky, 1997). This results in a "downward stickiness of prices", which leads to a big bid-ask spread as demand drops without a smooth correction in prices (Case & Shiller, 2003). The stickiness is most prevalent as interest rates increase, which leads to a drop in demand.

Households with adjustable rate mortgages might be forced to sell at a loss, as interest payments increase (Case & Quigley, 2008). This can be viewed as a self-regulating price mechanism of the market.

Shiller (2015) lists the commonly mentioned fundamental factors that drive the housing market: population growth, construction input factors becoming more expensive, and interest rate cuts. Between 1997 and 2006, real home prices increased by 85% in the US. Contradictory, the population growth was steady and gradual, construction costs were in line with long-term trends and rates were cut before without a similar boom, concluding that the market is not well anchored by fundamentals. Additional to fundamental factors, psychological factors are proposed to drive the market with *e.g.* the help from news media amplifying herd beliefs (Shiller, 2015).

In the developed world, insurance against fire and robbery is close to mandatory, despite the fact that these events happen with very low probability (Shiller & Weiss, 1999). The probability of being forced to sell your home in the situation of a low housing market is harder to predict as it can be caused by multiple scenarios, such as a relationship coming to an end or a job opportunity requiring relocating.

A risk management solution proposed by *i.a.* Case *et al.* (1993) and Englund (2009), is the use of property derivatives to hedge part of the risk exposure towards the housing market. The solution, however, relies on well-functioning derivatives markets, with a housing index as the underlying asset. Property derivatives have been tried, and has proven to be problematic to establish (*cf.* S&P/Case-Shiller Home Price indices Futures and Options, currently trading on CME). Geltner and Fisher (2007) discuss possible problems associated with constructing an index of the housing market. They mention noise<sup>3</sup> and lag<sup>4</sup> as two key concerns, as well as the issue of the underlying index not being tradeable. The same situation is, however, present for inflation products, where the Consumer Price Index (CPI) cannot be traded, yet frequent trading occurs in inflation linked derivatives.

Understanding derivatives trading is well beyond the financial knowledge of the average household. Case and Shiller (2003) discuss the possibility of an insurance solution, which would give households the opportunity to manage their housing risk. The discussion is further elaborated on by Smith *et al.* (2008), highlighting difficulties related to:

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<sup>3</sup>Random deviation between index value level and actual market price.

<sup>4</sup>Systematic tendency of the index to only partially reflect the true current return of a period.

how to package and construct a retail product out of housing derivatives, if there is a demand for such a product, and if governmental entities support this type of financial innovation. An attempt to handle these difficulties is partly presented in this thesis, where an insurance policy is created and presented, its demand examined, and subsequent risk transfer discussed. The insurance policy proposed covers a percentage of the market value of the asset; a long put option for the policy holder and a short put option for the policy writer. The hedging demand for the insurance writer is, further, proposed to be solved through securitization, removing the need for a liquid derivatives market.

Shiller and Weiss (1999) discuss the difficulties facing the development of a home-equity insurance, where moral hazard and selection bias are highlighted. Moral hazard that arises as the homeowner is disincentivized to maintain the house or that he or she might remodel the home to idiosyncratic taste, effectively decreasing its value. Selection bias is argued for as homeowners who know they might have over-paid for the home, value the insurance higher, transferring future potential losses to the policy writer. The proposed remedies are *i.a.* sharing parts of the potential loss, decreasing the incentives for fraudulent behaviour. Further, that the indemnity is benchmarked against an index and that certain maintenance investments are contracted into the policy agreement (Shiller & Weiss, 1999).

Case and Quigley (2008) discuss the potential macroeconomic effects of a decline in the housing market. The authors argue that, as the housing market falls, a contraction in consumer spending follows as experienced wealth is reduced (wealth effects). Additionally, as declines in home sales occur, a contraction in aggregate expenditures leading to reduced income and employment follows (income effects). As a consequence, a loss of the households home-equity would be relatively worse, compared to at a time where the experienced wealth and income of the household is high (Case & Quigley, 2008). Future income (*i.e.* return on human capital), has been shown to have positive correlation with the housing market. Especially in smaller cities with few, large employers, the demand for labor and the demand for housing in the area tends to have a high correlation (Englund, 2009).

The remainder of the thesis is structured as follows: firstly, the survey and the results are presented. Secondly, a product specification including the insurance policy, its pricing, and a securitization is outlined. Lastly, the results as well as the proposed product are

discussed and some final conclusions are drawn.

## 2. Method

In this section, the method is described by, first, briefly outlining the insurance policy. Next, follows a summary of the conducted survey and the data collection process. Lastly, some limitations are highlighted.

The insurance policy insures households towards the risk of a falling housing market, more specifically towards a fall in the price of the insured property. Through premium payments, the policy holder is guaranteed a prespecified lowest value for the insured property (loss limit), at a prespecified maturity. The insurance is a long American put option for the policy holder, and therefore a short American put option for the policy writer. This gives a separation of the control of the underlying asset and some of (or all of) the cash flows connected with the market value of it. The basic parameters underlying the insurance are: which underlying asset that is getting insured, the strike price of the insurance contract and the time to maturity of the contract. Further, the volatility and the risk-free rate are necessary variables for the pricing of the insurance policy. Standardizing the parameters facilitates an effective subsequent securitization (and valuation), why there are predetermined sets to choose from for the loss limit and the maturity. A summary of the parameters of the insurance policy and their price relationship can be found in Table 1 below.

Table 1: Parameters of the insurance policy

Variable	Choice sets	Effect on price	Other
Underlying asset	Insured property	0	Ownership required
Loss limit	ITV: 60%, 80% or 100%	+	
Maturity	1Y, 3Y, 5Y	+	
Volatility	2x relevant Valueguard	+	Estimation difficult
Risk-free rate	Gov. bond w/ same mat.	-	

*Summary of the variables of the insurance policy, a proposal of choice sets, and how the variables affect the pricing, where ITV refers to Insurance-to-Value.*

To determine how the respondents perceive risk in the housing market and whether a market value insurance policy was in demand, a survey was conducted. The survey consisted of five parts: (i) Financial literacy & current home-ownership status, (ii) Sce-



nario questions, (iii) Risk perceived in the housing market, (iv) Demand for insurance policy, (v) Background information (demographics). Firstly, three questions regarding financial knowledge were posed, to determine whether the respondent was financially literate. Secondly, questions regarding current ownership status and ownership history were asked. Next, the respondents were introduced to the insurance policy and three different scenario questions, with different ownership structures, were presented. Following the scenario questions, the respondents were asked about their views on risk associated with home-ownership. Follow-up questions were asked, depending on their views regarding risk. Next followed a series of questions regarding their interest for a market value insurance. If they were interested, different solutions were presented, if not, they were given the opportunity to explain why. Lastly, the respondents were asked a series of demographic questions, as suggested by Bryman and Bell (2007).

The data collection process was mainly done using available channels provided by the school, *e.g.* student email-lists and randomly drawn respondents residing in the university facilities. Data was further collected at the central station in Stockholm, asking random individuals at sight to partake in the survey. The survey took between 5 to 7 minutes to complete and was sent to approximately 1400 individuals, yielding a response rate of approximately 18%. The survey was done using the Qualtrics Survey Software. To encourage participation, a competition was included at the end of the survey, where the winner was given a price. The full survey can be found in Appendix C. 254 responses were collected, where some variables contained one or two missing data points. As the missing data is limited and spurious, it is not regarded as a systematic problem and the related observation(s) are omitted.

### *2.1. Limitations*

As can be seen in Table 2 below, certain cohorts are misrepresented in the sample. For example, the opinions of respondents entering the housing market for the first time, are expressed to a higher degree. This follows from the sample's average age and share of homeowners being lower than the population as a whole. The over-representation of first-time buyers is, however, considered to be beneficial, as these individuals often have excessive leverage (*i.e.* higher risk) and therefore can be seen as a viable customer base. The sample is not deemed to be representative for the population in Sweden, which is why

no claims of the generalizability of findings are made. When taking into consideration that the proposed insurance policy has not previously been presented for the general public, reliability of the survey responses depends on whether the respondents truly understand the product or not. This is a difficulty which is tried to be handled by, firstly, measuring the financial knowledge of the respondents. Secondly, introducing the product in a series of steps, and finally, asking whether they might be interested in such a product.

### 3. Demographics

In this section, demographic variables are presented, discussed, and compared to their population parameters. The formulation of the demographic questions and corresponding answer choices are taken from the Swedish Statistical Central Bureau "standardized demographics questions" (Statistiska Central Byrån, SCB, 2004). A brief presentation of the control variables that have been used is given, with corresponding previous research. A summary is presented in Table 2.

Table 2: Demographics comparison - sample and population

Description	Sample prop.	Pop. prop.	Source and year of data
Homeowners	36%	65%	Eurostat, 2016
With tertiary education	71%	43%	SCB, 2017
Financial literacy	75%	52%	Wieselqvist-Ekman, 2015
Female respondents	42%	50%	SCB, 2018
Have children at home	11%	23%	SCB, 2017
Age (mean/median)	28/25	41/41	SCB, 2018

*A comparison between the sample proportions and population proportions of demographic variables. Where SCB refers to Statistiska Central Byrån, the Swedish Statistical Central Bureau.*

**Home-ownership:** Aggregated numbers (Eurostat, 2017) show that approximately 65% of swedes are homeowners. The sample proportion is 36% and therefore significantly under-represents the true population proportion. Current home-ownership status is controlled for when deemed necessary, as it is hypothesized to have an effect on perceived risk in the housing market.

**Education:** The respondents were asked to state their highest achieved level of education. Three categories were created, namely: primary, secondary and tertiary education. In the sample, 71% had finished at least some college/university education, as compared

to 43% for the whole population. Considering the channels used to collect the data, this comes as no surprise. The survey has been made to fit all types of respondents.

**Financial literacy:** Three control questions were asked in the beginning of the survey. The questions were previously posed by Lusardi and Mitchell (2009), and are referred to as “*the five basic financial literacy questions*”, extensively used internationally. In this thesis, the authors chose to follow a study by Finansinspektionen, trying to establish financial literacy among Swedes, by posing the first three of the five basic financial literacy questions (Wieselqvist-Ekman, 2015). By collapsing the data a new variable was created, where correctly answering all three questions qualified as "literate" (*cf.* Appendix C to review the questions). We acknowledge that one in eighteen or roughly 5.56% of the respondents pass the test by pure chance. This is an error we try to handle by also controlling for *i.a.* education level, being a good predictor of financial literacy (Lusardi & Mitchell, 2011). 75% of our sample qualify as "financially literate", a significantly higher share than the 52% found by Finansinspektionen (Wieselqvist-Ekman, 2015). As the proposed insurance policy is complex, a financially literate and highly educated sample could be beneficial. As the sample is over-represented by highly educated and financially literate individuals, the argument could be made that the validity is increased.

**Share of female respondents:** Risk perception and propensity for financial risk taking has been shown to differ on an aggregate level between the two sexes (Byrnes, Miller & Shafer, 1999). Women are under-represented by some significant margin in our sample, 42% *vs.* 58% male respondents, which is why sex has been controlled for when multivariate analysis has been performed.

**Having children at home:** Görlitz and Tamm (2015) showed in their longitudinal study that risk preferences are affected by becoming a parent. Their results show that both men and women experience a significant decrease in risk appetite when becoming parents for the first time. These results are line with the findings of *e.g.* Eibach and Mock (2011). A control variable was included, trying to capture the effect that parenthood might have on risk perception. In our sample, 11% are living with children, as compared to the 23% observed in the population as a whole.

**Age:** Albert and Duffy (2012) conclude that risk preferences significantly differ between young and older individuals, showing that risk aversion increases with age, findings supported by *e.g.* Sahm (2012). Wang and Hanna (2007) show contradictory evidence,

finding support for risk tolerance increasing with age, while controlling for additional factors. The contradictory effects are discussed by Mather *et al.* (2012), finding support for differences in risk preferences when respondents are faced with a gain-gain type gamble. Older adults opted for a certain gain over a larger riskier gain, while younger adults preferred the risky alternative. However, the opposite was true in the domain of losses. When a certain loss and a potential larger loss scenario was presented, older adults exhibited larger appetite for risk than young adults (Mather *et al.*, 2012). Cohn *et al.* (1975) find evidence for decreasing relative risk aversion with age. They propose that capital gains tax serves as a “lock in” factor when positions have been held for a significant period of time, constraining individuals to readjust the risk profile of their portfolios. A discrete age variable was included, to control for the effect of age on perceived risk in the housing market. As expected, our sample is predominately below the median age in the population as a whole.

## 4. Results

### 4.1. Risk perception

A prerequisite for wanting an insurance policy, is that there is some perceived risk in the housing market. To study this, a question from Case & Shiller was posed (Shiller, 2015):

*"Buying a house in this area today involves:*

1. *A great deal of risk,* 2. *Some risk,* 3. *Little or no risk"*.

The proportions are presented in Table 3. A new binary variable was created, where alternative 1 and 2 were grouped and sum to approximately 70%. To test whether or not a significant majority perceived risk, two one-sided t-tests were performed. Testing against the null hypotheses that the proportion is equal to zero and equal to 0.5, where the alternative is that the proportion is larger than the nulls. The tests were statistically significant at a 5% confidence level. The output is presented in Table 4.

If the respondents chose either “A great deal of risk” or “Some risk”, they were asked to assess what type of risks were most relevant. A five-grade Likert scale was used, presented in Table 5. Most of the respondents were in agreement that the two main sources of uncertainty stem from *interest rate risk* and from *having to realize a loss* and

Table 3: Risk perception in the housing market

Risk	Frequency
A great deal of risk	7%
Some risk	63%
Little or no risk	30%

*Summary of respondents' answers to the survey question regarding riskiness of the housing market.*

Table 4: Risk perception - t-test output (one-sided)

Hypothesis	t-stat	P-value	Conclusion
1. Prop. of respondents perceiving risk = zero	24.46	0.00	reject
2. Prop. of respondents perceiving risk = 0.5	7.08	0.00	reject
<i>Share of respondents that perceived risk</i>			<i>70%</i>

*Test output and corresponding statistical inference regarding the perceived riskiness of the housing market.*

sell when the market has declined, the average answer was 3.90 and 3.92 respectively. 30% and 32% of the respondents chose alternative 2 or 4 (partly disagree/ partly agree) respectively, when asked about the risk associated with the inflexibility of owning one's own home. The respective frequencies are summarized in Table 6.

Table 5: Five-grade Likert scale

Description	Scale
Strongly disagree	1
Disagree	2
Neither agree nor disagree	3
Agree	4
Strongly agree	5

*A presentation of the five-grade Likert scale used throughout the survey.*

Additional risks considered relevant by some respondents are mentioned in separate comments. Firstly, the *risk of having a levered position* is discussed by several, as leverage increases the risk (volatility) of the invested home-equity. Secondly, the respondents mention the risk of *not having full control* over when to sell the acquired property. Separating from a partner with whom you jointly own, or losing your job, are mentioned as examples. Lastly, risks related to the tenant owner's association are discussed, from a perspective of asymmetric information and the lack of financial knowledge among households.

The respondents that perceived there to be "Little or no risk" in the housing market,

Table 6: Summary statistics of different risks perceived

Risk factor	Mean	Std. Dev.	1	2	3	4	5
Interest rate risk	3.90	1.00	1%	12%	12%	45%	30%
Inflexibility of ownership	2.95	1.18	11%	30%	19%	33%	7%
Having to realize losses	3.92	1.02	2%	10%	15%	41%	32%
Legislative risk	3.16	1.15	10%	20%	23%	38%	9%
<i>where: 1 = Strongly disagree</i>			<i>5 = Strongly agree</i>				

*Respondents' answer frequencies when asked to form an opinion of the relative prevalence of different risks associated with home-ownership.*

were asked to explain what their main attitude towards home-ownership was. Approximately 60% of the respondents' main attitude was to consume housing. Approximately a fourth (23%) claimed that their main attitude towards home ownership is to view it as "A type of savings regime". The alternative, "An investment I am expected to make a large return on" was chosen by 11%. The alternative "Risk-free investment" was chosen by 5% of the respondents. All choices and frequencies are presented in Table 7.

Table 7: Main attitude towards housing if little or no risk was perceived

Description	Count	Frequency
Investment I expect to gain a large return on	8	11%
A type of savings regime	17	23%
A risk-free investment	4	5%
The safety of living in your own property	30	40%
Emotional reasons	2	3%
Somewhere to live	14	19%
Other	0	0%
<i>Total:</i>	<i>75</i>	<i>100%</i>

*Respondents' answer frequencies regarding their main attitudes towards home-ownership.*

#### 4.2. Demand

To determine if there is a demand for the proposed insurance policy, the respondents were asked the following question:

*"An insurance policy that would cover potential losses incurred when selling my home would be of interest to me:*

- 1. Yes, 2. No, 3. Other".*

The question was posed after the insurance policy was introduced to the respondent, meaning they had had the opportunity to familiarize themselves with the policy, *e.g.* its costs and structure. A binary variable was created where respondents that chose "Yes" were grouped against respondents that chose either "No" or "Other". Approximately 53% said that they were interested, whereas 47% chose either "No" or "Other". Respondents that chose alternative "Other" were asked to leave a comment. In the cases with no ambiguity, they were reassigned to either alternative "Yes" or "No". Two one-sample t-tests were performed to test the hypothesis whether there is a demand for the insurance policy or not. Firstly, to test if demand was significantly larger than zero, and secondly, if a majority of respondents were interested (*e.g.* Proportion > 0.5). Table 8 summarizes the tests performed and the proportions of respondents' choices.

Table 8: Demand for insurance policy - t-test output (one-sided)

<b>Hypothesis</b>	<b>t-stat</b>	<b>P-value</b>	<b>Conclusion</b>
1. Prop. of respondents interested = 0	17.01	0.00	reject
2. Prop. of respondents interested = 0.5	1.07	0.14	cannot reject
<i>Share of respondents that were interested</i>			<i>53%</i>

*Test output and corresponding statistical inference regarding the demand for a housing market value insurance policy.*

If the respondents chose alternative "Yes" they were asked a follow-up question regarding what type of insurance they would prefer. Three different policies were suggested, all consisting of an insurance policy (American put) and a financing solution (European call). The strike of the put is referred to as the loss limit, and if expressed in terms of the underlying asset, it is referred to as the Insurance-to-Value (ITV). The strike of the call is referred to as the profit limit, if expressed in terms of the underlying asset, it is referred to as the Future-Value-to-Value (FVV). The fictitious policy holder has an Loan-to-Value (LTV) of 80% in all scenarios. The first suggested policy was constructed as a Total Return Swap (TRS), where the policy holder is completely insured (ITV=FVV=100%). Under this regime all capital gains are forfeited to, and all losses are reimbursed by, the policy writer. The second policy has an ITV of 90%, and a FVV of 120%. The last suggested solution has an ITV of 80%, to be on par with the LTV, meaning that the policy holder will receive at least the value of the mortgage at exercise. The policy further has an ITV of 133%, meaning all potential capital gains above 33% (at exercise) are forfeited

to the policy writer. Table 9 summarizes the different positions.

Table 9: Overview of solutions proposed

<b>Solution</b>	<b>Description</b>	<b>ITV</b>	<b>FVV</b>	<b>LTV</b>	<b>Cost</b>
1	Total Return Swap (TRS)	100%	100%	80%	0%
2	Insurance policy + Financing solution	90%	120%	80%	2%
3	Insurance policy + Financing solution	80%	133%	80%	0.9%
<i>T = 5y. Expressed as percentages of the current price of the underlying asset</i>					

Overview of the three total contract solutions given to respondents that expressed demand. Where the parameters Insurance-to-Value (ITV), Future-Value-to-Value (FVV), and Loan-to-Value (LTV), differs among the three solutions.

The same 5-grade Likert scale as presented in Table 5 was used. The respondents were asked to evaluate the relative attractiveness of each solution. The responses are summarized in Table 10.

Table 10: Summary statistics of the relative attractiveness of different risk solutions

<b>Solution</b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
1	2.72	2.19	31%	19%	15%	19%	16%
2	3.52	1.21	6%	13%	22%	42%	17%
3	3.63	1.06	4%	10%	22%	46%	18%
<i>where: 1 = Strongly disagree</i>			<i>5 = Strongly agree</i>				

Respondents' answer frequencies when asked to form an opinion on the relative attractiveness of different risk solutions.

To analyze if the different solutions differed in popularity, a single-factor ANOVA was performed, yielding statistically significant results at 99.9% confidence. The post-hoc t-test with Bonferroni correction showed that the interest for solution 2 and 3 differed from the interest for solution 1. The interest for solution 2 and 3 did not differ, as would be expected, since the main construction of the insurance policies is similar.

If the respondents were not interested in an insurance policy (*i.e.* "No" or "Other" was chosen) they were asked the follow-up question:

*"Why are you not interested in an insurance policy that would cover potential losses incurred when selling your home?"*

The respondents gave open-ended comments. Some general themes can be found in these responses, the three most common are presented below and further discussed in the



Discussion Section. Approximately half of the respondents find the probability of having to realize a capital loss too small for insurance to be valid. Close to a third, argue that the price of the insurance solution would be too high compared to the value it is adding. The smallest common group, argues that the market exposure connected with housing is irrelevant, as they will be selling to buy. Where the assumption is that they would be selling and buying in a the same market conditions.

In the Scenario Section of the survey, three different scenarios were presented to the respondent, where an insurance solution is suggested in each. The scenarios are all following the specifications of 'insurance solution 2', with an ITV of 90% and a FVV of 120% (*cf.* Table 9). The difference between the scenarios is the ownership structure of the apartment, all else remains equal. In the first scenario the respondent buys the fictitious apartment alone, in the second with a partner 50/50, and in the third a relative serves as a guarantor on the mortgage, summarized in Table 11. The purpose of this section was to capture the potentially changing appetite for the proposed insurance policy, associated with changes in risk exposure. The respondents were given a five grade Likert scale (*cf.* Table 5). After each scenario was presented the respondent was asked if the insurance policy would be of interest.

Table 11: Summary of the scenario questions

<b>Scenario</b>	<b>Ownership structure</b>
1	Alone
2	With partner (50/50)
3	With relative as guarantor on the mortgage
<i>Further specifications following insurance solution 2 in Table 9</i>	

*A brief description of the three scenarios presented in the scenario questions.*

As the different scenarios present different risk exposures to the individual, we expected to find differences in demand, which we did *not*. The F-test was insignificant and therefore we cannot say that at least one of the scenarios is considered more or less attractive to insure than the others. The following post hoc t-tests, with Bonferroni correction, were also insignificant.

### 4.3. *Home-ownership, risk perception and demand*

To determine if current home-ownership status affects risk perception and in turn the demand for the proposed insurance policy, a series of tests were performed. The first hypothesis, followed from the discussion made regarding the prevalence of the house-money effect in real estate. The hypothesis states that homeowners experience home-ownership as less risky than their non-owning counterpart. If true, it could follow that the interest for the suggested insurance policy would be lower. Which led to the second hypothesis, stating that current homeowners experience less risk, and therefore will be less interested in the proposed insurance policy.

Two one-sided, two-sample t-tests were made, to determine if perceived risk and demand was lower among owners than non-owners. As the first test was significant on a 1% significance level, the hypothesis that perceived risk is the same in the two groups was rejected. The second t-test was once again significant on a 1% significance level, meaning we rejected the hypothesis that the interest for the insurance policy is the same for owners and non-owners. The results are summarized in Table 12.

As *e.g.* gender, financial literacy and other variables have been shown to affect risk and are misrepresented in our sample (*i.e.* not on par with population statistics), further analysis was needed, where these demographic variables were controlled for. The results from the multivariate analysis are consistent with the findings in Table 12. The probability of perceiving risk is approximately 14% lower for homeowners as compared to respondents that did not currently own a home, all else equal. As previously determined, the lower risk perceived by homeowners, decreases their interest in the insurance policy. The probability of being interested in the proposed insurance policy decreases by approximately 17%, all else equal. The regression outputs are summarized in Table 13. Note that if risk perception is controlled for, the effect of home-ownership status on demand is no longer significant (at a 5% significance level).

Table 12: Home-ownership status, perceived risk and demand (two-sample t-test)

<i>Two-sample t-test with equal variances*</i>						
<i>Perceived risk grouped by ownership</i>						
<i>Owner</i>	<i>N</i>	<i>Mean</i>	<i>Std. Dev.</i>	<i>Std. Err.</i>	<i>95% Conf. Interval</i>	
					<i>Lower</i>	<i>Upper</i>
No	162	0.759	0.429	0.034	0.693	0.826
Yes	91	0.604	0.492	0.052	0.502	0.707
<i>Difference</i>		0.155		0.059	0.038	0.272
<i>HO:</i>	Difference = 0				t-stat	2.613
<i>Ha:</i>	Difference > 0				D.o.F	251
<i>Pr(T &gt; t)</i>	0.0048					
<i>Demand grouped by ownership</i>						
<i>Owner</i>	<i>N</i>	<i>Mean</i>	<i>Std. Dev.</i>	<i>Std. Err.</i>	<i>95% Conf. Interval</i>	
					<i>Lower</i>	<i>Upper</i>
No	162	0.605	0.490	0.039	0.529	0.681
Yes	91	0.407	0.494	0.052	0.304	0.509
<i>Difference</i>		0.198		0.064	0.072	0.325
<i>HO:</i>	Difference = 0				t-stat	3.080
<i>Ha:</i>	Difference > 0				D.o.F	251
<i>Pr(T &gt; t)</i>	0.0012					
<i>*Variance ratio tests insign. Equal variances assumed</i>						

Output from the two-sample t-test of home-ownership's effect on perceived risk and demand for a housing market value insurance policy.

## 5. Product specification

In this section, the choice variables when entering the proposed market value insurance policy are described more thoroughly. Further, a financing solution in the form of transfer of potential future profits is discussed. Additionally, the payoff calculation to the policy holder at maturity is outlined. Where, depending on if the insured asset is sold prior to maturity, close to sale at maturity or not to be sold, the settlement differs. Lastly, an approximate price of the insurance policy is calculated, using the discrete time Binomial Option Pricing Model (BOPM) as the put option is American (Cox, Ross & Rubenstein 1979).

Table 13: Home-ownership status, perceived risk and demand (control variables included)

<i>Multivariate linear probability model</i>							
<i>Perceived risk grouped by ownership (LPM)</i>							
						N	248
						F(7, 240)	1.65
						Prob > F	0.12
						R <sup>2</sup>	0.05
<i>95% Conf. Interval</i>							
<i>Perceived risk</i>	<i>Coef.</i>	<i>Rob. Std. Err.</i>	<i>t-stat</i>	<i>P &gt;  t </i>		<i>Lower</i>	<i>Upper</i>
<i>Constant</i>	0.934	0.289	3.25	0.001		0.370	1.508
<i>Ownership</i>	-0.140	0.068	-2.07	0.039		-0.273	-0.007
<i>+Controls (age, education, financial literacy, sex, children at home)</i>							
<i>Demand grouped by ownership (LPM)</i>							
						N	248
						F(7, 240)	1.53
						Prob > F	0.16
						R <sup>2</sup>	0.04
<i>95% Conf. Interval</i>							
<i>Demand</i>	<i>Coef.</i>	<i>Rob. Std. Err.</i>	<i>t-stat</i>	<i>P &gt;  t </i>		<i>Lower</i>	<i>Upper</i>
<i>Constant</i>	0.726	0.313	2.32	0.021		0.110	1.343
<i>Ownership</i>	-0.170	0.072	-2.37	0.019		-0.312	-0.029
<i>+Controls (age, education, financial literacy, sex, children at home)</i>							

Regression output from the Linear Probability Model of home-ownership's effect on perceived risk and demand for a housing market value insurance policy.

### 5.1. Variables

The choice variables of the insurance policy, as summarized in Table 1 above, are described more thoroughly below. All variables stem from option pricing theory.

**Underlying asset:** The insurance policy covers a property *owned by the policy holder*. When an insurance policy is initiated, a valuation of the insured property is necessary. The market price of the underlying asset at policy initiation is relevant as the insurance will be quoted in terms of Insurance-to-Value (ITV), *i.e.* the ratio of how much of the initial asset value that is insured. The value of the property is, though, not relevant for the pricing, as it is linearly determined by the ITV. To make this valuation feasible, the insurance policy is designed to be initiated upon acquisition of a property, as the market value is known at that moment. If initiating the policy on a currently owned property, a fair valuation is necessary. This valuation should be conducted by a party

with no incentives for either over- or undervaluation. Some companies in Sweden acts as both bank, insurance company and real estate brokerage firms, *e.g* Länsförsäkringar, whom should be able to conduct a fair valuation of the property through their real estate brokerage division. Today, Länsförsäkringar Fastighetsförmedling offers a service where its customers get continuous updates on the value of their apartment, based on an initial valuation as well as transactions of similar apartments nearby (Länsförsäkringar Fastighetsförmedling, 2019). This initial product proposition limits the property by type (apartments) and by geographical location (Stockholm or Gothenburg), to ensure that there exists feasible indices for the two markets, to use as a benchmark: NASDAQ OMX Valueguard Flats Stockholm and NASDAQ OMX Valueguard Flats Gothenburg, respectively (*cf.* Appendix A).

**Loss limit:** The loss limit of the insurance policy (strike price of the put option), is the value of the property insured towards market movements, *i.e.* the value that the insurance policy covers. A SEK 3M asset with ITV of 80% has an insured value of SEK 2,4M. The insured value, hence, follows from the ITV, which is standardized and decided upon, at initiation of the insurance policy. The ITV can be chosen at different levels, where this thesis proposes (i) 60%, (ii) 80% or (iii) 100% insurance. These level are set to give households (i) a "worst case" option, (ii) an option where the strike is set close to the LTV (Swedish mortgage cap of 85% since 2010), and (iii) an option where the household insures the entire market value of the property. A higher ITV corresponds to a higher price.

**Maturity:** The maturity of the insurance policy is, just as the ITV, standardized to three different time intervals: 1Y, 3Y and 5Y, which are chosen with the riskiness of the equity position in mind. As the LTV normally is high shortly after the purchase of a property, the largest risk exposure is exerted on the household in the first few years. From a leverage perspective, the value of the insurance for the household is reduced, as a significant portion of the mortgage principal has been repaid. However, the insurance remains highly relevant from a portfolio perspective for the full duration of the ownership. An opportunity to extend the maturity (or refinance) the insurance is a beneficial extension of the product, although outside the scope of this thesis.

### *The financing*

Other parameters needed to price the insurance policy are the volatility of the changes in house prices, and the appropriate risk-free rate. Additionally, a financing solution is proposed, where the premium for the insurance policy is reduced through transfer of potential future profits, above a profit limit, to the policy writer.

**Volatility:** The volatility of one specific apartment is not trivially measured, as market prices are available only upon transaction dates. Since the data frequency is insufficiently high to estimate volatility of each apartment, an approximation is made in this thesis. In the approximate valuation of the insurance policy, it is assumed that the CAPM-beta<sup>5</sup> of all relevant apartments in Stockholm and Gothenburg, equals to unity. In the pricing calculation below, an “idiosyncratic premia” is added to take this to account, by doubling the volatility of the respective indices representing the two markets examined. The annualized volatility for the Nasdaq OMX Valueguard-KTH Housing Index, sorted by Stockholm and Gothenburg, is approximately 7% (*cf.* Appendix A). The property specific volatility of approximately 14% is in line with previous estimations (Flavin & Yamashita, 2002).

An alternative way of estimating the risk of the single property, is by solving for the implied volatility by back-tracking it through the risk premium model, as given by Merton (1974). Though the model is primarily concerned with the pricing of corporate debt, it could be used to price a mortgage, essentially being a bond issued by the household on the existing property. Since a generic Yield-To-Maturity (YTM) can be approximated for the single mortgage, an estimation of the risk of the single home can be calculated. Equation 1 shows the relevant formulae used.

$$R_{(\tau)} - r = -\frac{1}{\tau} \log_e \left[ N(d_2) + \frac{N(-d_1)}{a} \right] \quad (1)$$

*where;*

---

<sup>5</sup>Representing the exposure of an individual generic property to its local housing market risk.

$R_{(\tau)}$  = Yield-To-Maturity (YTM) of risky mortgage

$$d_1 = \frac{\log_e\left(\frac{A}{X}\right) + \left(r + \frac{\sigma^2}{2}\right)\tau}{\sigma\sqrt{\tau}}$$

$$d_2 = d_1 - \sigma\sqrt{\tau}$$

$$a = \frac{Xe^{-r\tau}}{A}$$

$$\tau = T - t$$

$r$  = Risk-free rate

Table 14 summarizes the results when estimating the implied volatility of a generic property. A volatility of 22.42% is calculated, which is approximately one third higher than the volatility assumed when pricing the policy in the survey. The premium would increase as a consequence, as the price of the insurance policy is positive in volatility. If the household chooses to include the financing solution, the premium decreases. In general, the volatility can be split into systematic (market) risk and idiosyncratic risk. Table 14 further shows a crude estimation of the two sources of risk. As we can see, the majority of the risk of the single property is captured in the idiosyncratic component (4.53%/5.03%  $\approx$  90%). Only using two risk parameters might, thus, prove too simple. Risk factors that cannot be placed in either category (systematic or idiosyncratic) should be included, such as location, standard, and size. Note that the risky rate of return  $R_{(\tau)}$  not only includes the credit risk spread, but also a mark-up to cover the cost basis of the mortgage underwriter. The inclusion of the mark-up increases the calculated volatility, causing it to be upward biased. It is reasonable to argue that the volatility uncertainty is one of the main drivers of pricing errors of the insurance policy.

$$\sigma_i^2 = \sigma_m^2 + \sigma_\epsilon^2 \quad (\text{assuming } \beta_i = 1) \quad (2)$$

**Risk-free rate:** The risk-free rate, at which borrowing and lending is possible, is the final input for the pricing of the total contract. By convention, a government bond yield matching the maturity of the insurance policy is used.

**Financing solution:** An alternative payment method for the insurance policy is by contracting today on some of the possible profits at maturity. The policy holder

Table 14: Implied Volatility in single property

<i>Estimation of single home volatility</i>	
<b>Inputs</b>	
Time to maturity	5Y
Loan-to-Value (LTV)	80%
Risk-free rate (5Y Gov-bond)	-0.35%
Mortgage 5Y fixed rate (Swedbank)	2.30%
Observed risk premium ( $R_{(\tau)} - r$ )	2.65%
<b>Outputs</b>	
<i>Variance</i>	
$\sigma_i^2$	5.03%
$\sigma_m^2$	0.50%
$\sigma_\epsilon^2$ (from Equation (2))	4.53%
$\sigma_\epsilon^2/\sigma_i^2$ (variance captured by idiosyncratic term)	90.03%
<i>Volatility</i>	
$\sigma_i$	22.42%
$\sigma_m$	7.08%
$\sigma_\epsilon$	21.30%

*Implied Volatility as calculated by the observed risk premium, through Equation 1. Variance for the idiosyncratic component, calculated through Equation 2.  $\sigma_i^2$ ,  $\sigma_m^2$ , and  $\sigma_\epsilon^2$  represents the variance for the single home, the market, and the idiosyncratic component respectively.*

forfeits all potential future profits above a profit limit to the policy writer, as a means of reducing the premium paid for the insurance policy. The financing solution is a short European call option for the policy holder and therefore a long European call option for the policy writer. The combination of the insurance policy and the financing solution is referred to as "the total contract". Giving up parts of the possible profits at maturity will significantly affect the total contract premium, and can therefore be seen a feasible financing mechanism.

**Profit limit:** The profit limit is, as the loss limit, expressed in terms of the property value at the origination date. The ratio of the profit limit over the market value of the property upon initiation of the contract, is referred to as Future-Value-to-Value (FVV). By definition, the profit limit (FVV) is set equal to or larger than the loss limit (ITV). Depending on where the profit limit is set, the total position for the policy holder can range from a bull spread to locking in a future price (*e.g.* a TRS). As per the insurance policy, the financing solution is standardized such that all above the FVV belongs to the policy writer, upon exercise.



## 5.2. At maturity

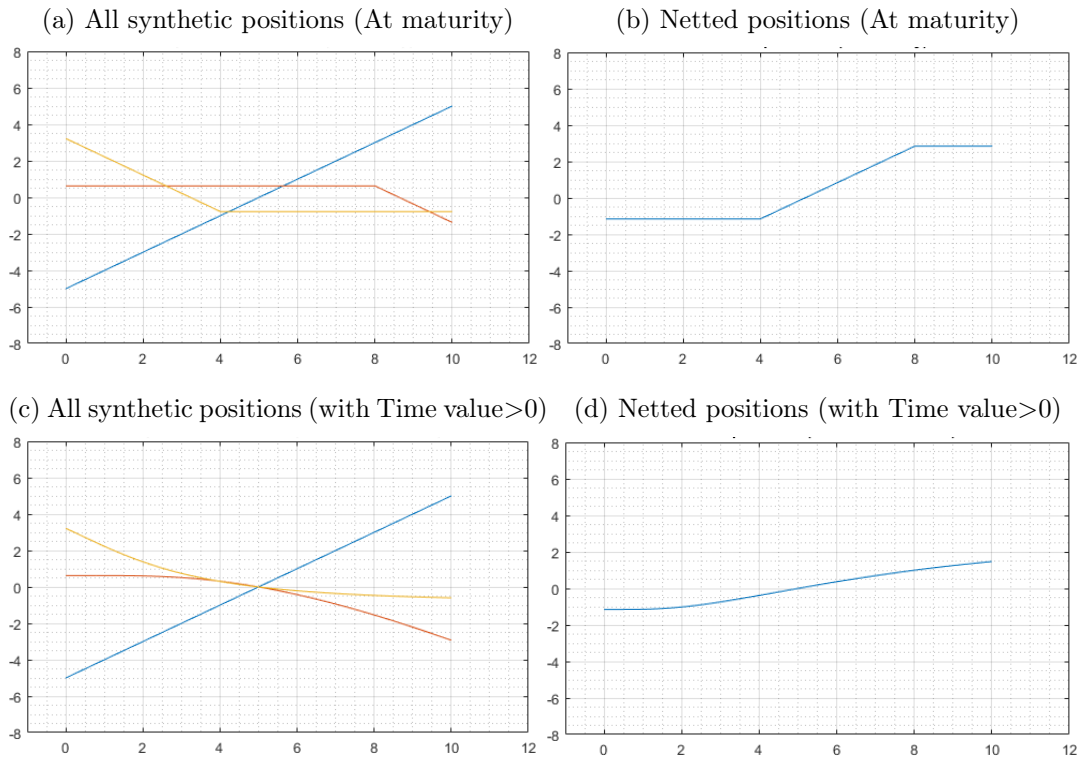
This section elaborates on the payoff calculations of the total contract. Table 15 summarizes the two constituents in the total contract and their respective contribution. Figure 1 further visually explains the total contract position before and at maturity.

Table 15: The total contract constituents

Variable	Option	Option Type	Price relationship	Strike	Ratio
Insurance	Put	American	+	Loss limit	ITV
Financing	Call	European	-	Profit limit	FVV

*A summary of the constituents of the total contract describing the options, price effect of the options, and what the strike prices represent in absolute and relative term.*

Figure 1: Static synthetic position of policy holder



*Static synthetic position of the policy holder at maturity, and when time value  $> 0$ .*

At maturity, the total contract (including both the put and the call) is cash-settled, with slight differences in payoff calculation method depending on which situation the household finds themselves in at maturity. The three possible scenarios are: (i) the insured apartment is sold prior to maturity, (ii) the apartment is close to sale at maturity,

or, (iii) the insured apartment is not to be sold. A summary of the possible scenarios and the payoff calculations can be found in Table 16.

Table 16: Summary of payoffs at maturity

Situation	Underlying asset valuation	Put	Call
Sold prior to maturity	Selling price	Cash-settled	Repurchased
Close to sale at maturity	Selling price	Cash-settled	Cash-settled
Not to be sold	Fair value	Cash-settled	Cash-settled

*Summary of the possible scenarios, how the underlying asset is valued, and the settlements at maturity.*

**Sold prior to maturity:** The insurance is tied to the specific property initially contracted on, and is contingent on owning the underlying asset. If the property is sold prior to maturity, the total contracted position is terminated and the strike prices are compared with the price the apartment is sold at. If the put is In-the-money (ITM) the policy holder receives the indemnity. Note that if the premiums on the put are paid on a monthly basis (*i.e.* payment plan to facilitate reasonable financing for the individual household), early exercise will imply that the payment plan is not completely fulfilled. The premiums on the put have to be paid until maturity, if not yet fully repaid. Since the call by construction has a higher strike price than the put, the call will in this case be Out-of-the-money (OTM). The amount that is paid out to the policy holder, is netted by both the remainder of the premiums outstanding as well as the price of a repurchase of the written call. If the put is instead OTM, the positions are closed in a similar way. The policy holder has to repurchase the call option as well as pay the policy writer the remainder of the premiums for the put option. The closer the call option is to be ITM, the more expensive it will be to repurchase. It is, though, necessary to repurchase the call to guarantee that the policy writer and the subsequent investors are indifferent with respect to the early exercise. *The feature of early exercise of the put option is only applicable for the policy holder if the underlying asset is sold.*

**Close to sale at maturity:** An interval around the actual maturity date is defined as "at maturity", (*e.g.* two weeks before and two weeks after maturity date) to give some flexibility in time to settle an apartment sale. If the apartment is sold within this defined interval, the strike prices of the put and the call are compared with the price at which the apartment is sold at, and the positions are cash-settled. If the apartment is not sold

within the interval, it is treated as "not to be sold".

**Not to be sold:** If the apartment is not to be sold, there is no known market price of the underlying asset. Therefore, the price needs to be objectively assessed by for example a real estate broker. If the broker has incentives for a over- or undervaluation, triangulation could be used to obtain a 'fair market value'. The positions are cash-settled, as previously, with the slight difference that if the call option is ITM there is no realized capital gain, meaning that the liquid assets of the policy holder might be limited. The possibility of mortgage add-on (also known as home equity loan or mortgage equity withdrawal) on the appreciated asset value solves this potential liquidity constraint.

### 5.3. Pricing the insurance policy

The fair price of the underlying property is hard to determine since buyers are unable to short sell and the trade volume of a single property is highly limited. This would imply that the regulating price mechanism most likely does not hold and the assumption of no arbitrage might therefore be violated. The limitations of short-selling on price discovery has been discussed by *e.g.* Diamond and Verrecchia (1987). Finding that in a rational model, a short-selling constraint might affect the short term pricing, but prices will converge to their fundamental value and no effect is present on long term market prices. Their research is mainly focused on stocks, the effect on housing prices is yet to be determined.

To calculate an approximate price of the insurance policy, several assumptions are needed. Firstly, it is assumed that the fair price of the property is the price paid by the buyer, and represents the value of the underlying asset when the insurance policy is written. It is further assumed that there is no predictability in prices of the property, which has been shown to be violated at least on an aggregate level in both the US (Shiller, 2015) and Sweden (Englund, Gordon & Quigely, 1999). As the insurance policy can be exercised prior to maturity, it is treated as an American style put option on the insured object.

A discrete time option pricing model (the BOPM) was used for the pricing of the insurance policy, since the put option is American, as proposed by Cox, Ross and Rubenstein (1979). Variables that will affect the premium paid by the policy holder are presented in Table 17. Variables such as, *e.g.* whether or not the individual chooses to use the

financing solution, what maturity that is contracted, and the assumption of price fluctuations will drive the premium paid. The price calculated is an approximate attempt to price the total contract. As this has not previously been done, no possible reference price can be used for comparison. The pricing of the total contract serves the purpose of grounding the policies proposed in the survey to some feasible price. For this purpose an approximate price is deemed sufficient. An example used in the survey is presented in Table 17. Further research is needed to determine a more definitive price. Research on American put option prices with real estate properties as underlying assets by Cadenillas *et al.* (2009) could serve as a basis.

Table 17: A pricing example

<b>An approximate pricing of a total contract using BOPM</b>	
Value of property (SEK million)	3
Insurance-to-Value (ITV)	90%
Time to Maturity	5Y
Volatility	15%
Future-Value-to-Value (FVV) <i>e.g. forfeited possible future profit</i>	120%
<i>Resulting in a monthly payment (SEK/month)</i>	1000
<i>Without financing solution (SEK/month)</i>	2400

*An example with total contract specifications and price, used in the survey.*

## 6. Securitization of insurance policies

In this section, the Market Insurance Backed Security (MIBS) is discussed more thoroughly. The synthetic option position for the outside investors, the payoff, and the cash flows from the MIBS are described.

To transfer the risk exposure from the policy writer, an investment product is created by pooling multiple insurance policies into a Special purpose vehicle (SPV). The pooling leads to diversification, *i.e.* having an idiosyncratic risk converging to null. However, the remaining risk in the SPV is substantial. It is therefore unlikely that the policy writer will be willing to bear the risk, associated with writing insurance policies on correlated assets. The cashflows from the pool of insurance policies are transferred, through the policy writer and the SPV (called MIBS), to subsequent outside investors. In principle, the investor invests a certain amount in the MIBS and in turn receives cash flows related to

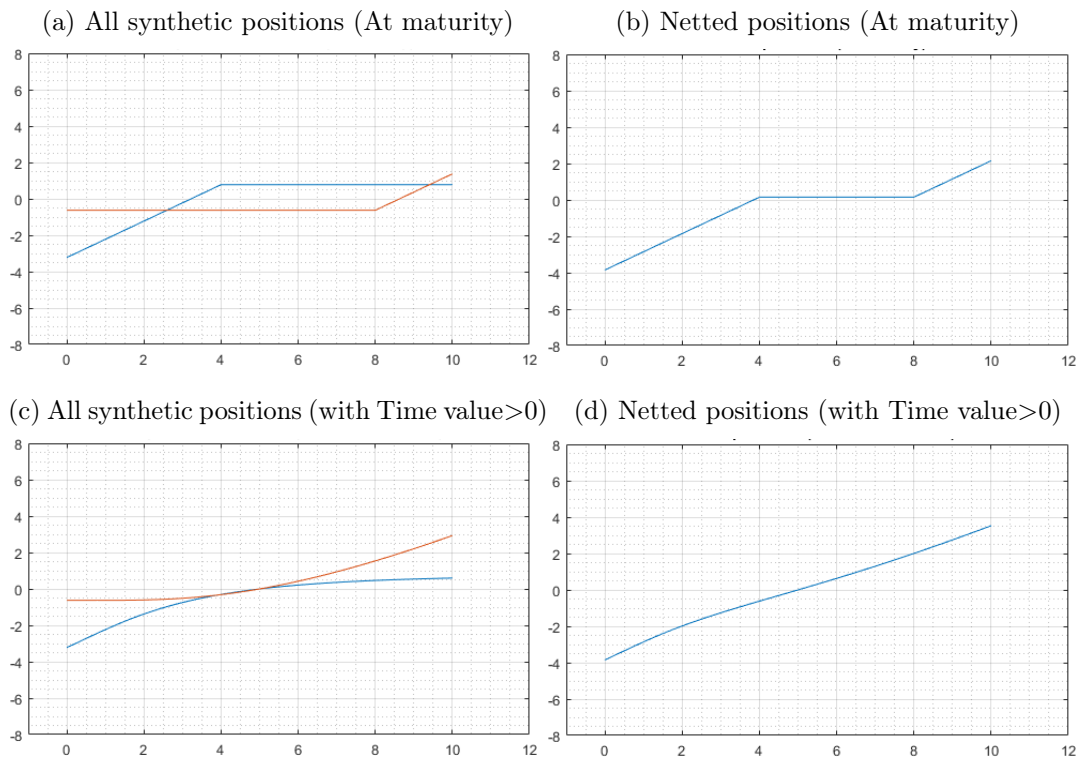
the underlying insurance contracts. To securitize, and therefore allow for investors to hold speculative positions in the housing market, is making the endeavor for commercializing market value insurance policies extra interesting. The greater the availability of funding, the larger the possibility to materialize the insurance policy, and therefore benefiting the general public. We therefore believe that the process of being able to finance the proposed policy will play a central role in the success of the undertaking.

### *6.1. Return on MIBS*

The MIBS yields a fixed coupon payment from the pooled policies' monthly premium payments, as well as any capital gains above the profit limit of the call option at exercise date. A proposed static synthetic position is provided in Figure 2, as seen from the investors perspective. The MIBS is proposed to have a catastrophe bond feature, where the policy writer raises capital that serves as collateral for the insurance policies. The capital raised has to equal the total insured value of the contracts in the pool, to be able to cover a 100% loss of all insured properties, if all put options are exercised and indemnity is to be paid out. Full coverage is necessary to facilitate for the policy writer to take all risk related to the insurance policies off its balance sheet, as the insurance policies are priced with the assumption that the value can fall to null. The raised capital is invested in government bonds. In a hypothetical scenario, where a number of identical insurance policies, similar to that specified in Table 17 (without the financing solution), are pooled. The effective, continuously compounded rate of return for the MIBS would be approximately 1.9% per annum. This would be the compensation paid to the investors for taking on the risk of downside exposure of the housing market.

The payoff calculation mechanism upon exercise has to be clear for the MIBS to be an interesting investment opportunity. To make the payoff calculation as simple as possible, the pool of securitized insurance policies is considered to be close to the NASDAQ OMX Valueguard Flats Stockholm index, and respective index for Gothenburg. The investor is, hence, exposed to the index movements. The MIBS is exposed to the market movements of the pool of insurance policies on one hand, and exposed to the index movements on the other hand. The settlement with the households at exercise is related to their specific property, while the settlement with the outside investors is related to the index. Naturally, the value of the insured properties will deviate to some extent from the relevant

Figure 2: Static synthetic position of investors



*Static synthetic position of investors at maturity, and when time value  $> 0$ .*

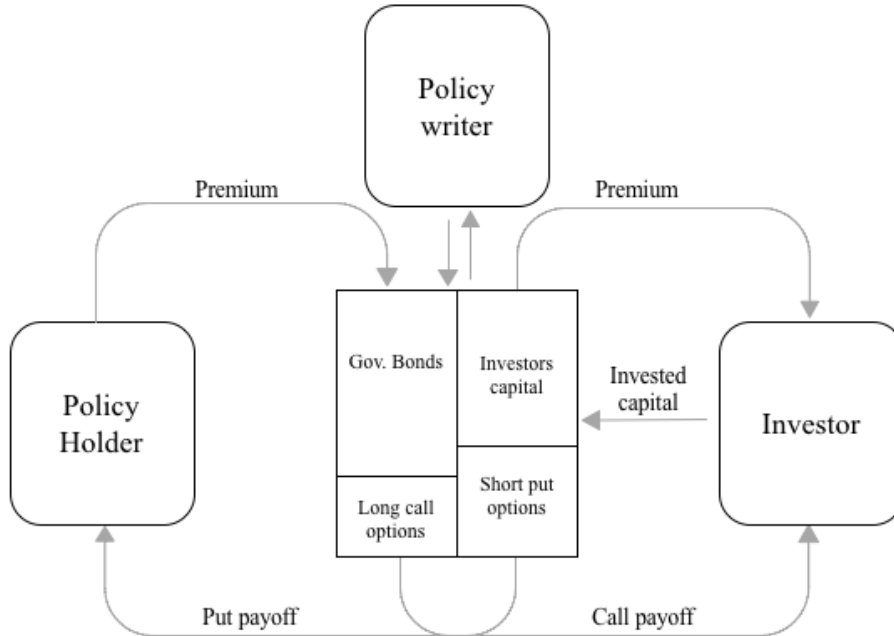
Valueguard index. If there is no systematic bias in the pool of insured apartments, it should, though, on average behave as the corresponding index. The spread is a possible gain/loss for the MIBS, which on average is assumed to be zero. The assumption of close correlation between the pooled insurance policies and the index, is a potential caveat of this brief securitization proposal, that would benefit from additional inquiry (*cf.* Discussion Section regarding "tranche structure"). A summary of the three stakeholders' asset exposure, ongoing cashflows and payoff at exercise can be found in Table 18 below. A visual explanation of the positions is further presented in Figure 3 below.

Table 18: Summary of stakeholder payoffs

Stakeholder	Asset exposure	Ongoing cashflows	Exercise payoff
Policy holder	$S_h =$ Owned apartment	- Put premium	$+K_1 - S_h$ or 0 $-S_h - K_2$ or 0
MIBS	Pooled policies & $S_i$	+ Put premium - Put premium	$+Spread \approx 0$ $-Spread \approx 0$
Investor	$S_i =$ Valueguard index	+ Put premium	$+S_i - K_2$ or 0 $-K_1 - S_i$ or 0

Summary of stakeholder payoffs, where  $S_h$  is the market value of the owned apartment at exercise,  $S_i$  is the comparison value of the relevant Valueguard index at exercise,  $K_1$  is the strike price of the put and  $K_2$  is the strike price of the call.

Figure 3: Ongoing cashflows and cashflows at maturity



Cashflows associated with the MIBS, before and at maturity.

## 6.2. Trading in MIBS

The investors likely to be interested in trading the MIBS could range from institutional investors to private households, parties wanting to add some housing market exposure to their portfolios. Homeowners with a TRS, as well as households that rent, should according to MPT optimally add some exposure to the housing market. Homeowners planning to move to a market which is not perfectly correlated with the market currently

owning in, can be protected against the relative deviations between the markets, by taking a long position in the market one is planning to move to in the future (Englund, 2009). The MIBS could be traded both OTC or in the open market. If traded in a secondary market, fluctuations in the housing market will have a direct effect on the yield of the MIBS. It follows from the change in market value of the respective calls and puts included in the SPV. If the housing market appreciates, so would the value of the calls. Therefore an investor partaking in the primary market might hold the position for 1 year and then close the position in the secondary market, thereby realizing the capital gains triggered by the appreciating value of the calls.

As of today, an investor in Sweden can be directly exposed to residential real estate only if he or she buys a basket of properties. There are securities currently trading (*e.g.* Länsförsäkringars fastighetsfond A) that partially track the Swedish real estate market. However, they carry a different risk exposure compared to the proposed MIBS, such as legislative and operational risks. Real estate mutual funds invest in large commercial and residential real estate developers and property managers (*i.a.* Fastighets AB Balder, Fabege AB & FastPartner AB). The MIBS presents investors with a focused investment opportunity, were the value of the product tracks a narrow segment of the market *i.e.* flats in Stockholm or Gothenburg.

## 7. Discussion

The results from the survey, and the product specification are discussed in this section. Lastly, a summary of the findings are presented in a brief conclusion.

### 7.1. Risk perception

Approximately 70% of the respondents perceive some risk in the housing market. In this section, the main risks are discussed and analyzed with the insurance policy in mind. Of the risk perceiving respondents, 75% agreed on interest rate risk as being relevant. Two possible mechanisms are considered: firstly, the effect that increasing rates would have on the household's ability to meet monthly interest payments. Secondly, real estate prices decline following higher rates. Some, or all, of the interest rate risk stemming from the first mechanism can be eliminated by fixing the interest rate. The insurance



policy suggested could additionally mitigate some, or all, of the interest rate risk that mechanism two carries. Having to realize losses was considered as being relevant by 73% of the risk perceiving respondents. The proposed market value insurance policy could mitigate some or all of the risk associated with having to realize a loss. 40% agreed that inflexibility of ownership posed a risk. This follows from *i.a.* if the market has declined, and the individual does not *have* to realize the loss, he or she can retain the asset and sell when market conditions are better. It is, however, not self-evident that better conditions are always ahead. This then leaves the individual with the risk of being “locked-in” in the position. If the policy is set up as *e.g.* a TRS, the policy holder has similar flexibility as a tenant who is renting his or her housing.

30% of the respondents perceived there to be little or no risk in the housing market. Out of these, the main attitude, expressed by 60%, was to consume housing. This implies that these respondents are not buying or selling properties as a speculative investment. What, though, should be noted is that the financial risk in their respective properties will not be different due to their attitude towards home-ownership. Mental accounting, and considering potential losses related to housing investments as "costs", are thought fallacies that could lead to this type of conclusion. (Thaler, 1999). Englund (2009) highlights that there is one additional risk to consider, namely, the consumption risk. This risk arises from changes in rents, which is the implicit dividend paid to the household that consumes housing. If renting becomes cheaper, the benefit of owning decreases for the homeowner (Englund, 2009).

Approximately a fourth of the respondents perceiving there to be little or no risk, claimed that their main attitude towards home-ownership is to view it as a type of savings regime. It is included as an alternative as interviews prior to constructing the survey confirmed this to be a common narrative when discussing housing. Its prevalence is regarded as confirmed, given the significant share of respondents that chose the alternative. The argument that housing is a "Little or no risk savings option" carries small or no theoretical validity given the volatile nature of housing prices. The long investment horizon one usually has when buying a property, might cause money illusion, *i.e.* individuals to believe that nominal profits leads to increases in one's wealth. This would justify the view of housing as a type of savings regime, even when real returns are null.

## 7.2. Demand for insurance

53% of the respondents of the survey claimed that they would be interested in a market value insurance policy. Demand was shown to be statistically different from zero, it can therefore be argued that there is a demand for this type of insurance product. The respondents interested in a policy, found the total contracts with a spread in loss limit and profit limit as more attractive than the TRS. With a TRS, all risks related to the market value of the property are taken away. From an optimal portfolio perspective, one should, however, have some exposure to the housing market (Englund, 2009). The Total Return Swap (TRS) could be argued for as serving as a guarantor on the value of the property, meaning that if the borrower defaults, the mortgage lender is guaranteed to receive the full principal outstanding. Under such a regime, an LTV of 100% would not entail additional risk for the mortgage lender, as compared to an *e.g.* LTV of 85%<sup>6</sup>. In a situation with an LTV of 100%, the TRS would be the optimal choice, as the household can fully separate the investment and consumption decision. This setup would allow investments in a diversified pool of housing related securities, as no home-equity investment is required. The household would further be able to consume housing and enjoy the tax deductibility of interest rate payments. In a scenario where the LTV is less than 100%, a TRS would "lock-in" the home-equity invested, without allowing it to add any exposure to housing in one's total portfolio. It is therefore sub-optimal to enter a TRS, and one should keep some of the idiosyncratic risk associated with the single property. This follows from the desirability to retain some of the exposure towards the housing market. The width of the optimal spread between the ITV and FVV, should, thus, be larger than zero. The optimal spread is determined by the outside positions of the household.

47% of the sample were not interested in a market value insurance policy. The most common explanations to why, are discussed below. A majority of the explanations were concentrated around the view that the risk of a falling housing market is not large enough to insure. This is consistent with the risk perception of our respondents, as 30% of our sample claims that there is little or no risk in the housing market. As we can see, the orthodoxy of a constantly increasing housing market is prevalent in our sample. The two main arguments presented by the respondents are that *"I have a long investment*

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<sup>6</sup>Under the assumption that the absolute value of the mortgage is the same in both situations.

*horizon and over time the market will increase*” and *“The risk that I will sell at a loss is very low, as my apartment has an attractive location”*. Further, the rationale of *“Looking at historic data, the market should continue upwards”* is used as an argument for the optimistic outlook on the market. We argue that many of these arguments are naïve and non-realistic. Historical performance is not a guarantee of future success. The assumption is made that the time frame considered as ‘historic’ by our sample, is the past 20 years (as the median age is 25). This is a period where the housing market has been increasing in an extreme pace, compared to previous 15 years leading up to the 21st century (*cf.* Appendix A). Therefore, the arguments put forth by the respondents are coherent and in line with what could be expected, however, faulty. Further, other respondents claimed that they will not sell if it would entail having to realize a loss, ignoring the risk of external factors forcing a sell, as mentioned in the introduction.

The second most common theme in the explanations, is the argument that the insurance would be *“Too expensive”* and/or *“A redundant, additional monthly cost not adding enough value for its price”*. Before answering this question, the respondents were asked to judge their interest for an insurance in three different scenarios. This means that they were primed to think about the insurance specifications related to the scenario questions, many are, hence, mentally considering an insurance with a monthly price of SEK 1000. This price would not necessary correspond to the price related to the respondents property, as it is connected to certain specifications for a SEK 3M apartment. If instead applied to a SEK 1,5M apartment, with the same specifications, the monthly price would be SEK 500. Additionally, the monthly cost can be adjusted by transferring more of the potential profit at maturity. Some, subsequently, argue that *“It would be more efficient to invest the insurance premium in other assets”* with the potential of making capital gains, to use as a ‘private insurance’. This argument is in line with the situation outlined in the introduction where additional accumulation of capital reduces the relative overexposure to housing in the total portfolio. It is further emphasized that *“A larger capital gain on one’s home is needed to cover the additional costs of an insurance”*. Taking the example from the first scenario question that many naturally have in mind, the total contract matures in five years, totaling in a cost of SEK 60 000 (*i.e.* 2% of SEK 3M). It is possible that the monthly payments proposed in the survey gives the illusion of being more expensive, compared to if the full premium is paid upon acquisition of the property.

A third topic that was frequently mentioned in the comments, is the correlation of price movements, and the way the risk of a falling housing market is claimed to be "*Mitigated if selling to acquire a new property correlated with the old*". The assumption that the two apartments both follow *e.g.* Valueguard Flats Stockholm (*i.e.* are strongly correlated) is therefore implicitly made. Further, it is claimed that if the index (market) falls, the realized loss made when selling apartment 1 can be netted with the lowered purchasing price of apartment 2, implying your purchasing power would be unaltered by the fall in prices. The assumption of correlated price movements is valid, as shown in Appendix A. What is, though, important to note is that this argument is conditioned on an unlevered investment. As the value of your current home falls, your equity capital is junior to the mortgage, therefore incurring the loss. When subsequently acquiring a new property, you have to invest additional capital in order to meet the equity requirement for a new mortgage (of at least 15% in Sweden).

Another important fact to highlight is that the volatility of price movements is higher in the metropolitan areas of Stockholm and Gothenburg, compared to the rest of the country (*cf.* Appendix A). This is in line with arguments made by Englund (2009) where he discusses household risk management based on where you are likely to want to live later on in life. If an investment product, as the one proposed in this paper, would be available, you could, if living in *e.g.* Stockholm, choose to have a long exposure to the pooled insurance contracts from Malmö, if you plan to eventually move there. Thereby, the relative price changes today could be locked-in, so that you can be sure that your current housing will not fall in value as your future housing becomes more expensive to acquire.

In the scenario questions, an apartment is to be bought with three different ownership structures (*cf.* 11). In the first scenario, the respondent is buying a SEK 3M apartment by herself, where in the second scenario a SEK 6M apartment is jointly acquired with a partner. The monetary exposures between scenario 1 and 2 can be considered to be equal for the individual. What differs, though, is the exogenous risk of buying together with another part. The additional risk is that the relationship will not hold, increasing the probability of a forced sell in a low housing market, or at fire sale price. Having an insurance on some value of the apartment, could guarantee that large monetary losses will not be a constraining factor for the separation. If instead comparing the first scenario

(alone) with the third (with relative as guarantor on the mortgage), the individual is acquiring a SEK 3M apartment in both scenarios. The difference being that, in scenario 3, the ultimate risk of the mortgage lies in the hands of the guarantor, which is why the individual only risks the home-equity invested. As the equity position is levered, the position fluctuates more than the housing market. The individual can, though, formally not lose more than the equity investment, and therefore has a lower monetary exposure compared to if acquiring the property alone. It can, though, be argued that the social aspect of being in debt to a relative is experienced as worse than, or no different than, being in debt to an institution. As the risk exposures are different in the three scenarios, it was expected that demand for the insurance policy would differ. When trying to examine if one of the scenarios was more or less attractive to insure than the others, the results were statistically insignificant. No conclusions can, therefore, be made.

### *7.3. Home-ownership, risk perception and demand*

Thaler and Johnson (1990) argue that investors are willing to take higher risks if they previously experienced large gains, referred to as *the house money effect*. The theory provides a frame of analysis, which if applied in a real estate setting, would imply that individuals with sunk gains put upward pressure on the housing market. The upward pressure follows from the reinvestment of profits from previous property sales, in new larger, riskier properties. Keeping the same leverage as when the previous property was bought, would entail significantly increased purchasing power. If the household retains the leverage, the absolute size of the mortgage is increased. The investment might, therefore, prove riskier to the household if the economic outlook changes, as the weight of housing in the wealth portfolio is increased.

With the the theory of house money effect in mind, two hypotheses were formed, to determine how current home-ownership affects risk perception and consequently demand for the insurance policy. The results presented in Table 13, are in line with the theories formed. The demand to insure was significantly decreased if the respondent is a homeowner. As previously argued for, the insurance might carry most value for individuals entering the market, often being highly levered, which the results support. The results further suggest that homeowners experience the current housing market as less risky, once again in line with what would be expected by the theoretical framework of the house-

money effect. When risk perception was controlled for, the effect ownership status had on demand was no longer statistically significant. This suggests that the effect ownership status has on demand, runs through risk.

The notion that amortization decreases the risk of the total portfolio of the household might be, at least to some degree, faulty. Deleveraging one's stake in housing might, not decrease but rather, increase the total risk of the household portfolio. Granted that future income is less volatile than the individual property, the increased weight in housing from amortization, increases the total volatility of the portfolio. This only applies when future income can be seized if the household defaults on the mortgage and the selling price does not cover the full outstanding principal. Once again, the rationale for insuring part of the potential loss is evident. However, from a macro economic point of view amortization lowers the systematic risk. This follows from the argument that, as principal repayments are made, the households become more robust to interest rate changes (Statens offentliga utredningar, 2015). If interest rates increase, the households are able to meet the higher monthly cost as the absolute value of the mortgage has decreased. With higher interest rates, property value decreases and households are worse off. This implies that the increased stability of the economy, comes at the expense of the households.

#### *7.4. Product related discussion*

As the market value insurance product proposed in this thesis is a first draft, this outline has many caveats and is in the need of further development. The product is limited to apartments in Stockholm and Gothenburg. Malmö could with ease be included as well, as Valueguard offers a partial index for apartments in Malmö. To insure apartments in less metropolitan areas would need additional indices not yet introduced. Other possible developments are highlighted in the following sections.

One of the many possible extensions of the product would be to allow for insurance transferring. By this extension, the insurance could be sold as an intangible asset connected to the property. If the put is OTM as a sale occurs prior to maturity and, hence, the policy holder does not exercise, the total contract (*i.e.* the put and the call) can be sold to the new owners and carry forward until maturity. This would ensure that the full time-value of the insurance policy can be exploited by the household(s), as the premium for the option is paid until maturity. The remaining time-value is as of now forgone at a

sale prior to maturity.

A substantial proportion of the respondents who were not interested in the insurance policy, claimed that the cost of the total contract was too high. The premium was chosen to be expressed on a monthly basis in the survey, in accordance with how other payment schemes in Sweden are structured. The anchoring effect, where comparison naturally is made to payment schemes for other types of insurances, is important to note here. If the premium would be presented as a one time cost instead, paid upon acquisition of a new apartment, the price could possibly be *perceived* as lower. A one time payment of SEK 60 000 once, with the price of the SEK 3M apartment as an anchor, as compared to SEK 1000 monthly (for 5Y), with another insurance as an anchor, is perceived as two different situations. If paying SEK 60 000 at the same time as acquiring a property for SEK 3M, the additional cost of 2% might not feel as heavy. The framing of the product and its pricing is, hence, important and an optimal way of presenting the product to potential customers is yet to be investigated.

The proposed insurance policy does not take inflation into account. To provide a real value insurance, the profit and loss limits should be adjusted for inflation. If not, the real insured value of the property is reduced with inflation. On the same note, mortgages are denominated in nominal terms, effectively reducing the leverage (and, hence, risk) with inflation. Assuming that Sweden fulfills its goal of an inflation rate of 2% per annum (as of 2019), the price level will have changed with 10.41% in five years. With a *real* market value insurance with TRS features, one could insure the value of the home for 50 years and consume housing with no risk (and no real return). This is a possible extension that could increase the attractiveness and utility of the insurance policy.

Potential moral hazard occurs if the value of the home approaches the strike of the put (loss limit), as the incentives for the policy holder to sell the property as expensive as possible decreases. A proposed solution to partially overcome this problem is by transferring the sale mandate of the real estate to the policy writer. This is beneficial since the policy writer has incentives to sell the property as expensive as possible. Transferring the sale mandate would also solve the moral hazard occurring as the price of the underlying asset is above the strike of the call, where the policy holder has no incentives of selling to a price above the profit limit. By this, it naturally follows that the risk of hazardous behaviour increases as the loss limit (strike of the put) and the profit limit (strike of the

call) are close to each other. If the two strikes are the same, the position resembles a TRS and the sell mandate should be completely transferred.

As previously suggested by *e.g.* Shiller and Weiss (1999), Moral hazard might also be present as the policy holder is disincentivized to take care of the property (*e.g.* maintenance and renovation). The policy holder is insured if the value deteriorates, effectively increasing the probability of ending up ITM. This effect might be magnified further by the fact that the policy loses value if large investments are made to increase the value of the property, which also could increase the probability of the short call ending up ITM. While this might be a problem, it can be included in the contractual specifications in the insurance scheme, and thereby be partly or fully omitted.

The total contract can be designed with the investor in mind to create an even more attractive investment product, where different risk preferences can be taken into account using a tranche structure. The tranches within the MIBS could have different seniority and different expected yield. For simplicity, consider two tranches: senior and junior. Senior can get a return of  $x\%$ , once the senior tranche has received its promised payments the junior tranche receives its return, a method currently used in Asset-Backed Security (ABS) today, called a waterfall. (Hull, 2015). On a similar note, losses up until  $z\%$  are taken from junior first and has to exceed  $z\%$  before affecting the senior investors. One possibility is that the issuer of the MIBS invests in the junior tranche, thereby having an 'equity position' compared to the more senior tranche held by outside investors. This structure could be optimized by slicing into multiple tranches, each targeting different risk preferences. Further, an extension of a geography based parallel structure could potentially be used to separate underlying insurance policies, depending on if the insured asset is located in Stockholm or Gothenburg. This could be developed further by adding contracts from Malmö, and subsequently the rest of Sweden (compared with NASDAQ OMX Valueguard Flats Malmö and Sweden respectively), giving an opportunity for the investor to select seniority as well as geographical exposure.

The latest numbers, presented by Finansinspektionen (Sweden's Financial Supervisory Authority), show that the average LTV for newly signed mortgage was 65% (Finansinspektionen, 2019). Even though volatility has a different interpretation than what individual investors generally perceive as risk (*e.g.* losing money)(Keppler, 1990), it is a widely used measure of risk. This can be exemplified by *i.a.* the Sharpe ratio or MPT,



where higher returns only are achievable by accepting a higher volatility. Risk, viewed simply as the deviation from the long term mean, would imply that an asset yielding strictly positive returns is considered a “risky” investment. We start by, first, accepting volatility as a measure of risk and, further, by making the conservative assumption that the volatility of the single property is on par with the volatility of its corresponding city index, *e.g.* 7% for Stockholm (annualized volatility *cf.* Appendix A). With the average leverage of 65% it would imply that the volatility of home-equity is 20%. This would, further, imply that investing in an apartment is an investment with a similar risk as OMXS30. In this setting, the argument of "Little or no risk" in the housing market, becomes flawed. However, if one is to view risk as simply being the probability of making a loss, the opinion of "Little or no risk" in the housing market, expressed by 30% of the respondents, carries some reason to it<sup>7</sup>.

If we assume that the same decreases, as the past increases, are possible<sup>8</sup>, the argument to encourage the insurance policy entails large social benefits. The use of *e.g.* smart choice architecture could alter behavior in a socially beneficial way, without enforcing the insurance policy. This can be achieved without interfering with the individual’s freedom of choice. Such an approach has been successfully used in *i.a.* the Swedish pension system and we find no reason to why a similar strategy, when signing a property purchase, would be any different (Sunstein & Thaler, 2003).

## 8. Conclusion

The aim of this thesis was to determine households’ view of risk in the housing market and whether there is an interest for a market value insurance policy. Further, a solution to the risk management problem was outlined and discussed. The main contribution of this thesis is the investigation of housing market risk management, from the households’ perspective. It is concluded that, a significant majority of the respondents believed there to be, at least some, risk in the housing market. The greatest risk perceived was, having to realize losses as a consequence of being forced to sell one’s property in a weak market. Approximately half of the respondents were interested in the proposed insurance policy,

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<sup>7</sup>Again, the assumption is made that the time frame considered as ‘historic’ by our sample, is the past 20 years.

<sup>8</sup>Decreases that are equally limited of being explained by changes in fundamental price drivers as past increases (*cf.* Introduction).

of which the policy regime where the loss limit is set to be on par with the mortgage (*i.e.*  $ITV = LTV$ ), was the most popular. Three common themes were found among those that were not interested in the insurance policy. Namely: (i) the probability of having to realize a loss was considered too small to be interesting to insure, (ii) the price relative to the utility of insurance was too high, and (iii) it was considered irrelevant to insure the market value, as respondents claimed to be selling, and buying a new property, under the same market conditions. The proposed risk management product differs from previous research, as it allows for efficient risk transfer to external investors, without the need of a well-functioning property derivatives market. If the policy is constructed as a TRS, one of the solutions proposed in this thesis, households are given the opportunity to do what is currently non-feasible, *i.e.* separating the investment and consumption decision.

## Appendix A. Benchmark Housing Price Indices

A generally accepted housing index, used by Swedish government authorities, as well as the private sector, is the *Nasdaq OMX Valueguard-KTH Housing Index (HOX®)*. The index is reported on a monthly basis for price changes in *e.g.* flats, separated in to locations such as Gothenburg and Stockholm municipality. Information provided in the indices is used on several occasions in the thesis and the indices are suggested to work as a benchmark for the proposed MIBS solution (investors' perspective). The indices presented below are the indices for the whole Swedish housing market (permanent housing), flats in Gothenburg and flats in Stockholm. The long term average is 6.29%, 7.54% and 8,97% respectively (*cf.* Table 19). The two-sided single sample t-tests (95% significance, with Bonferroni correction) suggest that all means are individually different from zero. The volatility of returns is similar between the three indices, where the cities exhibit slightly higher volatility than the country as a whole. A two-sided F-test of equality of variances between the Flats Stockholm and Flats Gothenburg was performed, and yielded insignificant results. This means that we cannot conclude that the variances are different in the two indices. Individually, the cities exhibit significantly larger volatility of returns, than the aggregate Swedish housing market does.

Table 19: Descriptive Statistics & t-test output, Nasdaq OMX Valueguard - KTH Housing Index (HOX)

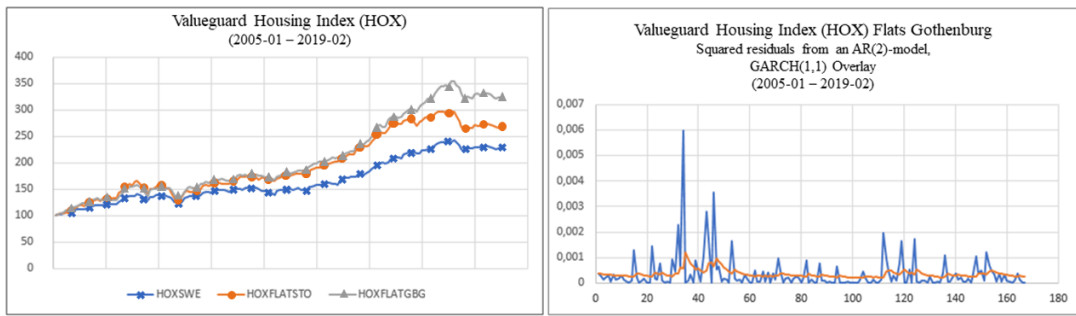
	<b>Sweden</b>	<b>Stockholm</b>	<b>Gothenburg</b>
Mean	6.29%	7.54%	8.97%
St.Dev.	5.62%	7.08%	6.90%
Minimum	-5.78%	-6.97%	-5.60%
Maximum	5.62%	6.83%	7.09%
Prop. of ret > 0	59.8%	65.7%	68.0%
<i>Mean and St.Dev. Annualized</i>			
<i>Minimum and maximum expressed on monthly basis</i>			
<b>t-test output</b>			
t-stat	4.05	3.86	4.69
P-value	0.008%	0.016%	0.001%

Descriptive statistics for Valueguard Housing Index (HOX) for (i) Sweden, (ii) Stockholm and (iii) Gothenburg. Test output (Single sample t-test) testing for historical mean = 0.

There is some significant autocorrelation in returns and conditional heteroscedasticity in residuals, effectively allowing for prediction of both return and volatility. Figure 4 shows the above described indices for the period 2005-01 to 2019-02 and a plot of squared residuals from an AR(2) model with an estimated GARCH(1,1) model overlay on the index *Flats Gothenburg*, highlighting the predictability of volatility. These findings are in line with Englund, Gordon and Quigley (1999), rejecting the Random walk hypothesis and concluding that house price changes are serially autocorrelated.

Figure 5 shows the inflation-adjusted permanent housing price index, provided by the Central Bureau of Statistics in Sweden SCB. It spans from the first quarter in 1986 to the the first quarter in 2019, showing

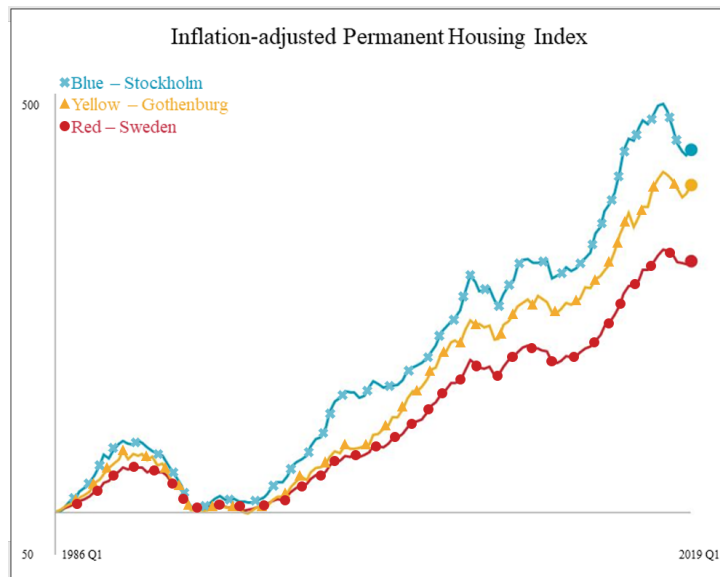
Figure 4: Additional analysis - Valueguard Housing Index (HOX)



Historical prices and Volatility modelling - Sweden/Stockholm/Gothenburg.

price movements of one or two family houses, town houses and terrace houses in (i) Sweden as a whole, (ii) Gothenburg and (iii) Stockholm.

Figure 5: SCB Permanent Housing Index, one or two family houses, town houses and terrace houses



SCB Permanent Housing Index (FastPI) - Sweden (red), Stockholm (blue), Gothenburg (yellow). Inflation adjusted, 1986 to present.

## Appendix B. Methodology (Extension)

### *Interviews*

Due to the speculative approach in this thesis, relevant professionals were interviewed in the early stages of structuring the insurance policy. To get a wide understanding of the topic, the occupation of the interviewees differ. The macro perspective was covered by the Director of Macroeconomic Analysis at Finansinspektionen. A Risk Manager at SEB provided the bank's view of mortgage related risks. A former Senior Equity Analyst within Construction and Real Estate at Danske Bank contributed with expert knowledge on the industry. A real estate broker explained the housing market from a sales perspective. Finally, a mortgage administrator provided insight on household's actions when applying for mortgages.

### *Survey caveats*

As negative aspects of the survey format, Bryman and Bell (2007) mention the fact that the respondents cannot ask for additional input on the questions asked. This could possibly give rise to a bias if the respondents do not understand the questions asked in the survey, due to the complexity of the product introduced and explorative form of the study. To get an indication of the respondents understanding of the questions they are answering, a section examining economic literacy is included. A pilot study was conducted, prior to distributing to the full sample.

### *Logistic regression vs. linear probability model*

When analyzing the effect of current home-ownership status on perceived risk in the housing market and demand for the proposed insurance policy, both the dependent variable and the independent variable are binary. Therefore, a logistic model could have been used. However, evaluating marginal effect following a logistic regression poses some difficulties in interpretation. As the logistic regression yields non-linear effects, different effect-sizes are calculated depending on which value of the binary independent variable (*i.a.* owner or not) is evaluated. The variability in effect sizes gives nonsensical interpretations as you are either an owner or not, and no specific value can therefore be chosen when evaluating marginal effects. This is why a linear probability model (LPM) was performed. Its superiority in interpretation is argued to outweigh its shortcomings. Shortcomings such as heteroscedastic error terms, by construction (addressed by using robust standard errors), or that predictions made by the model can assume values outside the natural bound of probability (*e.g.*  $Pr(Y = 1) > 1$ ).

# Appendix C. Full Survey (Swedish)

## Part 1

### EKONOMISK FÖRKUNSKAP

Du kommer nu att få svara på tre frågor gällande ekonomisk förståelse

1. Anta att du har 100 kr på ett sparkonto med 2 procents ränta. Hur mycket tror du att du skulle ha på kontot efter 5 år om du låter pengarna växa på kontot?

Mer än 102 kr      Exakt 102 kr      Mindre än 102 kr

2. Anta att räntan på ditt sparkonto är 1 procent och inflationen 2 procent. Om du låter dina pengar stå på kontot i ett år, kommer du då vid årets slut att kunna köpa för...?

Mer      Lika mycket      Mindre

3. Är följande påstående sant eller falskt?

”Att köpa aktier i ett enstaka företag är vanligtvis säkrare än att köpa andelar i en aktiefond.”

Sant      Falskt

## Part 2

### INTRODUKTIONSFRÅGOR

Du kommer nu att få svara på några korta frågor gällande din nuvarande boendesituation samt inställning till bostadsägande

1. Äger du en bostad?

Ja      Nej      Annat:

FÖLJDFRÅGOR (OM ÄGARE):

1. Vad för typ av bostad äger du?

Obs! Fler än ett alternativ är möjligt

Villa eller radhus      Bostadsrätt      Fritidshus  
Annat boende

2. Ungefär hur många år har du ägt denna bostad? (Antal år)

0-3      4-7      8-11      12-15      16+

3. Ungefär hur många år har du varit bostadsägare totalt?

(Antal år)

0-3      4-7      8-11      12-15      16+

4. Äger du din bostad ensam eller tillsammans med någon?

Ensam      Med partner      Med släkting      Annat:

5. Vid köptillfället uppgick din kontantinsats ungefär till ... (%) av det totala priset.

(Ex. Min lägenhet kostade 3 000 000 varav jag betalade 600 000 själv (20%) samt fick lån på resterande 2 400 000 (80%). Vilket innebär att min kontantinsats var 20% (600 000 / 3 000 000 = 20%) och banken finansierade resterande 80%.)

0-25%      26-50%      51-75%      76-100%

6. Hur finansierade du kontantinsatsen i din bostad?

	Större andel	Mindre andel
Sparpengar		
Arv		
Lån från släkting		

Annan finansieringslösning:

FÖLJDFRÅGOR (OM INTE ÄGARE):

1. Vad är den FRÄMSTA orsaken till att du inte äger din bostad?

Obs! Välj endast ett alternativ

Ekonomiska förutsättningar	
Flexibilitet*	
Risk associerat med att äga egen bostad	
Inte intresserad	

\*(Ifall jag behöver flytta med kort framförhållning)

Annat:

## Part 3

### SCENARIOFRÅGOR

Du kommer nu att få tre scenariobaserade frågor där du ska ta ställning till ett påstående.

#### Ordlista

\* En värde-försäkring för din bostad är ett sätt för dig att garantera att du får tillbaka hela eller delar av den mängd egna pengar du investerade i bostaden vid köptillfället, även om du tvingas sälja lägenheten med förlust i framtiden. Denna försäkring betalar du för genom en fast månadskostnad. När du tecknar försäkringen kan du välja att betala en lägre månadskostnad genom att överlåta delar av en eventuell vinst vid framtida försäljning till försäkringsbolaget.

Femgradig Likert-skala

(1)	Tar helt avstånd
(2)	Tar delvis avstånd
(3)	Varken instämmer eller tar avstånd
(4)	Inställer delvis
(5)	Instämmer helt

1. Du ska köpa en lägenhet i centrala Göteborg

I samband med köpet får du erbjudandet att teckna en värde-försäkring\* (som i ordlistan).

Specification:

Bostadsvärde	3 milj.
Kontaktinsats	0.6 milj.
Bolån	2.4 milj.
Skydd värdefall	90% (2.7milj)
Kostnad	1000 kr/månad
Giltighet	5 år
Överläten vinst	allt över 3.6 milj

	(1)	(2)	(3)	(4)	(5)
En sådan försäkring hade varit intressant för dig					

2. Du och din partner ska köpa en lägenhet i centrala Göteborg

I samband med köpet får du erbjudandet att teckna en värde-försäkring\*.

Specification:

Bostadsvärde	6 milj.
Kontaktinsats	1.2 milj.
Bolån	4.8 milj.
Skydd värdefall	90% (2.7milj)
Kostnad	2000 kr/månad
Giltighet	5 år
Överläten vinst	allt över 7.2 milj

	(1)	(2)	(3)	(4)	(5)
En sådan försäkring hade varit intressant för dig					

3. Du ska köpa en lägenhet i centrala Göteborg.

Dina föräldrar skriver lånet på sig om du står för insatsen själv

I samband med köpet får du erbjudandet att teckna en värde-försäkring\*.

Specification:

Bostadsvärde	3 milj.
Kontaktinsats	0.6 milj.
Bolån	2.4 milj.
Skydd värdefall	90% (2.7milj)
Kostnad	1000 kr/månad
Giltighet	5 år
Överläten vinst	allt över 3.6 milj

	(1)	(2)	(3)	(4)	(5)
En sådan försäkring hade varit intressant för dig					

Part 4

RISK

I detta avsnitt kommer du få ta ställning till ett påstående gällande din uppfattning om risk

1. Ett bostadsköp i min hemstad innebär

Stor risk    Viss risk    Liten eller ingen risk

FÖLJDFRÅGOR (OM "STOR/VISS" RISK):

1. Vilken eller vilka risker anser du är de främsta med att äga en bostad?

Obs! Välj endast ett svar per påstående

	(1)	(2)	(3)	(4)	(5)
Risk att räntan höjs så att jag får en högre månadskostnad					
Risk att jag vill/måste flytta, omständigt att behöva sälja					
Risk att vara tvungen att sälja med förlust					
Legal risk, exempelvis förändrade amorteringskrav					

Om annat, vad anser du är främsta risken:

FÖLJDFRÅGOR (OM "LITEN/INGEN RISK" RISK):

1. Vilken inställning har du FRÄMST till bostadsägande?

Obs! Välj endast ett alternativ

Investering jag förväntar mig att få en hög avkastning på	
En form av sparande	
En riskfri investering	
Det är en trygghet att äga mitt eget boende	
Emotionell*	
Någonstans att bo	

\*(Ex. arv, barndomshem)

Annat:

Part 5

FÖRSÄKRINGSLÖSNING

1. Anser du att det vore intressant att försäkra dig mot förluster vid bostadsförsäljning?

Ja    Nej    Annat:

FÖLJDFRÅGOR (OM INTRESSERAD):

Du kommer nu att få tre försäkringslösningar presenterade

1. Jag vill försäkra hela bostadens värde, mot ingen avgift. Jag som ägare kan varken förlora eller tjäna pengar när jag väljer att sälja.

Exempel:

Skydd värdefall	100% (hela värdet)
Kostnad	0 kr/månad
Giltighet	5 år
Överlåten vinst	allt (kan ej göra vinst)

	(1)	(2)	(3)	(4)	(5)
Vad anser du om följande försäkringsalternativ					

2. Jag vill vara säker på att jag INTE förlorar HELA min insats, mot en avgift. Jag vill behålla möjligheten att tjäna pengar om jag säljer med vinst.

Exempel:

Skydd värdefall	90% (hela värdet)
Kostnad	1000 kr/månad
Giltighet	5 år
Överlåten vinst	allt över 3.6 milj
Bostadsvärde	3 milj.
Kontantinsats	0.6 milj. (bolån = 2.4 milj.)

	(1)	(2)	(3)	(4)	(5)
Vad anser du om följande försäkringsalternativ					

3. Jag vill vara säker på att jag vid försäljning alltid har möjlighet att betala tillbaka mitt lån, mot en avgift. Jag vill behålla möjligheten att tjäna pengar om jag säljer med vinst.

Exempel:

Skydd värdefall	80% (hela värdet)
Kostnad	450 kr/månad
Giltighet	5 år
Överlåten vinst	allt över 4 milj
Bostadsvärde	3 milj.
Kontantinsats	0.6 milj. (bolån = 2.4 milj.)

	(1)	(2)	(3)	(4)	(5)
Vad anser du om följande försäkringsalternativ					

FÖLJDFRÅGOR (OM INTE INTRESSERAD):

1. Varför anser du att det INTE skulle vara intressant att försäkra sig mot eventuella förluster vid bostadsförsäljning?

Svar:

## Part 6

### BAKGRUNDSFRÅGOR

Slutligen ber vi dig besvara några korta frågor om dig själv.

1. Vilket år är du född (åååå)?

Svar:

2. Är du en kvinna eller man?

Kvinn	<input type="checkbox"/>
Man	<input type="checkbox"/>
Vill ej uppge	<input type="checkbox"/>

3. Vilken är din högsta genomförda utbildning?

Obs! Välj endast ett alternativ

Grundskola, folkskola, realskola eller liknande	<input type="checkbox"/>
2-årig gymnasieutbildning eller fackskola	<input type="checkbox"/>
3- eller 4-årig gymnasieutbildning	<input type="checkbox"/>
Universitets- eller högskoleutbildning (< 3 år)	<input type="checkbox"/>
Universitets- eller högskoleutbildning (≥ 3 år)	<input type="checkbox"/>

4. Ungefär hur stor är din inkomst efter skatt en genomsnittlig månad om du inte räknar in barnbidrag eller liknande

Dvs. ungefärliga beloppet du får in på ditt konto (kr/månad)

0 - 12 000 kr/månad	<input type="checkbox"/>
12 001 - 30 000 kr/månad	<input type="checkbox"/>
30 001+ kr/månad	<input type="checkbox"/>

5. Vilken är din huvudsakliga sysselsättning just nu?

Obs! Välj endast ett alternativ

Arbetar som anställd	<input type="checkbox"/>
Egen företagare	<input type="checkbox"/>
Studerande	<input type="checkbox"/>
Pensionär*	<input type="checkbox"/>
Långtidssjukskriven**	<input type="checkbox"/>
Tjänstledig eller föräldraledig	<input type="checkbox"/>
Arbetsökande***	<input type="checkbox"/>
Hemarbetande, sköter hushållet	<input type="checkbox"/>

\*(ålders-, avtals-, sjuk- och förtidspensionär)

\*\* (mer än 3 månader)

\*\*\* (eller i arbetsmarknadspolitisk åtgärd)

Annat:

6. Har du/din sambo några barn (under 16 år) som bor hemma? Obs! Räkna med de barn som bor minst halva tiden hos dig.

Ja	<input type="checkbox"/>
Nej	<input type="checkbox"/>

7. Har du några övriga synpunkter eller kommentarer?

Svar:



## Appendix D. Product form

### Policy holder

Name:

Civic registration number:

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### Property specifications

Address:

Market value of property:

Date:

---

### Insurance specifications

Maturity:            1Y     3Y     5Y

ITV:                    60%     80%     100%

Financing solution:    Yes     No

FVV:                    100%     120%     140%

---

*If the apartment is sold prior to maturity of the contract, settlement is conducted as per the date of the sale.*

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Total price:

Monthly premium:

---

Date:

Date:

Signature:

Signature:

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# Glossary

**financing solution** A proposed financing regime where the policy holder and policy writer share part of the potential capital gains at maturity, thereby reducing the monthly premium, *i.e.* the call option. 13, 14, 17, 21, 22

**home-equity** The residual value of the asset once the debt is repaid. 1, 5

**indemnity** The amount the policy writer is obliged to pay out if the put option is exercised, the difference between the loss limit and the market price ( $\geq 0$ ). 5, 24, 27

**insurance policy** The market value insurance on the asset, *i.e.* the put option. 1, 5–9, 13, 14, 16–22, 25, 30, 32, 35, 37, 39, 40

**loss limit** -  $K_1$  - The insured value of the property, all incurred losses below the loss limit will be covered by the insurance policy and paid out as indemnity. *e.g.* 80% of market value of the property. 6, 13, 19, 22, 23, 32, 37, 40

**MIBS** - Market Insurance Backed Security - The name of the security consisting of the pooled insurance policies, available for investors. 26, 27, 29, 30, 38, 41

**policy holder** The household purchasing the insurance policy, owning the insured asset. 6, 17, 18, 21, 22, 24, 25, 29, 36–38

**policy writer** The company (insurance company or bank) issuing the insurance policy. 5, 6, 20, 22, 24, 26, 27, 37

**profit limit** -  $K_2$  - The maximum profit the policy holder can gain, all above the profit limit belongs to the policy writer. 13, 20, 22, 23, 27, 32, 37

**total contract** The insurance policy and the financing solution combined. 14, 21–23, 26, 32, 36–38

**TRS** - Total Return Swap - An agreement where one party is compensated for all losses but also loses all gains associated with a reference asset. 13, 14, 22, 38, 40

# Acronyms

**ABS** Asset-Backed Security. 38

**BOPM** Binomial Option Pricing Model. 17, 25, 26

**CAPM** Capital Asset Pricing Model. 20

**CME** Chicago Mercantile Exchange. 4

**CPI** Consumer Price Index. 4

**FVV** Future-Value-to-Value. 13, 14, 22, 23, 26, 32

**ITM** In-the-money. 24, 25, 38

**ITV** Insurance-to-Value. 6, 13, 14, 18, 19, 22, 23, 26, 32, 40

**LTV** Loan-to-Value. 13, 14, 19, 22, 32, 38, 40

**MIBS** Market Insurance Backed Security. 1, 26–28

**MPT** Modern Portfolio Theory. 1, 29, 38

**OTC** Over the Counter. 30

**OTM** Out-of-the-money. 24, 36

**SCB** Central Bureau of Statistics in Sweden (Statistiska Central Byrån). 8, 41, 42

**SPV** Special purpose vehicle. 26, 30

**TRS** Total Return Swap. 29, 31, 32

**YTM** Yield-To-Maturity. 20, 21

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