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Hedging House Price Risk in Norway

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Content

1. Introduction

During last years, housing prices in Norway are steadily increasing, which makes the homeowners wonder: when will the prices go down, significantly reducing the value of owner-occupied houses? In the light of house price risk, homeowners may be willing to hedge themselves against price fluctuations. In 2006, CME acknowledged the necessity of hedging house price risk and introduced housing derivatives (futures and options). Betrus et al. (2008) and Schorno et al. (2014) examined the effectiveness of established housing futures for Las Vegas and concluded that CME futures were not that successful in mitigating house price risk. We decided to perform the similar analysis as in Betrus et al. (2008) and Schorno et al. (2014) but for Oslo. The question we want to investigate is whether it is possible to effectively hedge house price risk in Oslo using housing futures (and whether it is necessary to introduce housing derivatives in Norway).

The preliminary report is structured in the following way. After the introduction in Section 1, in Section 2 we present the overview of the existing studies about hedging house price risk using different hedging instruments. Section 3 consists of the methodology part and shows how we are going to perform our analysis. Finally, Section 4 presents the description of the data that will be used in the research.

2. Literature review

The importance of hedging house price risk

According to TradingEconomics.com, the homeownership rate in Norway in the beginning of 2017 was 82.7%, which is one of the highest in the world. This means that more than 80% of Norwegian residential real estate is owner-occupied. Homeowners buy houses for many reasons, mostly to have a place to live that corresponds to their tastes and needs (Englund, Hwang, & Quigley, 2002) or to protect themselves from rent fluctuations (Sinai & Souleles, 2005). No matter what reasons for the house purchase are, the result for homeowners is that the house begins to constitute a large portion of their investment portfolio. And when the price of housing falls, the value of this portfolio falls as well. Therefore, to secure homeowners from housing price fluctuations various instrument can be used, and in the following sections we will look at different studies those examined the effectiveness housing derivatives.

Introduction of housing derivatives

According to Jud & Winkler (2009), there were several attempts to start trading derivatives on real estate. In November 1990, the Chicago Board of Trade (CBOT) together with economists Case, Shiller, and Weiss evaluated the possibility to launch home-price futures. However, after finding out that people were more likely to sell such futures rather than to buy them, the CBOT decided not to start the project. In 1991, the London Futures and Options Exchange (FOX) began trading real estate futures. But the market for housing futures was shut down in October 1991 due to low demand for trading. Before 2006 there were also minor attempts to launch real estate futures; however, they all failed due to the same reasons: low trading volumes.

In 2006, Chicago Mercantile Exchange (CME) launched housing futures and options based on the S&P/Case-Shiller Home Price Index. The Index was first created in 1980s by Karl E. Case and Robert J. Shiller. Economists invented the Index for the purpose of measuring the average change in home prices for single-family housing. According to S&P CoreLogic Case-Shiller Home Price Indices Methodology (2017), the Index measures price changes given the constant level of housing quality and uses 'repeat sales method' of index calculations, i.e. only houses those were sold at least twice are included into Index calculation sample.

Hedging house price risk with CME futures

After the introduction of CME housing futures in 2006 many scientists decided to investigate the question of effective hedging with the newly available derivatives. Among the first ones to discuss this issue were Bertus, Hollans, & Swidler (2008). They consider hedging from the point of view of portfolio investors, real estate developers, and individual homeowners. The authors compare the effectiveness of two strategies: naïve one with hedging ratio equal to 1 and the minimum variance hedge strategy. For the period before the introduction of CME futures Bertus et al. (2008) use returns on S&P/Case-Shiller Home Price Index as a proxy for futures returns. The results show the overall hedging effectiveness of 89%. In addition, Bertus et al. (2008) indicate that for individual homeowner's beta is not statistically different from 1; therefore, hedging with the naïve strategy could be, surprisingly, quite successful. However, authors indicate a couple of limitations of their analysis. The first limitation is the data since it was taken for the period from 1994 to mid-2006. High effectiveness of hedging strategies should also be verified with the data from the crisis of 2007-2009. The second limitation concerns the number of used strategies and the hedging horizon. According to the authors' findings, hedging beta changes over time, which indicates that the analysis should focus on not only static but also dynamic strategies. Moreover, the authors consider the hedging horizon of one quarter; however, homeowners are exposed to price risk for much longer terms (e.g. 5-7 years).

Another article "Hedging house price risk with futures contracts after the bubble burst" by Schorno, Swidler & Wittry (2014) extends the existing literature in managing house price risk and covers the period 2006-2011. While the earlier paper by Bertus et al. (2008) considers only naïve and static hedging strategies, Schorno et al. (2014) analyzes the hedging effectiveness of the CME futures using forward-looking and conditional hedging strategies, which rely on market information to update a quarterly hedge ratio. The forward-looking strategies they test are rollover minimum variance and rollover conditional OLS strategies using a five years of data sample from just prior to the hedge horizon to construct the minimum variance hedge ratio. Following Bertus et al. (2008), the authors use returns on S&P/Case-Shiller Home Price Index as a proxy for returns on futures for the period before CME housing futures were available (before 2006). After 2006, Schorno et al. (2014) use directly futures returns, which is a big improvement compared to previous study. The authors test in total four different strategies with different results. The strategies tested are two strategies from Bertus et al. (2008), which are a simple naïve and a static minimum variance strategies, and two forward-looking strategies. Having used house price index as a proxy for futures returns authors conclude that the best hedging strategy is the rollover minimum variance, while the worst is the static minimum variance strategy. However, when the realized futures returns replace the index returns, the performance of all strategies is quite poor, which is likely due to illiquid market of CME housing futures. Interestingly, Schorno et al. (2014) find that the naïve strategy may have been the best approach to manage systematic risk given the difficulty of implementing the other strategies (i.e. homeowners need to monitor constantly the change in housing price to adjust their position in housing futures) combined with their low hedging effectiveness.

Other hedging instruments

In addition to the hedging strategies proposed by Bertus et al. (2008) and Schorno et al. (2014) other articles have also looked at other possible ways to hedge housing prices. Alternatives could be index-linked mortgages (Syz, Vanini, & Salvi, 2008), structured swaps (Fabozzi, Schiller, & Tunaru, 2009) or commodity futures that have high correlation with housing market (Hinkelmann & Swidler, 2008).

Fabozzi et al. (2009) look at three different types of structured swaps used in real estate market in the United Kingdom in relation to managing housing risk. These are balance guaranteed swaps, a cross-currency balance guaranteed swap and a balance guaranteed LIBOR-base rate. Unfortunately, there are many problems related to the design of all these swaps. In balance guaranteed swaps, the collateral coupon leg is paid at the end of the period and mortgage payments are collected every day in the period on a continuous basis. This creates a prepayment risk for the writer of the swap since payments are not done at the same time and it could be a big problem if interest rates are fluctuating. Because of this prepayment risk balance guaranteed swaps are often extremely expensive and very rare in practice. Also since the reference floating rate is three-month LIBOR, there is a basis between the reference three-month LIBOR collected monthly from the swap and the same reference three-month LIBOR paid quarterly to the note holders that funded the securitization. This basis risk will not be large as long as interest rates are stable but could create uncertainty for the home owners since the interest rates for the paid and collected amount will not be exactly the same. This means we have an imperfect hedge. Lastly, these types of products can become very complicated and difficult to understand for a private consumer with little or no experience in financial markets.

Index linked mortgages as proposed by Syz et al. (2008) is a much easier way to hedge for individuals than swaps and they are tailor made for retail consumers. Syz et al. (2008) use data from 1985-2005 and 5-year index linked mortgages. The basic idea of this type of hedge is to link the mortgage to a house price index so the interest payments and/or the principal are linked to the underlying index movements. The mortgage is therefore no longer an interest rate but a house price derivative. If the index drops, you will pay lower interest or price decrease is directly subtracted from the mortgage’s principal at maturity. Either way the volatility is reduced. Therefore, this type of property derivative reduces the homeowner's exposure to house price risk while reducing the credit risk exposure of the bank through asset-liability immunization.

Lastly, other articles have also looked at existing commodity futures and found a commodity that correlates with the house index (Hinkelman & Swidler, 2008). They used commodity future prices from 1983q2 to 2005q4 to examine whether existing futures contracts can effectively be used to offset volatility in national house prices. For this hedging strategy to work there needs to be a high correlation between the house prices and a portfolio of futures prices. Examples of futures could be currency, metal, energy, interest rate and grain to mention some. In Hinkelman & Swidler (2008), they tested 31 different futures and found only the British Pound and Platinum to be statistically significant for hedging house prices in the US market.

General problems with housing derivatives

Some scientists wonder whether it is optimal to use S&P/Case Shiller Home Price Index as the underlying for housing derivatives. Nagaraja, Brown, & Wachter (2010) point at some disadvantages of using repeat sales methodology in Case-Shiller Index. Firstly, only small amount of houses was sold more than once; therefore, according to authors, repeat sales indices are constructed based on very small and unrepresentative sample. Secondly, all houses depreciate over time; so, there is actually no repeat sale of the same house, which violates one of the basic assumptions of the Index methodology (the constant level of house quality). In addition, Dröes & Hassink (2013) state that house price indices cannot be used to measure house price risk due to the fact that the indices underestimate the idiosyncratic volatility of home prices. They perform the analysis for the Netherlands and show that the idiosyncratic variation in house prices is more than 85%. Therefore, according to authors, housing futures those use house price indices as the underlying provide good hedge only for the market risk of house prices, while the idiosyncratic component of the risk remains too high.

One major overall concern is the liquidity of the market for housing derivatives. In the US, the initial response to CME housing futures has been moderate and daily volume has been small. Cao & Wei (2010) argue this was because of absence of sufficient valuation models. Although real-estate derivatives should be preferred to insurance-type contracts because of direct settlement, the liquidity of housing derivatives is key to their use by individuals and professional asset managers. The problem is that liquidity can only be established after financial institutions decide to be more active in the housing derivative markets, as suggested by Case, Shiller, & Weiss (1993). The success of the housing futures depends upon whether they serve the needs of hedgers as well as speculators, and according to Hinkelman & Swidler´s (2008) analysis, hedgers may not be able to effectively manage their risk unless their geographic portfolio weights largely replicate those in the futures index that they are using since house prices vary a lot even within the same city. This means that if we own a house in a specific part of the city, we must ensure that our housing futures replicate this area and not an average of the city. This creates a problem both for the creation of futures as we would need specific futures for every district and a liquidity problem since the number of buyers will be drastically reduced compared to city level or national futures.

According to De Jong, Driessen, & van Hemert (2007) hedging with CME futures have little benefit for homeowners. Mainly this is due to large idiosyncratic variation in house prices. This is because CME futures use S&P/Case-Shiller house price index as the underlying; however, this index is a city-level index; therefore, CME futures cannot fully hedge the risk of individual home price change. This is called basis risk and arises when there is imperfect correlation between two investments and this creates the potential for excess gains or losses in a hedging strategy, thus adding risk to the position (Investopedia.com, 2018).

There is also another basis risk for hedgers since there is no simple adjustment factor to housing futures prices. All these factors imply ineffective hedging and investors will not use the housing derivatives to manage housing risk. Therefore, it appears that the success of home price futures contracts hinges upon whether there is significant hedging activity, which, in turn, is dependent upon whether the derivative contracts can be used to effectively hedge house price risk.

3. Methodology

In our analysis we will follow the methodology described in Bertus et al. (2008) and Schorno et al. (2014). We will evaluate the effectiveness of hedging house price risk with housing index that is constructed as the arithmetic repeat sales price index. The methodology of constructing such an index in described in Shiller (1991).

Arithmetic Repeat Sales House Price Index

First, we define the matrix of instrumental variable Z, where Z_{it} equals

a) -1 if house *i* was first sold at time *t;*

b) 1 if house *i* was sold for the second time at time *t*;

c) zero otherwise.

Then we define matrix of independent variables X and the vector of dependent variable Y, where

$$X_{it} = P_{it}Z_{it} \; for \; t = 1,2,\dots,n$$

$$Y_{it} = P_{it}Z_{it} \; for \; t = 0,$$

where P_{it} is the price of house *i* at time *t*.

By regressing Y on X, we obtain the vector of coefficients $\gamma = (Z'X)^{-1}Z'Y$, where $\gamma_t = \frac{P_0}{P_t}$.

Finally, we calculate the house price index with the formula

$$Index_t = \frac{1}{\gamma_t} \qquad \text{(Eq.1)}$$

Static Hedging Strategies

To estimate the hedging effectiveness we will start by running the following regression:

$$S_t = \alpha + \beta F_t + \varepsilon_t, \qquad \text{(Eq.2)}$$

where S_t is the percentage change on median house price at quarter t,

F_t is the percentage return on house price index at quarter t,

α is the constant regression parameter,

β is the regression slope coefficient for the risk minimizing hedge,

ε_t is the error term.

Since we do not have housing futures in Oslo, we will assume, similar to Bertus et al. (2008) and Schorno et al. (2014), that returns on repeat sales housing index are the good proxy for housing futures returns.

Based on equation 2, we will estimate the effectiveness of four hedging strategies:

1) a simple naïve strategy with β equals to 1 during the entire life of the hedge;
2) a static minimum variance hedge with $-\beta$ as the position in the housing index and this position does not change over time;
3) rollover minimum variance;
4) a rollover conditional OLS strategy.

The hedging horizon we will consider is 5 years, Schorno et al (2014).

For strategies 1 and 2 the effectiveness of the hedge can be estimated as the regression R^2, since the determination coefficient shows how much variance of the dependent variable is explained by the independent variable, i.e. how good house price index is in eliminating house price risk.

Rollover Minimum Variance Strategy

Equal to the static minimum variance strategy the rollover minimum variance strategy also uses five years of data from just prior to the hedge horizon to construct the minimum variance hedge ratio. However, the rollover strategy uses this hedge ratio only for the first quarter of the hedge and then rolls forward to the next successive window to estimate the hedge ratio for the second quarter of the hedge. As an example, if we want to look at hedging in the period 2011q1 to 2016q1, we first use data from 2010q4 back to 2005q4 to find the hedge ratio for 2011q1 then roll over and find hedge ratio for 2011q2 using the period 2011q1 back to 2006q1 and so on. Following a rollover strategy like this means you constantly rebalance and should maintain a more optimal hedge ratio throughout the hedging period. One additional risk with a rollover strategy is roll-over risk, the risk of rolling over at an unfavorable price.

Rollover Conditional OLS Strategy

We follow Miffre (2004) when implementing the conditional OLS strategy and like them assume a linear relationship between β_t and a set of mean zero information variables Z_{t-1} which are available at time t-1. We have the following specification for β_t:

$$(\beta_t|Z_{t-1}) = \beta_0 + \beta_0 Z_{t-1}, \qquad \text{(Eq.3)}$$

where β_0 is the mean hedge ratio and $\beta_1 Z_{t-1}$ is the deviation from β_0 as new information is known in the market, measured through the information variables. If we substitute the time dependent ($\beta_t | Z_{t-1}$) into eq. 2 we get the following formula:

$$S_t = \alpha + \beta_0 F_t + \beta_1 Z_{t-1} F_t + \varepsilon_t, \qquad \text{(Eq.4)}$$

where S_t and F_t are identical to those in Equation 2. We then see that if there is no new or meaningful information in the market at time t the vector of parameters β_1 is jointly equal to zero and the conditional OLS reduces to the traditional OLS model we see in equation 2.

Our set of information variables are based on Jacobsen & Naug (2004), where they find (1) interest rates, (2) unemployment, (3) household wages, and (4) new housing built to be the most important factors in Norway to drive housing prices.

4. Data review

In order to follow the methodology from "Hedging house price risk with futures contracts after the bubble burst" by Schorno, Swidler, & Wittry (2014) we have collected house price data from Norwegian Statistical Bureau (Statistisk Sentralbyrå, 2017) and Ambita AS. The Norwegian Statistical Bureau is the national statistical institute of Norway and the main producer of official statistics. They are responsible for collecting, producing and communicating statistics related to the economy, population and society at national, regional and local level. Ambita AS is a Norwegian technology company specialized in housing data and fully owned by The Ministry of Trade, Industry and Fisheries.

From SSB we got the house price index for Oslo (Statistisk Sentralbyrå, 2017) and this is S_t in our regression, and from Ambita we got an Excel sheet with over 400.000 house sales price, the date of the sale and a unique identification number for each house so we could construct our repeat sales index following Shiller (1991). This index will then be the F_t in our regression (equation 2).

The house price index from SSB is a quarterly index with data going back to 1992q1 and the dataset from Ambita is 1993-2017. The fact that we have data going back 24 years gives us a better chance to see how the hedging effectives will be over time and especially in times of recession like the financial crises 2007-2009.

The quality of the data is also an important part of the analysis. Both "The Norwegian Statistical Bureau" and "Ambita AS" is fully owned by the government and provides official housing prices that are reported after a sale. This makes our results more trustworthy knowing that the underlying data is of high quality.

In the Rollover Conditional OLS Strategy we also need data about (1) interest rates, (2) unemployment, (3) household wages and (4) new housing built since these are the most important factors to determine housing prices according to Jacobsen (2004). Data about interest rates in Norway are obtained from "Norges Bank" (Norges Bank, 2018) and goes back to 1991, updated monthly. The unemployment rate is downloaded from SSB (Statistik Sentralbyrå, 2018) and is updated quarterly since 1997q1. Household wages are also downloaded from SSB, but there is only yearly statistic available in the period 1990-2016 (Statistisk sentralbyrå, 2018). Lastly statistic about new housing built is also found on SSB on a yearly basis from 2006-2017 (Statistik Sentralbyrå, 2018).

In order to make our data comparable we need to convert all the data into the same time unit, and we have chosen quarterly. We already have the house price index and unemployment rate on a quarterly basis but we need to convert interest rates, household wages, and housing built from yearly data to quarterly data. Since we have yearly nominal interest updated monthly from "Norges Bank" we will use this to go from yearly to quarterly. This is done by taking an average of the yearly rates for every month in the quarter, and then raising one plus this average rate to the power of ¼. For example, if interest rates in January, February, and March are 1.3%, 1.2%, and 1.5% respectively, the quarterly rate would be:

$$(1 + ((0{,}013 + 0{,}012 + 0{,}015)/3))^{0{,}25} = 1{,}0033 = 0{,}33\%.$$

For the household wages and housing build it is reasonable to believe that this, on average, will be linear through the year and we can therefore take the yearly figure and divide by four to go from yearly to quarterly data.

The descriptive statistics for house price index, interest rates, unemployment rates, household after-tax income, and new housing built is presented in Table 1.

Table 1. Descriptive Statistics

	House price index*	Interest rate, %	Unemployment rate, %	After-tax income, NOK	New housing built
Mean	54.46	3.95	3.59	391778	311776
Standard Error	3.01	0.14	0.07	15148	3470
Median	49	3.50	3.50	373200	311214
Standard Deviation	30.43	2.53	0.63	78709	12020
Kurtosis	-0.60	-0.76	-0.73	-1.56	-1.12
Skewness	0.47	0.50	0.10	0.17	-0.09
Minimum	12.80	0.50	2.40	289500	292414
Maximum	128.90	10.87	4.90	508800	329358
Count	102	323	83	27	12

* 2015=100 in level

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