U21Global

Working Paper

No. 013/2005

House Price Risk – Some Risk Management Strategies

Max Neukirchen & Helen Lange

October 2005

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Graduate School For Global Leaders

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Max Neukirchen, McKinsey & Company
Max_Neukirchen@mckinsey.com

Helen Lange, Universitas 21 Global, Singapore [1]
hlange@u21global.edu.sg

ABSTRACT

As property is the most valuable asset for many home owners, house price risk is relevant to a large number of households. Two factors impacting this risk are the high leverage on the assets and the volatility of housing prices. This paper discusses different strategies for house price risk management in a three-step approach. First, eleven risk management strategies are introduced and discussed, focusing on the relevant literature and industry practice. Second, four basic risk management strategies (risk avoidance, risk retention, direct hedging and indirect hedging) are introduced and compared with respect to their hedging efficiency. Finally, the success probabilities of the remaining seven strategies, all specific direct hedging strategies, are evaluated. The paper finds that there are a large number of risk management strategies that can be employed to manage house price risk. However, not all of them are available in the financial markets. Of these, the paper finds that the direct hedging approaches are the most effective, and of these, index linked home value insurances and reinsurance receive the highest success possibilities in primary and secondary markets, respectively.

1. INTRODUCTION

In most developed countries, property is the single most important asset of private households. For example, in Germany, property makes up 44% of the total asset volume held by private households (Sander, 2005); and in the US and Australia, real estate represents around half of total private wealth (Harris, 2003; Reserve Bank of Australia, 2004). These numbers emphasise the relevance of housing prices for private households. Most households finance property ownership by mortgages, which lead to high asset leverage. High leverage makes households particularly vulnerable to credit defaults when the asset value declines.

Additionally, housing prices have significant impact on the performance of economies as a whole. Case, Quigley and Shiller (2001, p. 15) state: "We do find strong evidence that variations in housing market wealth have important effects upon consumption [and savings]." They are therefore not only relevant for current and future home owners, but also for real estate agents, banks, other financial institutions and also for the entire economy through consumption effects.[2]

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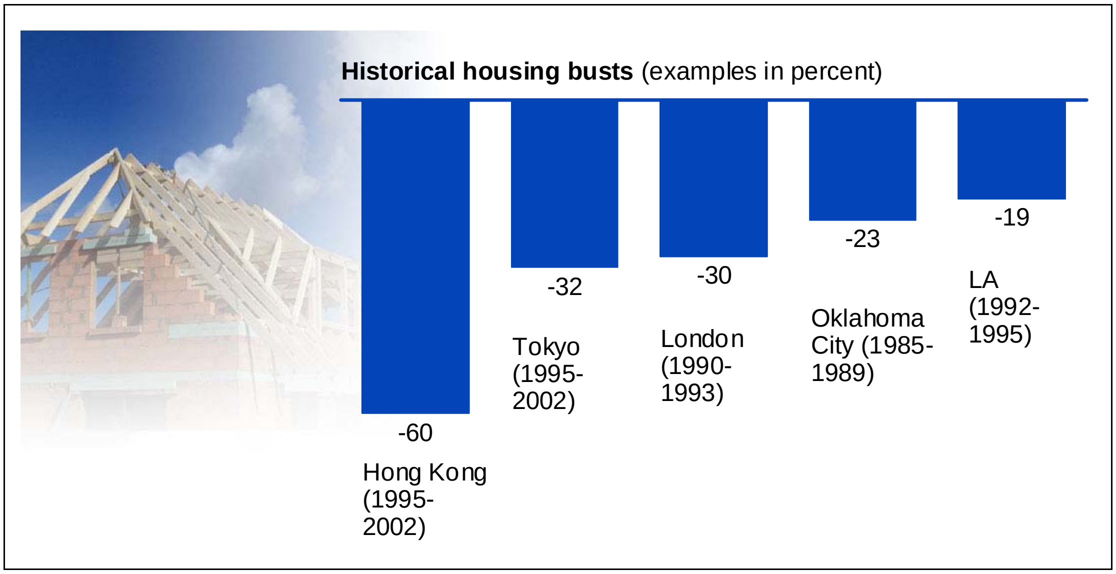
[1] Helen Lange is Associate Professor of Finance, and Director, MBA Program at Universitas 21 Global.
[2] Case, Glaeser and Parker (2000) show the large influence of the development of the housing market on the entire economy in the United States especially on consumer spending. McCarthy and Reach (2004) look at economic consequences of a bubble in housing prices (Stiglitz, 1990).

House price volatility can be significant in specific markets. The number of substantial declines in different housing markets around the world in recent years shows the large risks associated with property assets (Figure 1). The burst of a house price bubble can have devastating consequences for the property owners. Shiller (1993, p. 81) writes about the volatility of housing prices and the resulting risk and suggests that: "Speculative booms and busts in residential real estate markets are potentially more damaging than those in financial markets, in that the participants usually have much of their wealth concentrated in that local market and may be highly leveraged through their mortgages."

After the surge of housing prices in many countries (especially in Australia, the US, and Britain) since the late 1990s according to the *Economist House Price Survey* (Economist, 2005), more and more market participants point to the parallels to the internet stock crash in 2000, ask for the underlying substance of the price increase and estimate the economic impact of a potential bubble burst on the housing markets (Economist, 2004). Figure 1 provides a diagrammatic representation of recent spectacular housing price busts five cities. The 1995 to 2002 house price falls in Hong Kong property prices of 60 percent, represent the greatest of these.

Figure 1: Historic housing market busts



Source: McKinsey

The risk management infrastructure to deal with house price risk is often under-developed. Only limited financial instruments are available to diversify house price risk. The literature quotes a number of reasons for the lack of risk management opportunities (for example, Neukirchen, 2005) ranging from the high complexity and volume of the risk transfer to missing risk awareness among the risk bearers. In addition, the financial services industry experienced several setbacks in attempts to establish house price risk transfers, including the Chicago Board of Trade's unsuccessful attempt to introduce option trading on real estate indices (Patel, 1994) and the failed project of the London Futures and Options Exchange to set up index-linked future contracts for residential housing prices (Shiller, 2003).

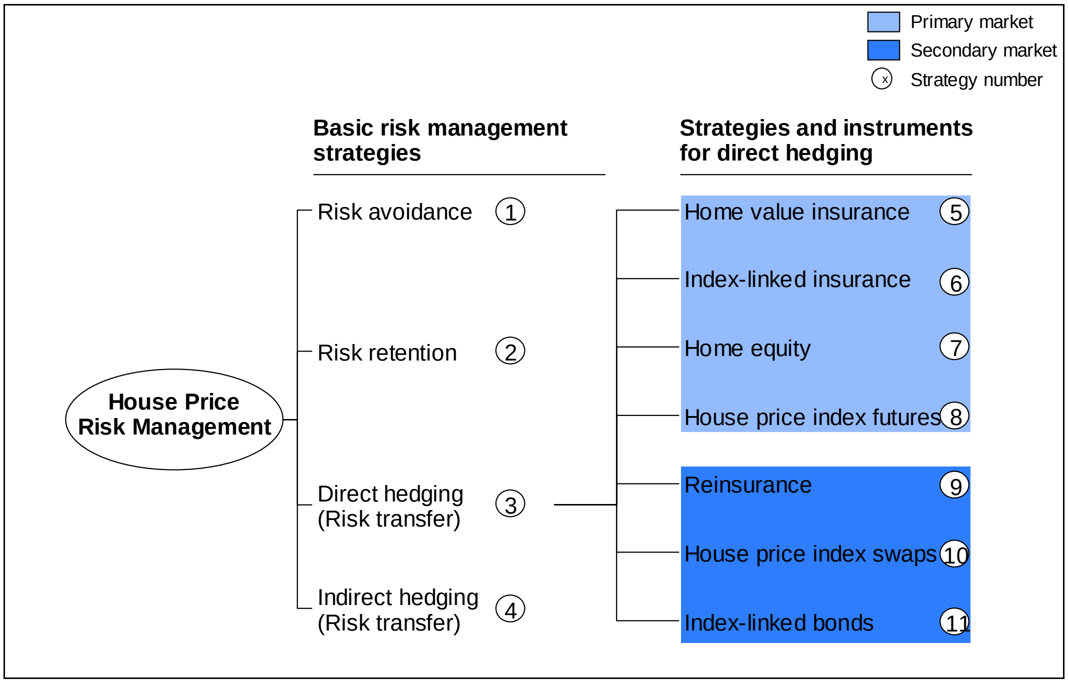
It is the goal of this paper to characterize and to compare different strategies for managing house price risk qualitatively and quantitatively. Through this, an overview of current opportunities and challenges for diversifying house price risk is also generated.

The paper is organized as follows. Section 2 identifies and discusses the key risk management strategies potentially available to home owners to manage their house price risk. In Section 3, the method and data used to examine the effectiveness of the four basic strategies of house price risk management (risk aversion, risk retention, direct hedging and indirect hedging), and the comparison of seven different direct hedging strategies for house price risk management, is discussed. Sections 4 and 5 report the results of the studies of the basic and the direct hedging strategies discussed in Section 3, and the paper is concluded in Section 6.

2. 11 STRATEGIES TO MANAGE HOUSE PRICE RISK

The discussion in this section is based on recent literature and also current financial services industry practice. Researchers discuss a number of strategies to deal with house price risk. Some of these are outlined in Figure 2 which provides an overview of the 11 different strategies assessed in this paper. On a basic level, four risk management strategies can be identified: risk aversion, risk retention, direct hedging and indirect hedging. For direct hedging of house price risk, seven strategies based on four financial instruments for the primary market and three instruments for the secondary market are compared, making up the 11 risk management strategies covered in this paper. Although some of these strategies are not yet available in financial markets, all eleven strategies are discussed extensively in the literature. In this section, the 11 strategies are outlined.

Figure 2: Overview of house price risk management strategies



2.1. Risk avoidance (S1)

Risk avoidance is the first house price risk management strategy (Rejda, 1998). Risk avoidance implies that all the risk exposure is eliminated in the first place. Realization of this strategy means that the property is sold. Risk avoidance is the most basic risk management approach. However, this strategy is not discussed extensively in this paper, as it does not require any risk management.

2.2. Risk retention (S2)

The second basic strategy for dealing with house price risk is *risk retention* (Rejda, 1998; Elliot, 2000). Risk retention is a passive strategy, because the risk bearer simply holds on to the asset at risk and is fully exposed to the consequences. No additional risk management measures are taken. Risk retention is currently the most commonly used strategy for house price risk. Most home owners do not use any active risk management strategies and fully bear the exposure in their portfolios.

2.3. Direct hedging with risk transfers (S3)

Direct hedging is the third basic risk management strategy. Direct hedging means that the risk bearer manages respective exposures by directly transferring the risk to a third party (Mason, Merton, Perold and Tufano, 1995). This section directly addresses a specific volatility. Figure 2 shows that there are a number of sub-strategies to direct hedging in combination with house price risk. These alternative strategies are presented below in 2.5 to 2.11.

2.4. Indirect hedging with risk transfers (S4)

The fourth basic risk transfer strategy is *indirect hedging* (Mason et al., 1995). Similar to direct hedging, indirect hedging is an active strategy. However, in many cases there are no financial instruments or opportunities for direct hedging available. This is especially true for house price risks where the risk management infrastructure is still underdeveloped. Indirect hedging means that the underlying drivers of a certain risk are hedged rather than the risk itself. House price risk serves as an example. Often, no derivatives are available for hedging transactions based on a house price index. However, derivatives are available for some of the potential underlying risk drivers (for example, interest rates or the stock exchange index). Indirect hedging strategies use derivatives on the risk drivers to hedge at least some part of the risk.

2.5. Home value insurance (S5)

Shiller and Weiss (1999) introduce the concept of *home value insurance*. Home value insurance involves an insurance contract written on the estimated value of a house for a certain duration. If the property is resold and yields a lower price than estimated, the difference is paid out by the insurer to the previous owner. The advantage of this strategy is its transaction simplicity, although the home value appraisal requires some effort. Shiller and Weiss (1999) point to some difficulties involved with such insurance schemes. First, there is a moral hazard problem because home owners lose their incentives to maintain their houses and to achieve high selling prices. Additionally, there may be a selection bias when only those home owners enter insurance who anticipate devaluations. The cancelability of insurances under strategic considerations of the home owner and the missing transferability of insurance policies are further potential limitations. To reflect these difficulties, Shiller and Weiss (1999) propose several modifications. One is that actual value losses are only partially recovered or that the insurance pays out refunds only below a certain floor to reduce but not to remove the risk seller's exposure. Another concept suggested by Shiller and Weiss to avoid speculation are "Life-event-triggered insurance policies", which pay only in cases of (rare) life events (such as an unexpected move to a different area or death).

2.6. Index-linked home insurances (S6)

To better control the moral hazard problem in home value insurance, the concept of *index-linked home insurances* was developed (Shiller, 1993; Shiller and Weiss, 1999). The payout of index-linked home insurances depends on a local house price index rather than the actual value of a specific property. Because individual transactions have little impact on the local house price index, the moral hazard problem is reduced. On the other hand, the basic risk of the insured home owners increases: the index does not necessarily reflect the price development of a specific home. In addition to moral hazard, more granular indices create smaller, less liquid markets. Most other features of traditional home insurances may also be used in connection with index-linked home insurances.

2.7. Home equity conversions (S7)

Home equity conversions are another group of house price risk management strategies. The general idea with home equity conversions is to treat the debt-free part of a property's asset value as equity. This home equity and its associated asset value risk may be transferred or sold to financial intermediaries in exchange for cash similar to equity shares in large corporations. Together with the assets, some of the associated risks are transferred. Chinloy and Megbolugbe (1994) and Manville (2003) discuss three home equity conversion instruments: (i) reverse mortgages, (ii) residentially secured loans, and (iii) shared appreciation mortgages.

Reverse mortgages are a product for elderly individuals who receive cash (in form of a one-off payment or annuities) for transferring their home equity to a financial institution. The property is sold and the money is paid back to the lender in case the reverse mortgage taker moves out or dies. As the loan is non-recourse, the property value is the only collateral and the lender bears the risk of the asset value.

While reverse mortgages are a product for elderly people (there are often restrictions limiting the offer to a certain minimum age), other home equity loans apply in a more general context. In residentially secured loans, a part of the home value is passed to the lender in form of equity in return for the loan. If the borrower defaults, the lender can sell the property, but thus bears the house price risk.

Shared appreciation mortgages are a third type of home equity conversion. A shared appreciation mortgage is a mortgage at cheaper conditions (for example, interest-free). In return, the mortgage lender receives a share of the property's value appreciation, but also bears the risk of house price declines.[3] In this case, it is not the existing equity but the retained earnings, which is transferred. Shiller and Weiss (2000) point to some of the difficulties associated with home equity conversions, especially the moral hazard issue, which is also observed with home value insurances.

2.8. Index-linked derivatives, Part 1 (S8)

Index-linked derivatives are the fourth group of financial instruments for the primary market. The direct hedging strategies discussed so far (S5 to S7) were institutionally-based, often in the form of customized contracts between a home owner and a financial institution. House price derivatives are for the retail market and are traded on exchanges. To allow for the required level of standardization, derivatives which can be used to hedge house price risk are based on house price indices (HPIs) as the underlying asset (Case et al., 1993). Shiller et al. (1999) discuss some challenges in the use of derivatives to hedge house price indices. For example, typically, home owners require long maturities to cover their exposures. Further, due to house price inertia, it is more difficult to price HPI derivatives: for example, the value of an option does not only depend on the current index value, but also on the trend.[4]

HPI-linked derivatives are studied in several articles (especially Case et al., 1993). In the UK and in the US, several attempts to establish continuous exchanges for HPI-linked derivatives were carried out, but most were not successful.[5]

2.9. Index-linked derivatives, Part 2 (S9)

After discussing the four direct hedging risk management strategies based on financial instruments for the primary house price risk market (S5 to S8), the focus now turns to three strategies to manage house price risk on the secondary market.

HPI-linked derivatives are not only suitable for the primary market but also a possible instrument for a secondary market strategy (Case et al., 1993). Finance professionals are more familiar with derivatives than most retail customers. For risk transfers between financial institutions, other types of derivatives based on an underlying HPI can be established (for example, customized OTC contracts or HPI swaps) because of the larger transfer volumes and the greater expertise of the market participants.

2.10. Structured investment vehicles (S10)

Using *structured investment vehicles* is another strategy for the secondary market. In their typical form, structured investment vehicles pool a risk exposure, securitize it with a predefined payment scheme and sell it on the capital markets.

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[3] Shared appreciation mortgages were introduced by the Bank of Scotland in the late 1990s in the US (Shiller and Weiss, 2000); UBS launched a similar program in Australia at the end of 2004 (Garnaut, 2004).

[4] Lo and Wang (1995) discuss resulting adjustments to the Black-Scholes formula.

[5] The attempts by the Chicago Board of Trade in the 1980s and by the London Futures and Options Exchange in 1991 (Tschulk, 2004) failed. Goldman Sachs started issuing warrants on the UK house price index in 2004. Several internet platforms also allow bettings on HPI standings that can be used for hedging.

Borensztein and Mauro (2002) discusses the example of governments issuing bonds whose coupon payments depend on the country's GDP growth to diversify economic risk. Similarly, catastrophe bonds ("cat bonds") were introduced to share the risk of natural catastrophes in the financial markets (Doherty, 1997; Gorvette, 1999). Cat bond coupon payments depend on the occurrence of natural catastrophes. Large financial institutions could issue bonds in the same way with payment conditions depending on the development of specific house price indices. Structured investment vehicles are particularly beneficial to diversify large simultaneous risk exposures.

2.11. Reinsurance (S11)

Reinsurance is the eleventh strategy to manage house price risk. Shiller et al. (1999) suggest the establishment of reinsurance for house price risk. Structure-wise, house price risk reinsurance would resemble very much existing reinsurance contracts as discussed in Grossmann (1990). Reinsurance has the benefit of further diversifying risk exposures geographically. This is especially helpful in the case of house price risk because initial risk buyers are likely to have locally concentrated portfolios.

3. METHODS AND DATA

Eleven strategies for managing house price risk were introduced and discussed in the previous section. The rest of the paper compares these strategies quantitatively. In this Section, the methods and data used for the comparison are outlined, and the results of the analysis are reported in Sections 4 and 5. Section 4 compares the efficiency of the four basic house price risk management strategies; Section 5 assesses the seven direct house price risk management strategies.

3.1. Effectiveness of four basic risk management strategies for house price risk management

In the second part of the research, the effectiveness of the four basic strategies of house price risk management, identified in Figure 2 and discussed in Section 2, are compared quantitatively based on Monte Carlo simulations.

The Monte Carlo method, encompasses any technique of statistical sampling employed to approximate solutions to quantitative problems.[6] In this paper, Monte Carlo simulation is used to generate random values for house price risk and some underlying drivers to compare the efficiency of the four basic hedging strategies. The random number generation has to fulfill certain side conditions determined by historic value distributions of the simulated parameters. Simultaneously, the correlations observed between the parameters in the data must be reproduced by the random values. The parameters simulated for the strategy comparison in this paper are the house price index, the interest rates, the GDP and the stock price index.

Data used for the quantitative evaluations and model calculations is Australian housing market data. Quarterly data on Australian house price indices and

[6] An article by Bonate (2001) gives an overview of the essential of Monte Carlo simulations. Rubinstein (1981) and Fishman (1996) provide background and theory of the Monte Carlo method.

macroeconomic indicators from 1986 to 2004 is used, and sourced from the Australian Bureau of Statistics.

3.2. Comparison of seven different strategies for direct hedging of house price risk

In the third part of the research presented in this paper, the remaining seven risk management strategies are compared using a risk-transfer-model. The seven remaining strategies are all direct hedging strategies, and are compared using a risk-transfer-model, developed and calibrated by Neukirchen (2005)[7]. The model is used to generate the success probabilities of innovative risk management strategies based on an evaluation of basic risk transfer economics and the evaluation of ten characteristic limiting factors. The Neukirchen (2005) model is designed as a causal expert model and was calibrated by a survey among 24 risk management and finance experts. In this paper, the model is used to illustrate the profiles of the different direct hedge risk management strategies for house price risk management and to calculate their success probabilities.

4. MONTE CARLO SIMULATIONS TO COMPARE RISK RETENTION, INDIRECT HEDGING AND DIRECT HEDGING

Figure 2 differentiates four basic strategies for house price risk management. This section quantitatively compares the efficiency of the three most relevant strategies: risk retention (S2), direct hedging via risk transfers (S3) and indirect hedging (S4) using the example of an Australian typical house price risk exposure. The three strategies are compared over a one-year period ($\Delta t = t_1 - t_0 = 1$ year). Note that the first basic strategy, risk avoidance, is ignored for obvious reasons.

The risk retention strategy (S2) is the acquisition of a property worth \$A1 million at t_0 and its resale at t_1. The direct hedging strategy (S3) is similar to S2, but in addition artificial HPI futures are sold (short) at t_0 and the position is closed at t_1. The indirect hedging strategy (S4) is also similar to S2, but enters balanced positions in interest rate, stock exchange and GDP derivatives in addition to the property transaction. In most countries derivatives on interest rates, the stock market index or the GDP are already available either in exchange traded or over-the-counter forms. Table 1 gives an overview of transactions in the three basic house price risk management strategies.

For S2, it is assumed that the acquired property is fully correlated with the Australian HPI ($\rho = 1$), which is indexed to 100 at $t = t_0$. The distribution of HPI values at $t = t_1$ is assumed to be normal. Its mean and standard deviation are derived from the historic distribution of one-year changes of the Australian HPI changes (1986-2004). House price inertia is not considered in this analysis.

[7] For the derivation and in-depth discussion of the risk-transfer model, refer to Neukirchen (2005).

Table 1: Transactions in basic house price risk management strategies

Strategy	Time	Transaction	Cash flow
S2	t_0	Purchase of property	-$A1 million
	t_1	Sale of property	$A1 million · I_{HPI1} / 100
S3	t_0	Purchase of property	-$A1 million
		Short sell of n HPI futures, maturity at t_1	n · F_{HPI0}
	t_1	Sale of property	$A1 million · I_{HPI1} / 100
		Purchase of n HPI futures to balance position	- n · F_{HPI1}
		Time value of delayed future delivery	$A1 million · 5%
S4	t_0	Purchase of property	-$A1 million
		Short sell of n_1 GDP futures, maturity at t_1	n_1 · F_{GDP0}
		Short sell of n_2 ASX futures, maturity at t_1	n_2 · F_{ASX0}
		Long purchase of n_3 interest rate futures, maturity at t_1	-n_3 · F_{IR0}
	t_1	Sale of property	$A1 million · I_{HPI1} / 100
		Purchase of n_1 GDP futures to balance position	-n_1 · F_{GDP1}
		Purchase of n_2 ASX futures to balance position	-n_2 · F_{ASX1}
		Sale of n_3 interest rate futures	n_3 · F_{IR1}
		Time value of delayed future delivery	(n_1 · F_{GDP0} + n_2 · F_{ASX0} - n_3 · F_{IR0}) · 5%

Strategy S3 includes all transactions of S2. In addition, a hypothetical HPI future is constructed, priced, and traded. The price of an index future (f) is given by Hull (1997, p. 59):[8]

$$f = I \exp((r - q)(t_1 - t_0)) \qquad \textbf{(1)}$$

where I is the value of the underlying index, r is the risk-free rate of return, q the expected index dividend. If one futures contract maps m times the index, the underlying asset value is given by:

$$F = m \cdot f \qquad \textbf{(2)}$$

It is assumed for all futures contracts that m = 500, that the risk-free rate of return is 5% and that t_1 - t_0 = 1. As a result, Equation 1 can be simplified:

$$F = I \cdot 500 \cdot \exp(5\% - q) \qquad \textbf{(3)}$$

[8] Whaley (2003, pp. 1139-1140) specifies the assumptions of the formula. The no-arbitrage principle is valid (two perfect substitutes must have the same price) and markets are frictionless (no trading or transaction costs).

For the house price futures contract, I = 100 at t = t_0 and q = μ = 8.5%. Using the value of F at t = t_0, the number of futures contracts required for the hedge (n) is calculated as n = $A1 million / F. The future price on t = t_1 depends on the respective value of I. Index futures are typically settled in cash (Hull, 1997, p. 61). Therefore, the direct hedging strategy S3 shown in Table 1 does not use the property to close the position. Instead, the position is settled in cash for the price of a new one-year futures position at t = t_1.

The underlying mathematics for index futures equally applies to the indirect hedging strategy S4. Strategy S4 is constructed based on the results of a regression on drivers of the Australian HPI as shown in Table 2. The beta values of the regression are used to determine the weights of the futures on the parameters in the indirect hedge. The analysis finds that GDP growth accounts for 23%, interest rates for 5% and the ASX index for 14% of the total regression beta. Correspondingly, GDP futures cover $A230,000, interest futures $A50,000 and ASX futures $A140,000 of the property value; with the residual amounting to $A580,000.

Futures prices and contract numbers (n_i) are calculated in the same way as in Strategy S3 (Equations 1 and 2). At t = t_0, I = 100 for GDP and ASX futures and I = 10 for interest rate futures. q = 0 for GDP and interest rate futures and q = 5.4% for ASX futures. The values of the three variables are assumed to be normally distributed at t = t_1, with means and standard deviations of one-year changes according to historic data: μ_{GDP} = 103.7, σ_{GDP} = 1.8; μ_{IR} = 9.843, σ_{IR} = 1.546; μ_{ASX} = 105.4, σ_{ASX} = 14.8. To account for the different signs of the regression variables, different hedging actions are taken. GDP growth and ASX changes have a positive sign, so they are sold short at t = t_0. Interest rates have a negative sign in the regression, so a long position is taken at t = t_1. The results are reported in Table 2, which shows that population is the largest economically significant driver of housing prices.

Table 2: Regression results on macroeconomic drivers of housing prices

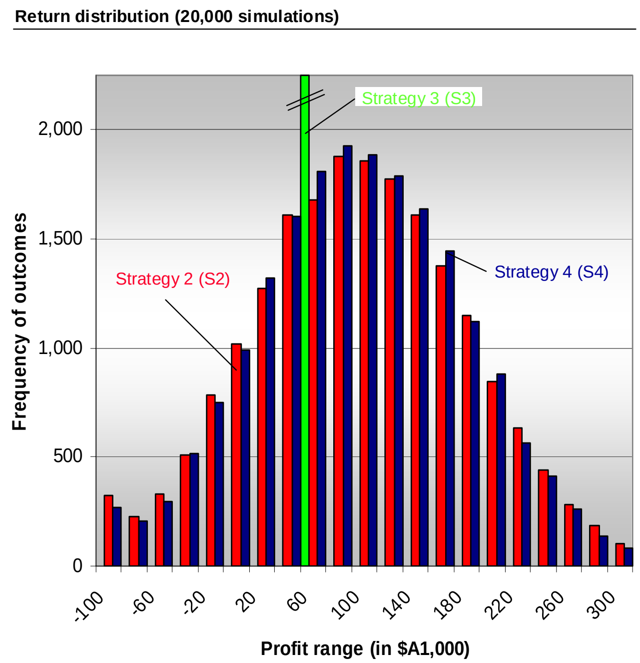
Macroeconomic drivers	Beta value	Significance
GDP	0.359	95%
Household income	-0.213	<90%
Interest rates	-0.070	<90%
Stock prices	0.215	90%
Population	0.519	95%
Completed housing	0.176	<90%

R^2-value = 0.304
Number of datapoints = 52

It is assumed that no transaction costs arise in any of the three hedging strategies. Finally, the time value of money of future positions, which are taken at t_0 and settled at t_1, must be considered. An assumed risk-free rate of 5% is used for this.

The hedging strategies are compared using Monte Carlo simulations. To generate meaningful results, the Monte Carlo simulation generates 20,000 sets of data points of the four parameters at $t = t_1$. Based on the results, the value of the property and the futures are calculated at $t = t_1$ to determine the financial result of each strategy in each case. The spread of the outcomes, their average and standard deviation are then used to compare the three strategies with respect to risk coverage and profitability. Figure 3 displays the outcome of the simulations in a frequency diagram and a table.

Figure 3: Monte Carlo simulation results



Distribution characteristics

Return distribution	Strategy S2	Strategy S3	Strategy S4
Mean (in $A)	84,000	50,000	83,000
Standard deviation (in $A)	85,000	0	82,000

The results shown in Figure 3 confirm the hypotheses on the outcomes of the hedging strategies. The direct hedging strategy with HPI futures (S3) delivers a perfect hedge. The result is $A50,000 in each of the 20,000 simulations, which corresponds to the risk-free time value of the initial property price. Due to the uniformity of the outcomes, there is no risk inherent in strategy S3.

Risk retention (S2) is the riskiest strategy, as it does not use any hedging. The average resulting asset value is $A84,000 with a standard deviation of $A85,000. These results are in line with the HPI return distribution because the property as the only asset is fully correlated with the HPI.

The indirect hedging strategy (S4) yields an average return of $A83,000 with a standard deviation of $A82,000. The typical effects of hedging can be observed: risk and return are reduced compared to strategy S2. The return moves by some amount towards the risk-free rate. The standard deviation is reduced by about $A3,000 expressing the risk mitigation. The difference between the two distributions of S2 and S4 is significant at the 99%-significance level. The typical error of the mean is given by

$\frac{\sigma}{\sqrt{n}}$ with σ as standard deviation and n the number of simulations (Bonate, 2001). The errors are around $A500.

Compared to the direct hedge of strategy S2, the risk reduction through indirect hedging (S4) is comparatively small. This can be explained in several ways. At first, there is no future contract available for population growth in Australia, which is the main HPI driver according to the regression results in Table 2 (beta weight of more than a third). Household income and completed housing as other important drivers are not yet hedgeable either. Second, even with full availability of futures on all indicators, the R^2-value of the regression is 0.304. The R^2-value explains to what extent the regression is likely to predict the HPI values. Only a value of $R^2 = 1$ would mean that the HPI risk can be fully covered by hedging the underlying drivers (under the assumption that future behavior of the indicators resembles the historic behavior). More analysis of the drivers of house price movement, and also more data are required to further improve the regression results and increase the R^2-value.

5. COMPARISON OF DIRECT HEDGING STRATEGIES USING A RISK-TRANSFER MODEL

Section 4 compared three basic strategies for hedging house price risk quantitatively with respect to their hedging characteristics. In this section the focus shifts to the seven direct hedging strategies, which are shown on the right hand side of Figure 2 and introduced in Section 2.

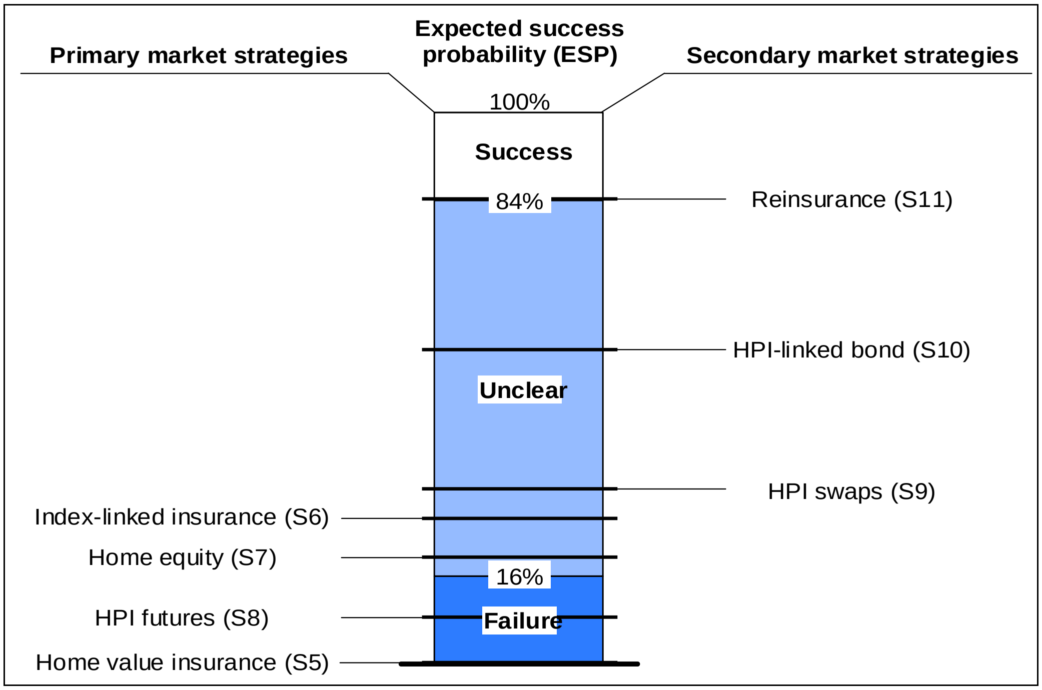
Table 1: Profiles of seven direct hedging strategies

	Risk attributes			Instrument attributes			Agent attributes			
	(Missing) risk seller alertness	Lack of risk transparency	Risk timing and occurence	Product/instrument complexity	(Missing) attractiveness to risk seller	Liquidity/investment motivation	Required risk seller effort	Potential dishones activities	Risk buyer investment situation	Risk buyer default risk
Primary market strategies										
S5 Home value insurance	6	4	5	7	7	6	3	1	2	6
S6 Index-linked insurance	6	6	5	6	5	6	7	6	3	6
S7 Home equity conversion	6	4	4	3	6	4	4	3	4	6
S8 HPI futures	6	7	5	2	1	3	4	6	6	7
Secondary market strategies										
S9 HPI swap	6	6	5	5	4	4	5	7	5	6
S10 HPI-linked bond	6	6	5	3	4	5	4	7	6	7
S11 Reinsurance	6	6	5	6	6	5	6	5	3	5

As most of the direct hedging strategies are still hypothetical, because the underlying financial instruments do not exist yet, it is difficult to assess their effectiveness through observation of the market. To gain better appreciation of the various options available, in this section, a causal risk-transfer-model is used to estimate the success probabilities of continuously establishing these different strategies and thus to estimate their suitabilities for managing house price risk. The risk-transfer-model (Neukirchen, 2005) evaluates risk management strategies along ten typical characteristics of the risk, the risk bearers and the financial instrument as shown in Table 1. For each of the seven strategies (S5 to S11), each of the strategy attributes is evaluated on a 7-point scale[9] by a panel of risk management experts, and the numbers in Table 3 are the result of the expert panel survey.

For home equity conversion (S7), reverse mortgages are used as the example. For index-linked derivatives (S8 and S9), HPI futures are used as example in the primary market and an HPI swap as example in the secondary market. The resulting expected success probabilities (ESP) of the seven direct risk management strategies for house price risk are shown in Figure 4.

Figure 4: Results of risk-transfer model



The four risk management strategies for the primary market are compared for a typical house price risk transaction. Economic capital requirements and transaction costs are estimated for each strategy along benchmarks of risk management strategies for other risks.

The evaluation of the key strategy attributes (limiting factors) in the risk-transfer-model reflects the different characteristics of the strategies. Home value insurance scores high for its simplicity and its attractiveness to risk sellers due to its high correlation with the risk. On the other hand, the moral hazard problem and the issue of simultaneous exposure in case of devaluation are expressed in the low scores for "Potential dishonest activities" and "Risk buyer investment situation".

The index-linked home value insurance features a different profile. The moral hazard problem is largely reduced by linking payments to the index. In return, the

[9] With "1" being the worst grade and "7" being the best grade.

instrument complexity increases. "(Missing) attractiveness to risk seller" also receives a lower score, because a particular property value and the house price index may not be perfectly correlated, which means that the risk is no longer fully hedged.

The attributes of reverse mortgages resemble the profile of home value insurance, although the instrument is perceived as more complex (Szymanoski, 1994). Similar to home value insurance, the risk seller's risk is fully transferred, which leads to the problems of moral hazard and adverse selection. In the US, a state guaranteed mortgage insurance is offered to improve the investor's/risk buyer's investment situation. This characteristic is therefore evaluated quite positively.

HPI-linked futures have a different profile. As standardized market-based instruments, they receive high scores for "Risk transparency" and "Risk buyer investment situation". Disadvantages include the complexity of derivatives especially to retail customers and the reduction of the match between hedge and actual exposure due to standardization. In addition, the HPI-linked future market is illiquid compared to other derivatives, due to the local differences in house price indices. As a consequence, HPI-linked futures score low in these three dimensions.

The different profiles of the four primary market strategies find their expression in the model results shown in Figure 4. Generally, all four strategies receive comparatively low success probabilities between 0% and 23% in the risk-transfer-model. The overall ESP level corresponds to the observation that there are still no important house price risk transfers on most markets. If the establishment of such risk transfers was easy with higher ESP values, house price risk transfers would already be established on a large scale.

From the four instruments, index-linked insurances have the highest ESP of 23%. This strategy is a compromise between the perfection of the hedge for the risk seller and the moral hazard issue of the risk buyer, which results in a balanced limiting factor evaluation. The low evaluation of the "Risk buyer investment situation" still point towards the necessity of establishing a secondary market.

Reverse mortgages have similar economics, but a less advantageous profile in the limiting factor evaluation, which results in an overall ESP of 18%. Despite their low ESP reverse mortgages exist already. However, they are introduced as credit product and not as risk management product. There are additional interest payments in the instrument economics, which are not considered by the model. The remaining two strategies receive ESPs of only 8% (HPI futures) and 0% (home value insurance). In both cases, the basic economics are quite similar to the other two instruments. However, the adjusted transaction costs are significantly higher either because of instrument complexity or because of moral hazard problems.

After four risk management strategies (S5 to S8) were evaluated for the primary market, the risk-transfer-model is used in the next step to evaluate three strategies for the secondary market (S9 to S11). The three strategies for the secondary market are compared based on the economics of a large property portfolio that needs further diversification.

The evaluation of the key characteristics reflect the strategy attributes. The HPI swap scores lower at "Attractiveness to risk seller" and "Liquidity" because it is highly standardized and the market is still small. Compared to the evaluation of HPI-linked derivatives, scores like "Product complexity" receive a higher evaluation score, since finance professionals in the secondary market are more familiar with the instrument. The HPI-linked bond receives lower evaluations at "Product complexity" and "Required risk seller effort" because the setup of such an investment vehicle requires a high degree of structuring skills (Tacke, 2004, p. 14). Reinsurance generally receives the highest evaluations, but scores low on "Risk buyer investment situation", for the reason that it is difficult for the reinsurer to further diversify any assumed house price risks.

Overall, the risk transfer model allocates higher expected success probabilities (ESPs) (31% to 84%) to the strategies for the secondary market relative to those strategies for the primary market. There are two main reasons for this. At first, the average secondary market transaction is larger, which leads to an "economies of scale"-effect. Secondly, limiting factor evaluations are higher because the secondary market is more professional and experienced. Still, existence of a primary market is the premise for the establishment of a secondary market.

Reinsurance receives with 84% the highest ESP of the three secondary market strategies. The result is plausible, as reinsurance is an existing concept applied in a new context. Apart from basic economic considerations, the main problem to overcome is the further diversification of any local house price risks.

The ESP of the HPI-linked bond is 69%. The instrument complexity lets the adjusted transaction costs rise. The HPI swap receives an ESP of 31%. Missing flexibility and liquidity let the transaction costs increase. The result is similar to the primary market: institutions-based instruments receive higher ESPs than market-based instruments. In the categorized model output, all three instruments receive an "Unclear" result. While reinsurance is just at the "Success" threshold and HPI-linked bonds well above the 50%-mark, HPI swaps are closer to the threshold of "Failure". The lower ESP for HPI swaps does not result from a bad evaluation of the limiting factors, but from a smaller benefit from the assumed economics. Different setups with lower transaction costs to attract liquidity and create economies of scale can help to increase the ESP of HPI swaps.

6. CONCLUSIONS

A number of conclusions on the management of house price risk can be drawn from the research presented in this paper.

First, there is a significant number of potential strategies to deal with house price risks, although they are not all available yet in every property market. Nevertheless, financial institutions and researchers conduct a substantial amount of work to design risk management solutions to cover value fluctuations in the most important asset of many households.

Second, from the basic risk management strategies (S1 to S4) direct hedging typically offer the best risk coverage. Nevertheless, the simulation results show that indirect hedging of underlying house price risk drivers is a sensible alternative in case no direct hedges are available. The comparison of the basic risk management strategies focuses on the efficiency side of the hedges and does not consider their costs. This is an opportunity for further research.

Third, the seven direct (and mostly still hypothetical) house price risk management strategies (S5 to S11) have different characteristics, which lead to different success prospects. Main challenges to overcome for their implementation are moral hazard problems, the complexity of the financial instruments and the large volume of highly correlated risks. Index-linked home value insurances and reinsurance receive the highest success probabilities for the primary and secondary markets respectively. The low overall level of expected success probabilities for the house price risk management strategies illustrates the importance of the remaining challenges. The market developments in the next years will show which strategies will become widely accepted by home owners, financial intermediaries and investors.

REFERENCES

Bonate, P. 2001, "A Brief Introduction to Monte Carlo Simulation", *Clinical Pharmacokinetics*, 40(1), pp. 15-22

Borensztein, E. and Mauro, P. 2002, "Reviving the Case for GDP-Indexed Bonds", *IMF Policy Discussion Paper*, 10(02), pp. 1-24

Case, K., Quigley, J. and Shiller, R. 2001, "Comparing Wealth Effects: The Stock Market Versus the Housing Market", *Working Paper*, W8606, National Bureau of Economic Research

Case, K., Shiller, R. and Weiss, A. 1993, "Index-Based Futures and Options Markets in Real Estate", *Journal of Portfolio Management*, 19(2), pp. 83-91

Chinloy, P. and Megbolugbe, I. 1994, "Reverse mortgages: Contracting and crossover risk", *Journal of the American Real Estate & Urban Economics Association*, 22(2), pp. 367-387

Doherty, N. 1997, ""Innovations in Managing Catastrophe Risk", Journal of Risk and Insurance, 64, pp. 743-748

Economist 2004, "Scares ahead – Scares ahead – The World Economy", *The Economist* (London), 2 October

Economist 2005, "Global House Price Survey", *The Economist* (London), 20 April

Elliott, M. 2000, *Risk Financing*, Insurance Institute of America, Malvern (Pa.)

Fishman, G. 1996, *Monte Carlo*, Springer Verlag, New York

Garnaut, J. 2004, "Cheaper homes arrive, at a price", *Sydney Morning Herald* (Sydney), 13 December

Gorvett, R. 1999, "Insurance Securitization: the development of a new asset class", *Discussion Paper*, Casualty Actuarial Society, New York

Grossmann, M. 1990, *Rückversicherung – Eine Einführung*, Institut für Versicherungswirtschaft, Sankt Gallen

Harris, L. 2003, *Trading and Exchanges*, Oxford University Press, Oxford

Hull, J. 1997, *Options, Futures, and Other Derivatives*, Prentice-Hall, Englewood Cliffs (NJ)

Lo, A. and Wang, J. 1995. "Implementing option pricing models when asset returns are predictable", *Journal of Finance*, 50(1), pp. 87-130

Manville, P. 2003, "Taking a Look at Reverse Mortgages", *Business & Economic Review*, 50(1), pp. 18-19

Mason, S., Merton, R., Perold, A. and Tufano, P. 1995, *Cases in Financial Engineering: Applied Studies of Financial Innovation*, Prentice-Hall, Englewood Cliffs (NJ)

Neukirchen, M. 2005, "An Integrated Approach to the Management of Macro Risks", *PhD dissertation*, Macquarie University, Sydney

Patel, K. 1994, "Lessons from the FOX residential property futures and mortgages interest rates futures market", *Housing Policy Debate*, 5(3), pp. 343-360

Rejda, G. 1998, *Principles of Risk Management and Insurance*, Addison-Wesley Educational Publishers, Reading (Mass.)

Reserve Bank of Australia 2004, "The Composition and Distribution of Household Assets and Liabilities: Evidence form the 2002 HILDA survey", *Reserve Bank of Australia Bulletin*, April edition, Sydney

Rubinstein, R. 1981, *Simulation and the Monte Carlo Method*, John Wiley & Sons, New York
Sander, P. 2005, "Auf Schatzsuche", *McKinsey Wissen*, 4(13), pp. 40-43

Shiller, R. 1993, *Macro Markets*, Oxford University Press, Oxford

Shiller, R. 2003, *The New Financial Order: Risk in the 21st Century*, Princeton University Press, Princeton

Shiller, R. and Weiss A. 1999, "Home Equity Insurance", *Journal of Real Estate Finance and Economics*, 19(1), pp. 21-47

Shiller, R. and Weiss, A. 2000, "Moral Hazard in Home Equity Conversion", *Real Estate Economics*, 28(1), pp. 1-32

Szymanoski, E. 1994, "Risk and the home equity conversion mortgage", *Journal of the American Real Estate and Urban Economics Association*, 22(2), pp. 347-366

Tacke, T. 2004, *Bringing Shiller's New Financial Order to Reality: Can Macro Securities Help to Hedge Longevity Risk?* Unpublished Dissertation, Paris

Tschulk, P. 2004, *Economic Derivatives – Fundamentaldatenderivate und deren Einsatz in einer Hedge Fonds Strategie*, Diplomarbeit, Wien

Whaley, R. 2003, "Derivatives", in *Handbook of the Economics of Finance*, eds. G. Constantinides, M. Harris and R. Stulz, North Holland, Amsterdam

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U21Global
5 Shenton Way
#01-01 UIC Building
Singapore 068808

Tel: +65 6410 1300
Fax: +65 6410 1358