Practical Considerations in Evaluating a Long-term Care Securitization

By Doug Andrews and Jaideep Oberoi

University of Kent

Centre for Actuarial Science, Risk and Investment

Cornwallis E227,

Canterbury, UK CT2 7NF

dwa007@hotmail.com J.S.Oberoi@kent.ac.uk

In many countries seniors requiring long-term care (LTC) are required to pay much of the cost of care themselves. Private LTC insurance has had relatively low take-up rates. In countries such as Canada and England a significant amount of seniors' accumulated savings is represented by the equity in their homes. Traditional equity release products also have relatively low take-up rates. At the IAA Colloquium in Hong Kong in 2012, Andrews presented an outline of a public-private-partnership that might be used to release home equity for the purpose of financing LTC expenses that would involve a securitization. For this paper, the authors obtained data from various sources to attempt to price this LTC equity release securitization. They encountered a number of practical problems, such as inconsistencies in the housing data, determination of suitable LTC incidence rates, how to apply the housing data to longer time periods, and they developed some practical solutions. This paper presents some of the problems encountered and the solutions developed.

house price index, long-term care, securitization

In England and other countries, such as Canada, home equity represents a substantial portion of the net worth of the population over age 55. As the financial requirements of this older age cohort change, it will become more necessary to access the equity in the residential home. A straightforward method to access the equity is to sell the home; however, this raises the further question of where the individuals will reside. For many, there appears to be an attachment to the home, which may generate a "possession value" that is greater than the market value on sale, resulting in a desire to remain in the home. To accommodate the combined desires of providing access to home equity and enabling the homeowners to remain in their homes, home-equity-release (HER) products have been developed. However, the take-up on these HER products in the United Kingdom, Canada and the United States has been very limited.

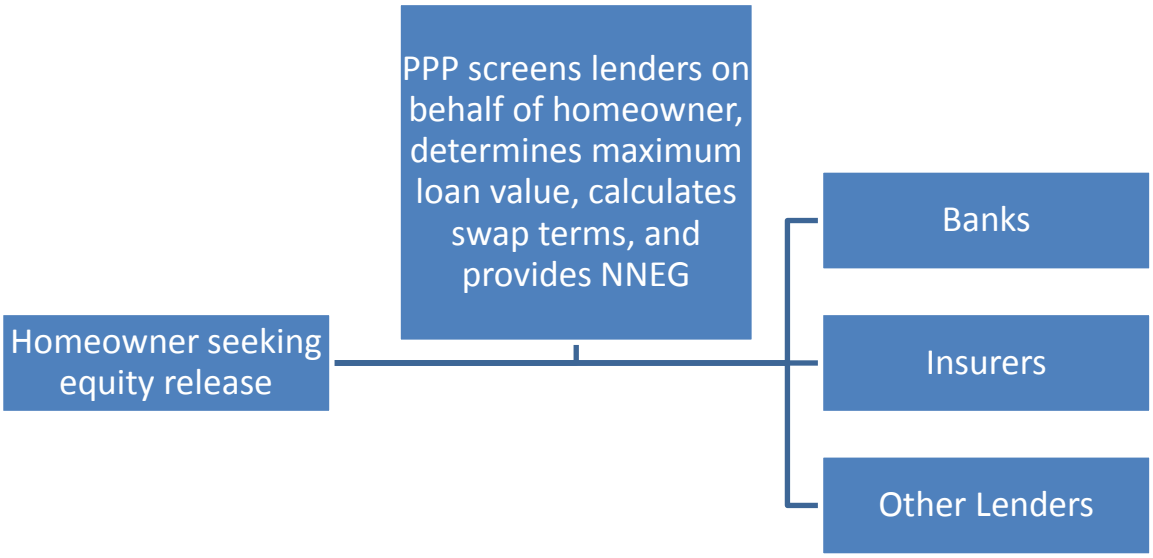
Many of the HER products (or legislation governing HER loans) contain a provision that if the value of the home is less than the value of the outstanding loan, there is no further obligation to repay the loan (beyond the funds received on home sale), which will be referred to as the No Negative Equity Guarantee (NNEG). Various authors (Andrews (2009, 2012), Hosty et al. (2008), Li et al. (2010)) have suggested that the typical price charged for the HER product when the NNEG is present makes the HER products unattractive and explains, at least in part, why the take-up of such products has been low.

Hosty et al. (2008), Ji et al. (2012), and Li et al. (2010) have developed models to price the NNEG that produce prices considerably less than typically available in the market place. Andrews has suggested that the NNEG risk is more suitably borne by the state through an agency (2009) or through a public-private-partnership (PPP) (2012). In this paper we follow the PPP model as illustrated in Figure 1. The PPP would write the NNEG. The PPP would have the responsibility for (but might outsource the administration of) accepting applications from homeowners, appraising the home, underwriting the mortality and morbidity risks of the applicants, and taking competitive bids from financial institutions, in order to determine the maximum loan value.

We have conducted research that we plan to publish (Andrews and Oberoi, 2013), which defines a specific HER product related to long-term care (LTC) requirement that might be provided by a PPP. That paper develops a pricing approach for the product, and provides guidance regarding product provisions, data requirements, and pricing considerations. In conducting this research we obtained data from various sources to attempt to price this LTC HER product. We encountered a number of practical problems, such as inconsistencies in the housing data, determination of suitable LTC incidence rates, how to apply the housing data to longer time periods, and developed some practical solutions. This paper presents some of the problems encountered and the solutions developed.

The paper proceeds as follows. In section one a description of the product is provided. In section two the literature regarding pricing real estate derivatives is reviewed and the approach to be used in this paper presented. The third section discusses three practical problems encountered and presents the solutions developed. Section four concludes.

Figure 1: Role of PPP in Arranging Home Equity Loans



1.0 PRODUCT DESCRIPTION

The product priced in this paper is a refinement to the product outlined by Andrews (2012). It is assumed that a PPP would be established, which would receive applications from home owners requiring income with respect to a requirement for LTC. The applicants may not require institutional LTC at the time of application, but may require funds for residential care or to modify the home to make it more accommodating to the applicant's needs and mobility. The PPP would process the applications, which would include an appraisal of the home, a determination of the amount of equity, an assessment of its prospects for house price inflation in line with an established house price index (HPI), and an underwriting of the mortality and morbidity (i.e., the LTC risk that will affect the time of sale of the home and the cessation of the loan). The PPP would seek competitive bids from banks, insurers and other financial institutions in order to obtain the most attractive interest rate for the loan. Because the NNEG is written by the PPP there is no insurance risk associated with the loan, which should broaden the pool of available lenders and sharpen the loan pricing. The PPP would then specify the maximum loan amount and the loan rate basis.

1.1 Standard Roll-up Mortgage

The standard HER loan, referred to as a roll-up mortgage, is based on a fixed interest rate. In this paper we consider writing the loan on a floating rate basis. The floating rate we propose is the house price index for the region. There are several advantages to setting up such a loan arrangement over a fixed rate. First, it allows for a more efficient pricing approach as it does away with a major problem of predicting long-term real estate price movements. Second, Shiller and Weiss (2000) suggest that providing an incentive to the homeowner-borrower to maintain the property may reduce the "moral hazard" problem and result in better performing loans. This floating rate approach maintains the interest of the homeowner-borrower in the on-going pricing of the loan, which may result in greater attention to property maintenance resulting in improved loan performance and a

lower NNEG charge. Third, this approach would permit the PPP to create a new type of security that is based on average house price appreciation and which would attract several investor classes that wish to have exposure to the real estate market.

1.2 Securitizations

The HER loans would be written on a floating rate basis using HPI plus a fixed spread. Although not a conventional product, since the entire repayment is at the end; it has some similarities to a credit line. Because the PPP would write a NNEG with respect to the HER loan there would be no risk of loss to the financial institution making the loan. However, if a more conventional product were required a (primary) securitization could be arranged wherein the financial institution making the loan received loan payments calculated at a fixed rate from the securitization purchasers. At the termination of the loan, the securitization purchasers would receive the outstanding loan calculated using HPI plus a fixed spread, which would be protected by the NNEG. This should result in a competitive and efficient loan process.

Such a securitization is a pure investment play related to a HPI and a spread. The pricing of such securitizations is well known and hence is not the subject of this paper. (However, the loan differs from the norm by being written at a floating rather than a fixed rate).

Andrews (ibid) has stated several reasons that the PPP structure is desirable. The loan would include a NNEG provision. The state is better placed to bear this risk, given that the NNEG is affected by HPI, which the state's actions may influence. The state may be able to use some of the homes acquired for social housing. The PPP structure provides a vehicle:

- for the state to pass some of the risk to the private sector through a residual account; and
- to enhance the attractiveness and availability of HER product.

The main investors identified to whom participation in the residual account and in making HER loans may appeal are pension funds and life insurers. It would be surprising if banks did not become interested in participating in the HER loans, if the product has large participation by the public. LTC providers may also be interested in participating in the residual account since the applicants are seeking loans for LTC needs and are, therefore, prospective customers.

Participation in the residual account would be through a (secondary) securitization. This securitisation would remove any risk of loss from the PPP. Income to the residual account would occur from:

- NNEG premiums incorporated into the loans,
- the fee charged for administrative, maintenance and servicing included in the loans; and
- settlement payments when the residual account was negative.

Payments from the residual account would occur from:

- payments required by the NNEG when the loan value exceeds the house value on sale;
- expenses incurred by the PPP for administration, maintenance and servicing; and
- dividends to investors to share any profits in the residual account.

The payments on the NNEG arise because the loan value, calculated at cumulative HPI plus the lender's spread (including the NNEG premium), exceeds the house value on sale. The date at when this comparison takes place is on the sale of the house due to either institutionalisation or on death. Hence, the risk associated with the NNEG includes both morbidity and mortality. The PPP could reduce its exposure to some of this risk through a swap, as discussed by Andrews (2012), but this is beyond the scope of this paper.

Where the house price at sale exceeds the value of the loan, calculated at the HPI index plus a spread, the homeowner would have the option to receive the excess or to seek a mortgage for the loan amount and retain the home. If the expected sale price, before sale-related expenses, would be close to the loan value, and if the property were deemed suitable for social housing, the homeowner might agree to transfer ownership to the PPP, so that the home could be used for social housing.

This securitization of the residual account is in respect of morbidity, mortality and specific house price increases in comparison to a house price index. It is the practical problems arising in the pricing of this secondary securitization that are the subject of this paper.

2.0 PRICING REAL ESTATE DERIVATIVES

HER is becoming an increasingly popular topic in the academic literature. Fabozzi et al. (2011) developed new methods for pricing the main real estate derivatives — futures and forward contracts, total return swaps, and options. They outlined a suitable modelling framework that accounts for the incompleteness of this market, which can produce exact formulae, assuming that the market price of risk is known.

The HER concept addresses a need – the ability to unlock equity to provide income while continuing to live in the home. However, the take-up on HER products has been very low. Li et al. (2010) and Hosty et al. (2008) analyse the pricing of the NNEG and conclude that the pricing basis used is conservative, resulting in unattractive prices.

One explanation for conservatism in pricing is that price appreciation of a particular property may be difficult to predict. Although, HPI may increase in a way that is readily modelled, a particular house may not keep pace with HPI. Shiller and Weiss (2000) consider that once equity has been released in the property, there may be little incentive for the residents to maintain the property; hence, reducing the asset value. Although they refer to "moral hazard", a failure to maintain the property may be due to incapacity attributable to old age or due to (fear of) lack of income.

Based on an analysis of Australian data, Ong (2009) found that being 75 years of age or older lowers annual house price appreciation by 1.4 percentage points and further that being aged 75 or older lowers home improvement expenditure by over 3,000 AUD per year and is attributable to a decline in income in old age. Based on a review of American Housing Survey data for the period 1985 to 2001, Davidoff (2004) observed that annual spending by homeowners 75 and older is approximately $270 less on routine home maintenance and $1,100 less on home improvement than by younger homeowners with similar homes. He observed that older homeowners realize weaker price appreciation than younger owners of similar homes in the same markets over identical horizons by approximately three per cent per year (ibid).

In the HER product described in this paper, a fee is included for maintenance. We envision regular (perhaps annual) inspections of the property and a contractual agreement that the residents maintain the property to some (minimum) standard.

Another explanation for conservatism in pricing is the uncertainty regarding improvements in mortality and morbidity, which may increase the potential time until the loan is repaid, hence, increasing the risk exposure period. With respect to UK data, Jagger (2012) states that over the previous decade life expectancy (LE) at birth increased at a relatively constant rate, rising by 2.4 years for men and 1.7 years for women, and that disability-free life expectancy (DFLE) has increased by 3.6 years for men and 2.3 years for women. However, these averages hide differences within the UK by country (England, Northern Ireland, Scotland, and Wales). Moreover, there are differences in the extent of improvement in LE and DFLE among European countries (ibid).

These findings have implications for HER products in general and especially for HER products related to LTC. Davidson (2009) suggests that HER may affect demand for LTC insurance and is a substitute for such insurance. Andrews (2012) has proposed a model to tie HER to LTC and this idea is expanded and developed in this paper.

The idea of relating HER to a specific life event is discussed by Andrews (2009) with respect to retirement. Ji et al. (2012) developed a semi Markov multiple state model for pricing reverse mortgage terminations. They consider three different modes of reverse mortgage termination: death, entrance into a long-term care facility, and voluntary prepayment; and also models the event-triggered dependency between the lifetimes of a husband and wife. Ji et al. (2011) discuss Markovian approaches to joint-life mortality, which is relevant to reverse mortgage terminations, as the termination is frequently affected by events that happen to a couple. In this paper we follow their mortality modelling and parameterization.

2.1 Data and Methodology

In this paper we are concerned with some of the practical data issues which arose in trying to price the annual premium to charge to provide protection for the event that price changes for individual houses are less than the HPI, and the solutions developed. From the Land Registry, we purchased data regarding house sales during the period January 1, 1995 to December 31, 2011 for post codes in the county of Kent, England, CT1 and CT2, which correspond to the Canterbury area, and ME8, which corresponds to the Medway area. The data was matched and filtered, so that only houses that were sold at least twice during the period were included. The first sale was used to determine the market price and subsequent sales could be used to determine individual house price inflation. This inflation could be compared to the real estate HPI for the same period pertaining to the county of Kent, as calculated and published by the Land Registry. This approach provided a set of data points comparing actual house price increases to a broader county-wide HPI. By drawing at random from these data points with replacement (bootstrapping) we could evaluate the differences between the HPI and changes in individual house prices.

In order to estimate the impact of mortality and morbidity, we used the following approach. Following Ji et al. (2011) we used a Gompertz mortality model ($\mu_x = BC^x$) parameterized according to their Table 3. We followed their adjustments to mortality probabilities to reflect the "bereavement effect" associated with death of a spouse. It should be noted that the data used for the parameterization is based on information from joint and last-survivor annuity contracts in force with

a large Canadian insurer over the period December 29, 1988 through December 31, 1993 (Chen, 2010).

We assumed that applicants for the HER loan would likely be couples of approximately age 65 at a time when one of the couple had requirements for some form of care expenditure. We used a Markov model to estimate the likelihood of a change in status that would result in the home having to be sold and the loan repaid, in each year. Once a person requires care we did not permit the possibility of recovery. We considered the following end of year states of the healthy partner X and care-requiring partner Y:

1. No change in state of X and Y
2. X healthy, Y deceased
3. X requires care, Y requires care
4. X deceased, Y requires care
5. X requires care, Y deceased
6. X deceased, Y deceased

It was assumed that a change to states 3, 4, 5 or 6 would result in sale of the house and settlement of the loan. If the couple remains in state 1 the loan continues. If the transition is to state 2 we assume that the loan continues and calculate the probability that in subsequent years X will be in the states:

7. X healthy
8. X requires care
9. X deceased

It was assumed that transitions to states 8 or 9 would result in sale of the home. An alternative assumption would have been to assume voluntary loan repayment on transition to state 2. We have not assumed any prepayments.

Figure 5a of the Intercompany Study Report (Gagne et al., 2011) for ages 65-69 shows the ratio of female to male incidence with respect to care requirement to be 149%. Accordingly we assumed that 60 per cent of the applicants would be a couple with a healthy male and female requiring care expenditures and that 40 per cent of the applicants would be a couple with a healthy female and a male requiring care expenditures. To evaluate these probabilities we used the incidence rates shown in Figure 4 for Unlimited Benefit Period, modified by the rates by gender from Figure 5a, in the Intercompany Study Report (ibid).

2.2 How Our Approach Differs

Our approach to designing the HER product and its pricing differs from other published approaches in a number of significant ways, as summarized briefly in this subsection.

Rather than the loan writer being required to write the NNEG, we propose the unbundling of the loan and the NNEG. Further, we propose that the participation in the pricing of the NNEG be securitized. Given the apparently wide range in prices calculated for the NNEG between providers and academics, this product provides opportunity for return potential.

Moreover, by unbundling the loan and the NNEG, it would be simple to offer the loans on a variable rate basis, rather than the standard fixed rate basis. Variable rate loans tend to have more competitive pricing since the basis risk for interest rate changes over potentially lengthy and uncertain time horizons is removed.

Finally, published pricing models typically use ARCH or GARCH processes to model house price inflation and the index (e.g., Li et al., 2010). Moreover, the housing index commonly analysed has been the Nationwide Index (Hosty et al., 2008, Li et al. 2010), whereas our approach is based on actual house price data for England from 1995 to 2011, obtained from the Land Registry. It has been suggested that the Land Registry index is a more appropriate index because of its manner of construction (Calnea Analytics, 2007).

3.0 PRACTICAL PROBLEMS AND SOLUTIONS

In this section we consider three practical problems encountered and discuss the solutions developed. The three problems concerned: inconsistencies in the housing data, the determination of suitable LTC incidence rates, and the application of the housing data to longer time periods.

3.1 Inconsistencies in Housing Data

The data set received from the Land Registry contained 30,724 transactions, which included 18,747 repeat transactions. There were multiple repeat transactions for some properties. The following tables summarize the data with respect to the full data set and the data set of repeat transactions. Because the 18,747 figure includes the initial sale, the number of annualized returns in respect of repeat transactions was 10,555. While using this dataset, several filters are necessary. Firstly, some transactions are repeated with separate IDs. This may be due to data entry errors or because the property changed hands more than once on the same day at the same price. As the data is based on reported values, there can also be a situation where a property's value changed by 5-10% over the course of a day according to the Land Registry data. When translated to annualized returns, this works out to 3650%, a rather unlikely return value. Further, some homes change in type from

Table 1A: Complete Dataset: Number of Transactions by Area Code, Type and Period

Area Codes -->	CT1	CT2	ME8	Total
Total Number	8,495	7,337	14,892	***30,724***
Freehold	6,036	6,186	13,746	***25,968***
Leasehold	2,459	1,151	1,146	***4,756***
Detached	908	1,465	2,612	***4,985***
Semi-detached	2,343	2,732	5,175	***10,250***
Terraced	2,887	2,045	6,061	***10,993***
Flat	2,357	1,095	1,044	***4,496***
New	1,132	612	672	***2,416***
Old	7,363	6,725	14,220	***28,308***
1995-1999	2,126	2,213	4,879	***9,218***
2000-2004	2,648	2,495	4,981	***10,124***
2005-2009	2,928	1,950	3,965	***8,843***
2010-	793	679	1,067	***2,539***

Table 1B: Complete Data Set: Average Price of Transactions by Area Code, Type and Period

Area Codes -->	CT1	CT2	ME8	Combined
Overall Average	150,414	156,598	127,520	***140,794***
Freehold	158,132	165,660	131,679	***145,922***
Leasehold	131,469	107,894	77,638	***112,792***
Detached	243,326	238,423	192,823	***215,423***
Semi-detached	145,463	143,998	130,727	***137,632***
Terraced	139,344	140,350	105,137	***120,671***
Flat	133,103	108,906	78,188	***114,458***
New	190,589	136,889	136,543	***161,953***
Old	144,238	158,392	127,094	***138,988***
1995-1999	72,157	80,877	71,852	***74,089***
2000-2004	142,665	151,570	126,399	***136,857***
2005-2009	197,881	219,365	182,502	***195,723***
2010-	210,835	241,607	182,986	***207,361***

detached to semi-detached or flat, but may even reverse from terraced to detached. This affects the price in an arbitrary way and we excluded these observations.

From Tables 1A and 2A it can be seen that the number of transactions is approximately equal for the Canterbury (post codes CT1 and CT2) and the Medway (post code ME8) subsets of the data. From Tables 1B and 2B it can be seen that the average price for the repeat transactions is less than the average price for the full data set. Also the average price for Canterbury transactions exceeds that for Medway transactions.

Table 2A: Data for Repeat Transactions: Number of Transactions by Area Code, Type and Period

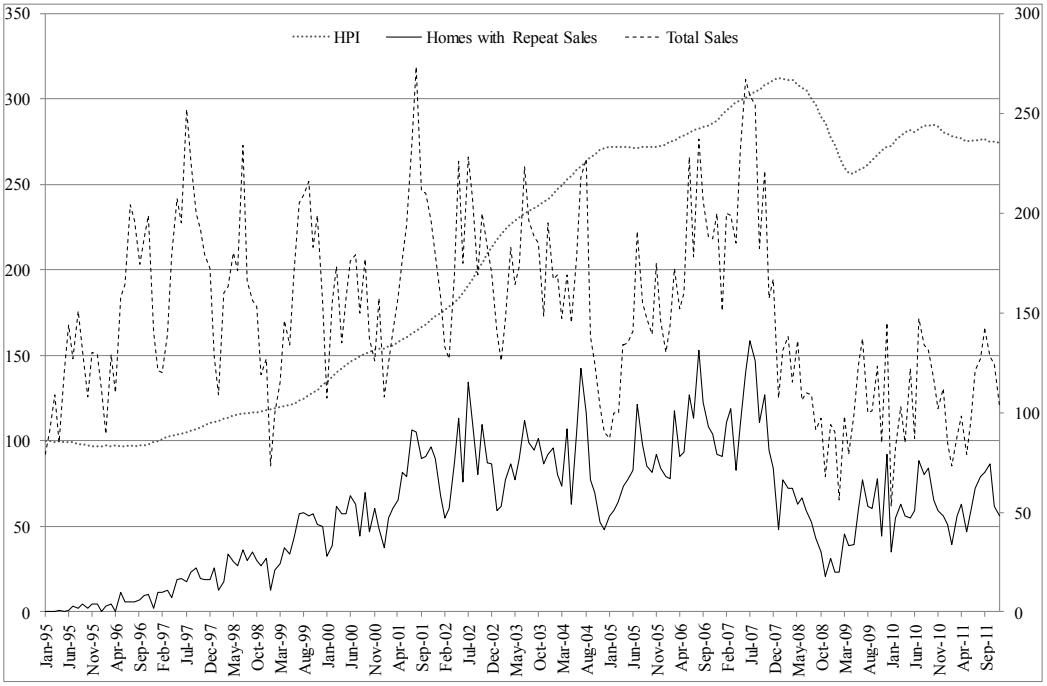
Area Codes -->	CT1	CT2	ME8	Total
Total Number	5,055	4,391	9,301	***18,747***
Freehold	3,787	3,582	8,496	***15,865***
Leasehold	1,268	809	805	***2,882***
Detached	452	764	1,487	***2,703***
Semi-detached	1,464	1,561	2,993	***6,018***
Terraced	1,928	1,278	4,094	***7,300***
Flat	1,211	788	727	***2,726***
New	258	301	341	***900***
Old	4,797	4,090	8,960	***17,847***
1995-1999	1,393	1,272	3,009	***5,674***
2000-2004	1,763	1,628	3,296	***6,687***
2005-2009	1,459	1,144	2,407	***5,010***
2010-	440	347	589	***1,376***

Table 2B: Data for Repeat Transactions: Average Price of Transactions by Area Code, Type and Period

Area Codes -->	CT1	CT2	ME8	Combined
Overall Average	140,954	151,600	124,510	***135,289***
Freehold	150,527	161,283	129,141	***141,503***
Leasehold	112,366	108,728	75,632	***101,084***
Detached	237,601	233,383	195,402	***213,194***
Semi-detached	142,313	143,236	130,289	***136,573***
Terraced	134,738	138,788	103,170	***117,743***
Flat	113,135	109,657	75,891	***102,197***
New	164,957	111,179	112,519	***127,103***
Old	139,663	154,575	124,966	***135,702***
1995-1999	70,295	78,928	68,643	***71,354***
2000-2004	136,379	145,499	123,683	***132,342***
2005-2009	192,965	217,564	181,446	***193,048***
2010-	210,522	229,150	181,872	***202,956***

Because the data is for the period January 1, 1995 to December 31, 2011, the repeat transaction data is more voluminous during the middle portion of this time period and more closely matches the transaction volumes for all transaction from the 2000s onwards. This occurs because if an original sale occurred before the period started the first sale would not be treated as a repeat sale. This effect can be seen in Figure 2.

Figure 2: Monthly Transaction Volumes and the House Price Index for Kent County, England



We considered adjusting for the "under representation" in the earlier years. However, HPI increased very strongly between 2000 and 2008, when volumes were heavy. We did not adjust our data for this effect because it might introduce an upward bias into the results.

With respect to the period after 2008 when volumes decreased substantially, an argument could be made that during this period there may have been sales desired but insufficient buyers. This is a potential problem with pricing the NNEG associated with the HER loan for two reasons. House sales under HER loans are triggered by biometric events and not house-price appreciation and during a period of lower volume there may also be lower prices. However, from Figure 2 it can be seen that the repeat sales in our study capture a relatively consistent proportion of the index volume; hence, no adjustment was made for this consideration. Moreover, the suggested design of the HER product provides that houses could be used for social housing, which may remove some of the concerns regarding the potential for forced sales at lower prices.

The strong overall increase in HPI shown in Figure 2 masks the extreme variability in monthly HPI experienced over the time period, which is shown in Figure 3A. Given this variability the data period is useful for pricing the NNEG.

It is also noteworthy that monthly HPI shows significantly persistent autocorrelation, as shown in Figure 3B, which may prove challenging for individuals using models that are not based on historical data. The ARCH or GARCH models used by other authors (e.g., Li et al., 2010) will have to account for autocorrelation for long periods, well in excess of 3 years. Our approach, which uses historical data instead of a model, is to calculate the price of the NNEG based on the actual data. It thereby incorporates the historical autocorrelation. Furthermore, the autocorrelation shown in Figure 3B is more persistent than noted by Li et al. (2010). They used the Nationwide Price Index and found that a strong autocorrelation effects lasts for approximately 2 years. Hosty et al. (2008) also analysed the Nationwide Index and found that the autocorrelation and volatility vary by region. They do not cite figures separately for the county of Kent so we are not able to make further comparisons to their work.

On investigating the repeat transaction data, which was used in our analysis, we found some extremely high annualized returns and some extremely low annualized returns. In some cases transactions are recorded very close to each other in time. In such cases, annualizing the difference in returns leads to extremely large values in absolute terms. Another feature of the data is that recorded prices consist of reported values rather than confirmed ones, and sometimes do not reflect errors that do not account for changes in a property. Other reasons for apparent anomalies may be attributable to last minute changes in price, speculative flips, re-parcelling the property for resale, family transactions, or some other such reason. From the data, we could not ascertain any reasons for such extreme returns.

We then compared the difference in annualized returns between the individual house price inflation to the HPI for the comparable period between transaction dates. The transaction data has exact dates, but the HPI is calculated at month ends. We used linear interpolation on the HPI values

to be able to match the period between transaction dates. We decided to remove the most extreme values of the differences in annualized returns between individual house price inflation and HPI from the subsequent analysis. For the highest 5 per cent of the annualized return differences (i.e., above the 95th percentile) we substituted the value for the 95th percentile and for lowest 0.5 per cent of the annualized return differences we substituted the value for the 0.5th percentile, i.e., we winsorized both tails.

Figure 3A: House Price Index Returns: Monthly HPI Returns

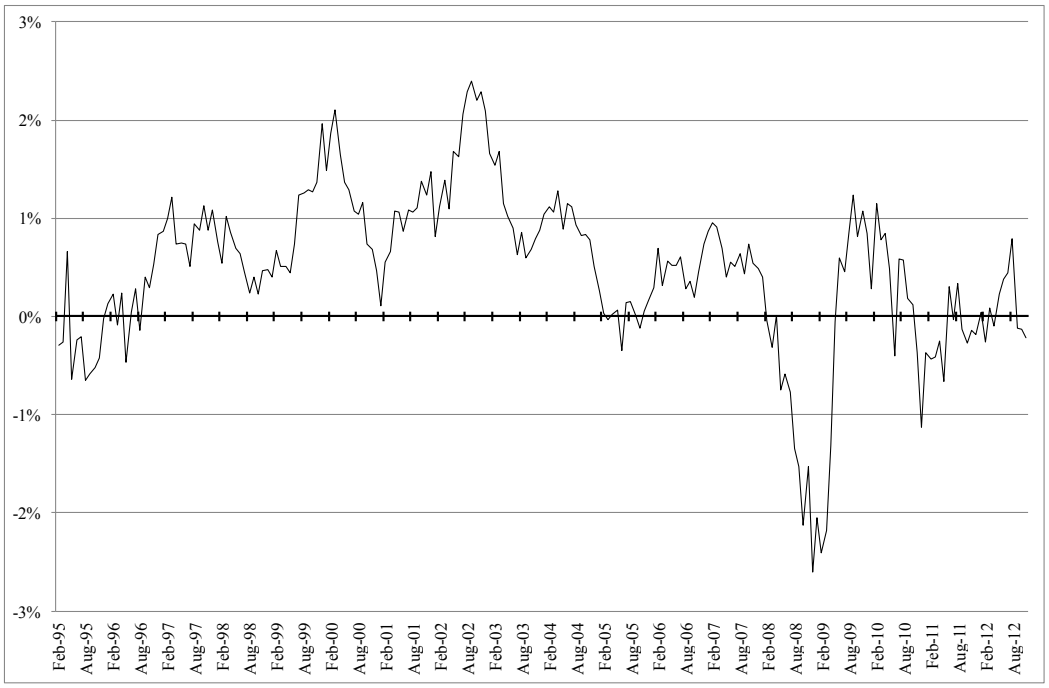


Figure 3B: House Price Index Returns: Autocorrelation in Monthly HPI Returns

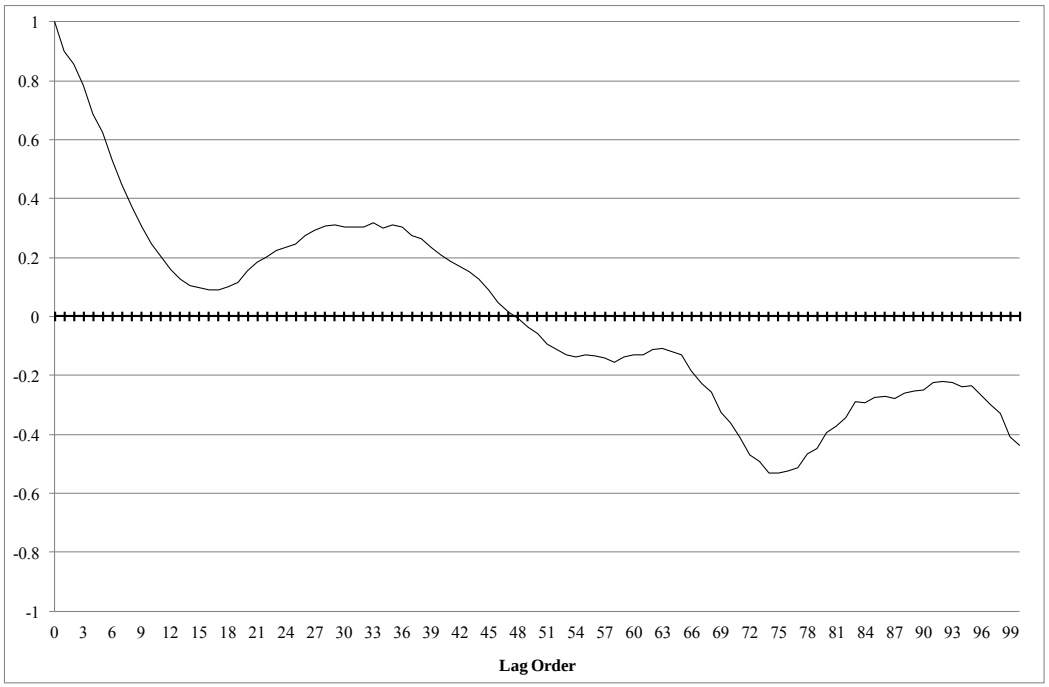
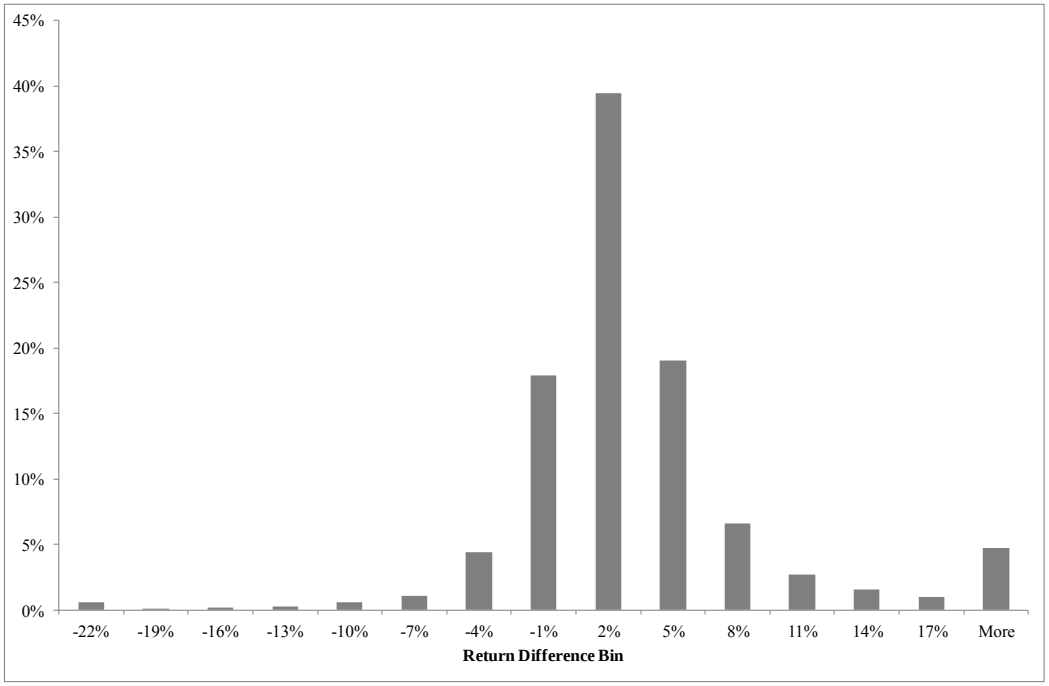
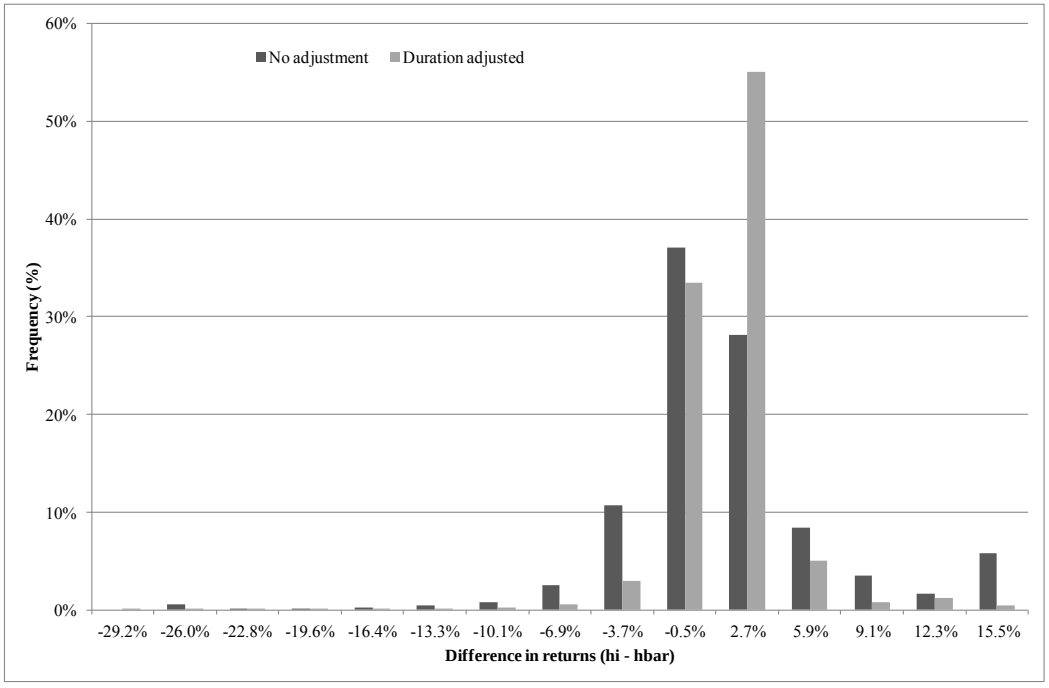


Figure 4: Histogram of Winsorized Return Differences between Individual Homes and HPI



The results of the winsorization process are evident in the size of the extreme left and right hand bins of Figure 4. From the shape of the histogram it can be seen that the return differences have a positive median. Although we cannot be certain of the reason for this effect, we suspect that it is due to our data being in respect of sales in relatively desirable urban centres in the county, whereas the HPI is calculated based on all sales within the county.

Figure 5 De-meaned Differences Both Raw and Maintaining Duration



To remove the impact on pricing of having a positive median, we recalculated the distribution of return differences by subtracting the mean difference from the data underlying Figure 4, which we refer to as "de-meaning". This resulted in the distribution shown in Figure 5, which we used to price the NNEG. Note the long left tail.

3.2 Determination of Suitable LTC Incidence Rates

Since our data is in respect of HPI in a county in England, it would be desirable to have information for England regarding incidence rates of entry into care and duration in care once entered. We could not find any publicly available information that provided this information. It was suggested that a proxy for the information might be experience in the United States. In this regard, we contacted Inter-University Consortium for Political and Social Research and acquired access to the National Long Term Care Study (NLTCS). The NLTCS is a longitudinal study with available data for 1982, 1984, 1989, 1994, 1999, and 2004. It has very detailed information regarding participants and their care requirements. Unfortunately, the data does not provide sufficient information to construct appropriate incidence and exit tables.

To overcome this problem, we found a published report (Gagne et al., 2011), which is based on private insurer data in respect of policies in the U.S. Because private insurance contracts are normally for specified maximum benefit periods and the product design described in this paper is a lifetime commitment based on joint lifetimes, the experience may not be completely comparable. To mitigate this problem we used the data from the report (ibid) for the unlimited benefit period. The report provides incidence rates on a unisex basis in five-year age bands, and ratios for incidence by gender. Hence, we were able to construct sex-distinct incidence rates in five-year age bands. We assumed that for the experience with the unlimited benefit period, which is a moderate indicator of more severe LTC, that once care was required it would be required for the remainder of life.

In terms of the product design under consideration, we assumed that a typical situation would be a couple with a home where one member required care. We assumed that the application for the HER loan would most likely occur when the couple were (approximately) age 65. We assumed that both spouses would be the same age. Using the data in the report and these assumptions we calculated that of the couples applying for HER 40 per cent would be comprised of a healthy female and care-requiring male spouse and 60 per cent would be comprised of a healthy male and care-requiring female. This weighting was used in the calculation of the premium.

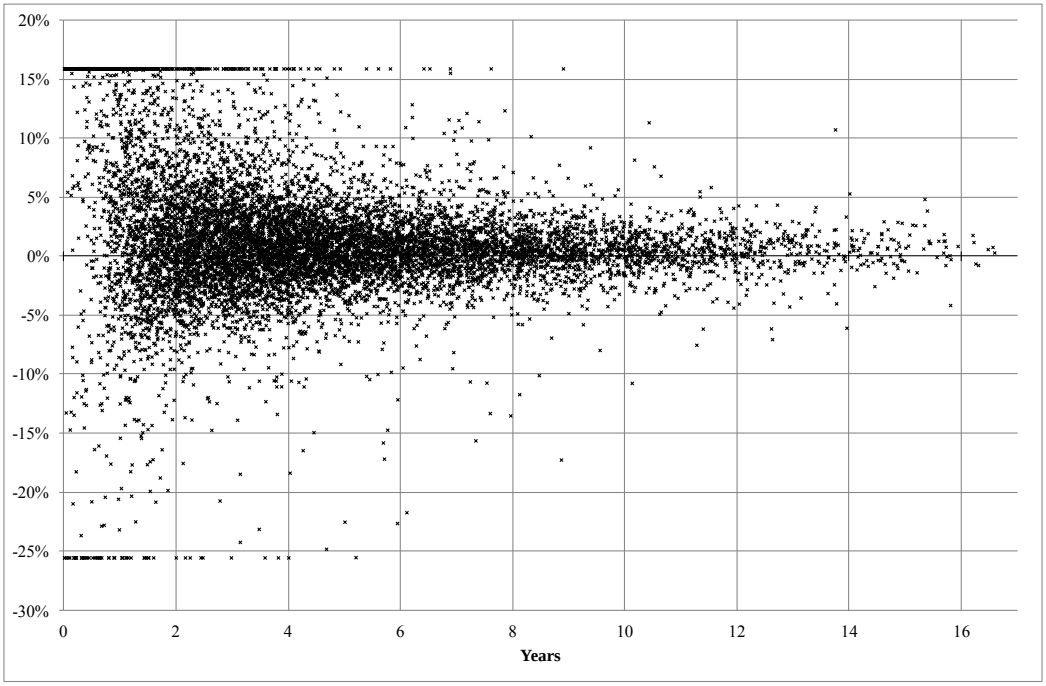
3.3 Applying Housing Data to Longer Time Periods

To calculate the premium we used one million simulations. For each simulation a path for the original status was followed until and exit resulting in a house sale arose (i.e., entry into states 2, 4, 5, 6, 8, 9 as described in subsection 2.1). At the point of exit and house sale a random drawing from the winsorized data of annualized return differences of individual house price inflation and HPI is made.

In our analysis of the data of annualized return differences we noted a duration effect as shown in Figure 6, which is based on the data underlying Figure 4. The bolder horizontal lines at the top and bottom of the Figure result from the winsorization of the data. It can be seen that there is an

overall positive return skew, as discussed previously. But it is particularly interesting to note that as the time between transactions increases the variability of return differences reduces. However, it takes at least 10 years before it might be considered stable.

Figure 6: Annualized Return Differences by Time between Transactions



We then faced the problem of whether to reflect this duration effect in our calculations, and if so, how. Given the propensity for couples to wish to remain in their homes for as long as possible, we thought it more realistic to try to incorporate the duration effect. However, practical limitations are that our data only covers a 17 year time period and the number of data points for longer durations is much smaller (because of the time period and the approach of using repeat transactions that occurred within this period). We decided to winsorize the annualized return data at 15 years. Hence, for durations of 15 years or longer we draw a return difference from the bin of 15 or more years.

4.0 CONCLUSION

Based on the solutions to the problems described, we were able to price the premium to provide this product and to perform analyses with respect to its variability and its sensitivity to certain assumption changes. It is not our purpose here to present and discuss those results. They will be presented and discussed in another paper (Andrews and Oberoi, 2013). Our purpose is to identify some of the practical problems, which arise in trying to price a product in respect of HER that relates to LTC. We identified three problems: inconsistencies in the housing data; determination of suitable incidence rates; and applying the housing data to longer time periods. Our practical solutions to the first and last problem were to use winsorization, which we think is a reasonable solution. We also "de-meaned" the data to eliminate the positive bias. Our approach to the second problem was to use published private insurance company data in respect of U.S. participants for LTC incidence and exits and to use Canadian insurer data with respect to joint and last-survivor annuity mortality experience

for mortality rates. We assumed that they would provide an appropriate proxy for the LTC morbidity and mortality of English participants. We are not confident that these are appropriate assumptions but they were the most practical assumptions available.

Given the practical data problems and solutions identified, there is some uncertainty regarding the range of results. In the other paper (ibid) we examine this uncertainty and conclude that the standard pricing used for HER products is unduly conservative. But the practical data problems do warrant some degree of conservatism.

With an aging population in many developed countries, where home equity likely represents a significant portion of the individuals' savings that will have to be accessed, and with the propensity to wish to remain in the home as long as possible, there is an urgent need to gather data by country that can be used for pricing HER products. Given the nature of the risks involved, such as house price inflation and LTC access and availability, which can be influenced by state action it is our contention that the state should play a role in the provision of the HER product. We have proposed a PPP but other approaches with state involvement are possible. Given the foregoing we would urge governments to take the necessary steps to facilitate the collection of appropriate data that could be made available to price such a product.

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