Assessment of benefits and risks of reverse mortgages in China

Jun Feng 3233129

**Project Overview**

Aging is an inevitable trend for most countries. Increasingly, more and more countries enter “old” era and discover that the public support system alone is not sufficient to ensure the welfare of the elderly. China is not an exception. As a last resort, reverse mortgages, introduced in the 1980s in the US, are a supplement to the public welfare system. The increasing popularity in the US and other countries such as Australia has attracted Chinese scholars to study this financial product.

Early data analysis in the US indicated great potential of reverse mortgages. Through surveys, target groups were studied and the benefits reverse mortgages brought were analysed. Risks of reverse mortgages were identified and presented in journals in 1994 and were left untouched since then. Empirical study of reverse mortgages is limited in only a few countries where such products exist. Like many other countries, research on reverse mortgages in China remains theoretical.

This proposal is prepared to enhance the understanding of the existing knowledge of reverse mortgages and its impact on China. This research is critical in assessing the benefits and risks of reverse mortgages in China and in providing a way of analysing potential reverse mortgage markets. By creating Chinese economic scenarios with historical data and building proposed models to simulate individual spending behaviour, this study will examine reverse mortgages from both consumer and supplier perspectives.

This research is based on the well-established theory in finance, economics, and actuarial science. It builds on theories like (1) utility theory, (2) retirement planning and (3) consumption theory, (4) annuitization theory and (5) risk management theory. It uses (a) statistic modelling techniques such as time series analysis to create economic scenarios and (b) a simulation method to analyse the impact of reverse mortgages to households and product providers.

This study generates several intellectual merits; the impacts will be substantial and can be categorized in two ways:

1. The assessment results will add to the growing literature in the Chinese reverse mortgage field and will contribute to the understanding of how well the product will work and how to stimulate the development of the reverse mortgage market.
2. The proposed method of analysing reverse mortgages will provide a new way to assess reverse mortgages in other countries and will also provide a method to evaluate new financial products.

The proposed research will be carried out over a 12-month period by the Principal investigator and a Co-Investigator. Primary steps include: 1) an ongoing literature review ( 1 month), 2) data collection and statistical modelling (3 months), 3) model development, programming, and simulation (4 months), 4) data analysis and summary of results (3 month), 5) publication (1 month).

The proposed research will provide extensive information on the potential of Chinese reverse mortgage market and will be beneficial to academics who are interested in this area, reverse mortgage product providers as well as Chinese regulators.

The next section of the proposal contains a discussion of the overall problem of aged-support and reverse mortgages in the context of the Chinese market. This is followed by a literature review of current reverse mortgage study in China and around the world. The third section outlines the methodology and a description of dataset to be used in the modelling and simulation. This is followed by a brief summary of key activities during the proposed 12-month duration of the project. Anticipated results and further discussions conclude the proposal.

**Problem Statement**

Global population aging is an inevitable trend in the coming decades as a result of lower fertility rates and increased life expectancy. A UN study (UN 2007) on population aging shows that population aging is unprecedented, pervasive and enduring.

China has been experiencing a similar trend as the rest of the world. But the pace of population aging is much faster than other countries. It took almost 50 years for the US to double its older population proportion. The process in China, however, will only take 20 to 30 years. This is caused by the rapid improvement in the standard of living and the one child policy implemented to control population growth. Being a developing country, however, population aging is taking place at a much lower levels of socio-economic development and gives China less time to adjust to the consequences. As Centre for Strategic and International Studies (CSIS) concludes in their latest report (Jackson, Nakashima et al. 2009), the pressure on social security, pension and health systems could impose serious issues that lead to social instability in China.

As a supplement and last resort to financing retirement lives, reverse mortgages are one way to tackle the aging problem and release some of the burdens from the government. Reverse mortgages are one way to unlock home equity without moving out of the house. Borrowers benefit from liquidating their housing asset while continuing to live in their current home. Practices in the United States, Great Britain, and Australia have presented a promising future for the product as a means of utilizing home equity and improving retirement lives.

It is natural to wonder whether such a good product will be popular in China. This implies questions like: what are the benefits to the Chinese elderly in accessing this product, what are the risks involved in the transactions and how big are they, what should be done to promote this products.

Unfortunately, the international literature is mainly attracted by the American market for its size and successfulness. There is only a little literature that discusses the situation in China (Yan 2008). The Chinese literature, on the other hand, focuses on introducing the concept and discussion on applicability of the product. Due to the page limit (usually 4-5 pages maximum), the discussion is brief and abstract. These discussions alone are not enough for analysing the Chinese market, nor have there been any empirical studies attempted based on the Chinese context.

To enrich the knowledge of reverse mortgages under the Chinese context, this research tries to answer questions by using simulation techniques with Chinese data. Chinese financial environment will be generated based on the historical data. Individual lives will be simulated based on Chinese mortality data. The benefit of the reverse mortgages will be assessed and overall risks will be analysed.

The objective of this research is to investigate the Chinese reverse mortgage market. In particular, the aim is to assess the benefits to the consumer and the risks to the supplier. The results of the assessment are a good support to government policy decisions.

**Literature Review**

1. The reverse mortgage studies

Reverse mortgages as a financial product aimed at helping retirees with their after retirement lives took its debut in 1987 in the United States (Szymanoski 1994). The product is described as an asset management tool that can help tapping the equity of older homeowners while still keep their home thus alleviate seniors from poverty (Kaplan 1993; Rasmussen, Megbolugbe et al. 1997; Kutty 1998).

It was not until 1993 did the academia start to focus on this product. Most of the studies about reverse mortgages are based on products offered in America. Researchers focused on areas such as introducing the reverse mortgage products, estimating the potential market, discussing related risks and their impact on reverse mortgages, as well as evaluating existing programs. Researches outside America, except for a few (Tse 1995), still remained at discussions on theoretical level and still remained in developed countries like Australia, Japan, etc. The developing countries are catching up though; they’ve started to seek the urgency and possibility of having such a product under very broad terms.

The studies in the reverse mortgage area can be characterized into several categories:

*Introduction and discussion*: The introduction of the product can be traced back as early as 1980s, before the HECM program was introduced. It is designed to benefit senior households aged 62 or above with low income but have the right to their homes free and clear. It is estimated around over 6 million elderly in US can benefit from the project (Mayer and Simons 1994; Merrill, Finkel et al. 1994). However, researchers also warned the use of reverse mortgages, as means to help the old poor with no kids’ families, may bring problems such as potential expose to compound interest, losing homes, etc. Although there are a lot of news and updates on reverse mortgages in publications, some of the studies are qualitative research with great theoretical value.

*Risk analysis*: The discussion on risks of reverse mortgages was the centre of research in 1994 where a number of papers on this topic were published in a special edition of Journal of the American Real Estate and Urban Economic Association. The risks involved in reverse mortgage transactions are named crossover risks (Chinloy and Megbolugbe 1994; Klein and Sirmans 1994). It is a combined impact of risks on the reverse mortgages in which the aggregated sum of the loan exceeds the value of the house. These risks include: borrowers’ longevity risk, interest rate risk, property appreciation risk, and moral hazards (Boehm and Ehrhardt 1994; Miceli and Sirmans 1994; Szymanoski 1994). Pricing models used by HECM scheme is discussed (Szymanoski 1994) and a valuation model is developed to compare interest rate risk between fixed-rate reverse mortgage and other fixed-income securities (Boehm and Ehrhardt 1994). Methods used to analyse risks vary from qualitative discussion to modelling and drawing conclusion from survey data. They provide a framework to assess the risks in reverse mortgages.

*Estimation and evaluation*: There aren’t much reviews of the reverse mortgage in the US. Pritchard (1986), Case (1994) and Klein (1994) assess the American mortgage market based on the survey and transaction data from different reverse mortgage programs. Performing simple statistical calculation on survey data and participation records, researchers describe the profile of typical participants and estimate the benefits to different groups. Based on the trend showed in data, market size and potential target groups are identified. Recommendations on more housing counsellors and more comprehensive legal and regulatory system are also made. The evaluation of the market is performed when reverse mortgage had just started. Though the method was simple, it, nevertheless, is a way to look at the market.

Researches on reverse mortgages in other markets are scarce relative to the large quantity of researches in the United States. Except for a few data analysis study (Tse 1995) where reverse mortgages with fixed and variable interest rate are studied using Singapore data, other researches remained at theoretical level and within developed countries like the Australia, Great Britain where products are offered.

Recent study started to look at potential reverse mortgage markets. Most of the studies (Mitchell and Piggott 2004; Chou, Chow et al. 2006) analysed market environment such as culture, financial market, legal system and discussed the feasibility of the reverse mortgage product. Reverse mortgage research in China largely falls into this category.

1. Chinese reverse mortgage research

In China, reverse mortgage products have yet to be introduced, although researches have been going on for several years. Unlike the American style research, studies on the Chinese market are mainly theoretical. The focuses of those researches are concentrated on the urgency of providing the reverse mortgages, the advantages of the reverse mortgages, and the obstacles and suggestions.

China has one of the largest populations in the world. The number of greying population is overwhelmingly worrying as the one child policy downsized average family into one child supporting two elderly. The ongoing reforms in the health care system, social security system, and pension system have imposed even greater risks in elderly welfare (Feng 2005; Zou 2005).

Researchers see the reverse mortgage as a potential solution since the reform of property ownership made home equity a large fraction of senior’s total wealth. Reverse mortgages are seen as beneficial to both the individual and society as a whole. It can not only improve living standards, liquidate assets for individuals, but also stimulate consumption, promote development in the finance sector and provide a new line of business to financial institutions (Meng 2002; Chen 2004; Yan 2007).

Like the American market, high fees and charges are a general concern of the scholars. Aside from that, the incomplete systems that may lead to high legal, financial risks and lack of protection mechanisms will drive away both lenders and borrowers. The underdevelopment of the secondary housing market further worsens the situation (Feng 2006; Yang 2007).

Thus researchers recommend that the Chinese government should be the initiator of the reverse mortgage. Its involvement in this market is the best protection to both financial institutions and individuals. The cooperation between social security supervision agencies, banks and insurance companies could greatly enhance the performance of the market. Pilot tests and gradual expansion of practice could be a possible way of promoting the reverse mortgage (Wu 2004; An 2006; Fan 2006; Hu and Deng 2007; Yan 2008).

The literature on the Chinese reverse mortgage market is still theoretical and is still on higher level. More empirical studies are needed to support theories and point directions for industrial practice.

1. Current development in the Chinese reverse mortgage market

Although the research of reverse mortgages has been going on for several years, there still aren’t any reverse mortgage products available in the Chinese market. Nevertheless, there have been some attempts in utilizing home equity to support old age life in Beijing, Shanghai, and Nanjing, each has its unique feature.

Nanjing’s model involves nursing home and individual consumers. Individuals entitle nursing home full rights in their property after their death in exchange for free accommodation in nursing home. Only four cases were observed in two year’s practice.

Following similar idea, Shanghai proposed “home equity self support” model in which individuals sell their house to Shanghai Housing Fund Management Centre. In return, they receive a lump sum and keep living in their house. This program also attracted little attention.

In Beijing, the scheme is called “house bank”. The scheme differs from programs in the other two cities in that it does not involve the change of ownership of the property. A real estate agent works together with a nursing home. The former helps to manage individual’s property by leasing it out. The rent is used to pay the fees for staying in the nursing home. Despite the difference, this scheme is not popular at all.

As one of the first advocator of the reverse mortgage, Happy Insurance was enthusiastic in seeking alliance in providing such a product. Since the establishment of the company in 2007, Happy Insurance has been working on the design of the reverse mortgage product. To date, there is still no product available according to company’s website, but news says that it will be put into operation in 2009. It is still unknown how reverse mortgages will operate; however, as Happy Insurance is looking for partners in banking industry, it is likely that reverse mortgages will be introduced in the private financial sector first.

1. Conclusion and motivation

According to Chinese scholars’ theoretical analysis on the Chinese reverse mortgage market, the potential for reverse mortgages is huge due to rapid aging process, large population base, reforms in health care, social security and pension system. The government should have a great incentive to encourage the development of the product.

The observation of the current situation of home equity conversion program suggests otherwise. Neither is there a small number of entities involved in this business, nor are there much participation in the program. What is more, government’s attitudes toward this product are still unclear, though there is a change of property law and relax on restrictions on financial institutions.

Such contrast lead to people wondering whether there is a gap between theoretical conclusions and industry practice. In particular, questions like whether reverse mortgages can truly bring benefit to the elderly, how much could that be, why the government and financial institutions are not interested in such product, etc.

Consulting the international study on reverse mortgages, there aren’t many research methodologies we can adopt. This is due to the fact that there is no available data in China since reverse mortgage is yet to be introduced. Simulation, in this case, can be a good way to model the individual behaviour and study the aggregated effect of the reverse mortgages.

**Methodology and data description**

1. A multi-period simulation model

To evaluate the effect of the reverse mortgages on the Chinese seniors, and to assess the aggregated risk on suppliers, this section lays out a multi-period model of a typical Chinese senior’s retirement account balance.

The basic assumptions are as follows: A retiree aged at *t* has a total wealth *w*, which consists of liquid asset *w1* and home equity *w2* (*w*=w*1*+*w2*). For the liquid asset, he can either deposit in the bank earning the short term interest rate for each period, or invest in the stock market. The weight of investment in stock is denoted *π*. For the illiquid asset, he is allowed to take out a reverse mortgage against it. The upper limit of the reverse mortgage loan in the model is set at 80% of current home value.

The reverse mortgage options used in the model are adopted from the US practices, since US product choices are the most mature design in the reverse mortgage field; hence literally, there is no practice in the Chinese market for reference.

According to the experience of the US and Australian market, lump sum, line of credit (LOC) and hybrid of annuity and LOC are most popular among all the choices offered. Lump sum can be seen as a special case of LOC option in which the senior takes out 100% of his credit at first period. In addition, the effect of hybrid of annuity and LOC can be derived from combining two options. Thus LOC and annuities are the study subjects in our simulation.

One who chooses annuities buys actuarially fair priced annuities (*ax*, indicated by equation 1, where *r* is the discount interest rate and *λ*, *m*, *b* are the Go-Ma parameters (Milevsky 2006).) using part of his accessible wealth (liquid asset plus accessible home equity) at period 0. And one who chooses LOC takes out credit when liquid asset is not enough to cover consumption. The credit grows at the short term interest rate.

****

The loan (*APt*) is charged at a fix/variable interest rate which is equal to the long term interest rate plus a premium. It is repaid one period after people die, and no assumption on early move out is made.

Consumption (*ct*) decisions are based on total accessible wealth and life expectancy. The retiree evenly distributes his wealth for expected remaining life and adjusts at the start of each period. If the retiree does not have any home equity, a monthly rent (*cr*) is deducted from his consumption. When the consumption is not enough to pay the rent, a minimal consumption amount equals to rent is assumed.



Where



The utility gain for each period follows the constant relative risk aversion utility function with risk aversion level γ:



Where  is the indicator of not having any home equity.

For the whole life of a retiree, he has the following lifetime utility function:



Where *r* is the discount interest rate, *B* is the bequest motive indicator, *It* and *It’* are indicators of life status.

The aim of the simulation is to compare the expected utility, and certainty equivalent wealth for different scenarios detailed in the next section and to see the effect of the reverse mortgages on Chinese seniors.

1. Parameterization

Table 1 lists parameter choices for consumer’s consumption problem.

Table 1: Parameterization of the Consumer’s Problem

|  |  |  |
| --- | --- | --- |
| Symbol | Meaning | Values |
| *T* | Age | Min 60, 65, Max 105 |
| *Gen* | Gender | Male, Female |
| *γ* | Risk aversion parameter | 2, 5 |
| *B* | Weight on terminal bequest | 0, 10 |
| *H* | Starting home value | 0, 4001 |
| *w* | Starting total wealth | 6001 |
| *π* | Weight on investment in stock | 70%, 35% |
| *C* | Cap on the loan | 80%, 40% |
| *I* | Loan interest rate type | Fixed, Variable |
| *r* | Discount interest rate | Average long term interest rate2 |
| *rl* | Averaged loan interest | Average long term interest rate plus premium2 |
| *rp* | Premium charged by RM loan | 1.5% |
| *RMSta* | Status of Reverse Mortgage usage | Yes, No, CPI3 |
| *Rent* | Rent per month deducted if there is no initial home equity | 11 |
| ---Note: 1 Yuan value in thousand 2 Estimated from statistic modelling  3 Reverse Mortgage with inflation-adjusted annuities. |

The age groups that are of interest are 60 through to 90, in which 60 and 65 are the most important. The current retirement age for male in China is 60. As fewer workforces are expected in the future, there is a possibility that the retirement age will rise. Thus, 65 will be a sensible age to study.

The home equity is set at two thirds of individual’s total wealth. This assumption is made according to the ratio of the average saving and average home equity value of the elderly in China. Although the figure is slightly higher than that of the American’s (Davidoff 2009), it is consistent with the parameter used in Davidoff’s simulation. Since we are focusing on house rich, asset poor groups, this should be a reasonable assumption.

The weight on investment in stock is set at 70% and 35% for risk aversion levels 2 and 5 respectively. This follows a simulation result by Viceira (2001), where optimal percentage portfolio share of stocks in the retirement states are suggested. We lower the weight on stock from 90% and 36% to current level for the two risk averse levels in the consideration that the Chinese market is more volatile then Viceira’s setting, and there is more conserve attitude toward risky asset among Chinese people.

The discount rate, average loan interest rate are calculated from the historical data. The discount interest rate is the averaged long term interest rate, while the loan interest rate charged is equal to the discount rate plus a premium (*rp*) set at 1.5%. The inflation-adjusted annuity is calculated with an average inflation rate.

1. Economic scenario generator

The simulation is based on the Chinese context which includes the simulation of future financial data such as interest rates, inflation rate, stock exchange fluctuations, and housing price changes. At the same time, simulation is based on Chinese individual lives, thus modelling individual mortality is also an important element. For simulation purpose, data are collected on monthly basis.

The data to be used are short, mid, and long term interest rates indicated by SHIBOR, Chinese bond market, bank deposit and loan interests. Inflation rate is modelled by assessing CPI published by the National Bureau of Statistics of China. Stock index data comes from Shanghai and Shenzhen stock exchange indices.

There are various housing price index: national or regional, new property or second hand property, for instance. Since the property at the time of disposal, which is at the end of the contract, is always a second hand property, the main source of data will from second hand housing index.

In terms of mortality, there is no national mortality data available. The China Insurance Regulatory Commission (CIRC) has published several China Life Insurance Mortality tables. It is an appropriate source since there is still argument on whether there is adverse selection problem in the reverse mortgage. The degree of adverse selection built in life insurance mortality table may be the same as that in the reverse mortgage; otherwise, it could be easily adjust with high mobility rate.

The models used to recreate Chinese context are models used to analyse time series and mortality rate, in particular the ARIMA model and Gompertz-Makeham (Go-Ma) model. The ARIMA model is typically used to assess and predict future values of a time series. It is used to recreate Chinese financial environment and housing market. Go-Ma model is used to fit Chinese mortality table and recreate life status.

1. Simulation process

The simulation process starts with a creation of a large number of life paths for each gender starting from age 60 or 65. On monthly basis, life status (alive, dead) is randomly generated based on the survival rate of the month and the life status of previous month. Only individual with life status alive in the previous month is generated for the following month. And one cannot survive after 105.

Equal number of economic scenarios is then created for each starting age matching each life paths created. The standard normal random variables are firstly generated and transformed by multiplying the Cholesky matrix calculated from the covariance matrix of fitted residuals from the ARIMA models. This transformation captures the influences among random shocks of each financial indicator, thus allowing dependence among indicators. The ARIMA models indentified in statistic modelling process are then used to calculate the indices month by month.

Before going into calculating the cash flow for each life month by month, initial conditions are set according to parameter settings. In the case of LOC, individual invests his non-housing wealth according to *π*. If he opts for annuity, half of accessible wealth (non-housing wealth plus wealth borrowed against the house) is used to buy annuities, except when he has bequest motives but cannot borrowe against the house where he only use a quarter of his non-housing wealth to buy annuities. The rest are distributed among cash and equity according to *π*.

For every life, cash, equity, housing value, debt and wealth are determined month by month according to following formula:

 

 

 

 

 

Consumption, expected utility are calculated according to the model specified in previous sections. Dying age, expected utility and loan loss are recorded for analysis.

**Time Schedule**

The proposed research can be separated into five activities:

(1). One month will be devoted to a literature review on reverse mortgage research and current status of practice and research in Chinese reverse mortgage market. [One month]

(2). Primary data will be collected and basic static analysis will be preformed to examine the appropriateness of the data. Based on the preliminary analysis of the data, proper ARIMA models will be identified for each index, and parameters will be estimated for each model. [Three months]

(3). The simulation model will then be developed, and the economic scenario generator will act as an input to the simulation model. The model will build on R, and the result will be stored in spread sheet for analysis. [Four months]

(4). Analysis of the outputs from simulation will involve the evaluation of utility and consumption alleviation of consumers and loss rate and aggregated loss of supplier. Stress test will be performed to assess the influence change in premium and loan cap. [Three months]

(5). And finally, analysis results will be presented in the form of publication. [One month]

**Expected Results**

The expected results obtained from the proposed research can be classified in three folds:

1). The results are expected to confirm the conclusions of many researchers in China that the reverse mortgage is a good financial tool to help maintain a good living standard after retirement. The results are also expected to reveal the big risks imposing suppliers and partly explain why there is a shortage of supply.

2). The results are expected to provide data support for government policy making, corporate strategy decisions as well as industry participants’ judgement. The model helps the government assess the risks for suppliers and thus provide appropriate protection if they were to support reverse mortgages. The model also enables corporation price reverse mortgages and examine the effect of price changes. In addition, the model gives industry participants a piece of evidence and data support to facilitate retiree’s decision on entering reverse mortgage transactions.

3). The simulation method and modelling process provide a way to analyse reverse mortgage markets in other countries as well as new financial products in China. This approach, although not new, is seldom used in these areas. This research will demonstrate the strength of simulation in analysing the effect of new financial products.

The reverse mortgage could be an important aspect of retirement financing in China given the current economic development level, social and family structure, and government reforms. This research provides another approach to present reverse mortgage and enhances the current knowledge on reverse mortgages.

**Reference**

An, H. (2006). "Difficulties and recommendations to Reverse Mortgage [in Chinese]." *Journal of Guangxi Financial Research* **398**(7): 34-36.

Boehm, T. P. and M. C. Ehrhardt (1994). "Reverse mortgages and interest rate risk." *Journal of the American Real Estate and Urban Economics Association* **22**(25): 387.

Case, B. and A. B. Schnare (1994). "Preliminary evaluation of the HECM reverse mortgage program." *Journal of the American Real Estate and Urban Economics Association* **22**(25): 301.

Chen, B. (2004). "Develop Reverse Mortgage, Improve Social Security System [in Chinese]." *Housing Security*(5): 16-17.

Chinloy, P. and I. F. Megbolugbe (1994). "Reverse mortgages: Contracting and crossover risk." *Journal of the American Real Estate and Urban Economics Association* **22**(25): 367.

Chou, K.-L., N. W. S. Chow, et al. (2006). "Willingness to consider applying for reverse mortgage in Hong Kong Chinese middle-aged homeowners." *Habitat International* **30**(3): 716-727.

Davidoff, T. (2009). "Housing, Health, and Annuities." *Journal of Risk & Insurance* **76**(1): 31-52.

Fan, Z. (2006). "Bright future for Reverse Mortgages [in Chinese]." *Rural Credit Cooperative of China*(10).

Feng, J. (2005). "Reflections on Reverse Home Mortgage [in Chinese]." *Journal of Shanghai Finance University*(5): 46-49.

Feng, J. (2006). "International Reference and Practice of Housing Reverse Mortgage Loan [in Chinese]." *Journal of Financial Theory and Practice*(5): 26-29.

Hu, R. and J. Deng (2007). "Development of old age finance based on International experience [in Chinese]." *Journal of Guangxi Financial Research*(3): 40-42.

Jackson, R., K. Nakashima, et al. (2009). China's Long March to Retirement Reform, Center for Strategic & International Studies**:** 1-50.

Kaplan, R. L. (1993). "Tapping the equity of older homeowners with reverse mortgages." *Journal of Accountancy* **175**(2): 36.

Klein, L. S. and C. F. Sirmans (1994). "Reverse mortgages and prepayment risk." *Journal of the American Real Estate and Urban Economics Association* **22**(25): 409.

Kutty, N. K. (1998). "The scope for poverty alleviation among elderly home-owners in the Untied States through reverse mortgages." *Urban Studies* **35**(1): 113.

Mayer, C. J. and K. V. Simons (1994). "A new look at reverse mortgages: Potential market and institutional constraints." *New England Economic Review*: 15.

Meng, X. (2002). "Building Reverse Mortgage Insurance - recommendation to elderly social security system [in Chinese]." *Real Estate Guide*(17): 12-14.

Merrill, S. R., M. Finkel, et al. (1994). "Potential beneficiaries from reverse mortgage products for elderly homeowners: An analysis of American Housing Survey Data." *Journal of the American Real Estate and Urban Economics Association* **22**(25): 257.

Miceli, T. J. and C. F. Sirmans (1994). "Reverse mortgages and borrower maintenance risk." *Journal of the American Real Estate and Urban Economics Association* **22**(25): 433.

Milevsky, M. A. (2006). *The Calculus of Retirement Income: financial models for pension annuities and life insurance*, Cambridge University Press.

Mitchell, O. S. and J. Piggott (2004). "Unlocking housing equity in Japan." *Journal of the Japanese & International Economies* **18**(4): 466-505.

Pritchard, A. J. and K. J. Mahoney (1986). "The Connecticut Reverse Mortgage Program - Achievements, Problems And Lessons." *Gerontologist* **26**: A46-A47.

Rasmussen, D. W., I. F. Megbolugbe, et al. (1997). "The reverse mortgage as an asset management tool." *Housing Policy Debate* **8**(1): 173-194.

Szymanoski, E. J., Jr. (1994). "Risk and the home equity conversion mortgage." *Journal of the American Real Estate and Urban Economics Association* **22**(25): 347.

Tse, Y. K. (1995). "Modelling reverse mortgages." *Asia Pacific Journal of Management* **12**(2): 79.

UN (2007). World Population Aging, Department of Economic and Social Affairs Population Division**:** 1-483.

Viceira, L. M. (2001). "Optimal Portfolio Choice for Long-Horizon Investors with Nontradable Labor Income." *Journal of Finance* **56**(2): 433-470.

Wu, H. (2004). "Introduction to Reverse Mortgage [in Chinese]." *Journal of Zhejiang University (Humanities and Social Sciences)* **34**(6): 39-39.

Yan, A. (2007). "Discussion of Reverse Mortgage in China [in Chinese]." *Keji Jingji Shichang*(3): 56-57.

Yan, A. (2008). "The Aging of the Population and Housing Reverse Mortgages in China." *Canadian Social Science* **4**(4): 76.

Yang, M. (2007). "Analysis of Reverse Mortgage in China [in Chinese]." *Journal of Capital University of Economics and Business* **9**(6): 36-38.

Zou, X. (2005). Reverse Mortgage: an area in need development [in Chinese]. *CCISSR Forum*.