An exploratory analysis of payoffs for the lifetime mortgage of farming assets and its policy implications

Gil H. PARK, Deokho CHO

Daegu University, Gyeongsan, South Korea

Abstract: This study discusses and calibrates a pioneered model of estimating the payoffs for the farming-asset pension (FAP), which is to comprehensively integrate the components of farming assets into the recently implemented farmland pension (FP) in South Korea. The FP was introduced first in the world so that farmland may be liquidated by the lifetime mortgage of farmland. However, it differs from conventional lifetime or reverse mortgages because its annuity program is implemented by the government according to the actuarial model whose variables are adjustable from the viewpoint of the elderly welfare. By introducing a simple standard of comprehensive farming assets into the FP model, the FAP model augments this social security measure, the step-by-step improvement of which is also expected to formulate the future policy implications of regional economic revitalisation as well as the elderly welfare for other countries.

Key words: Farming-Asset Pension (FAP), reverse mortgage, rural elderly, farmland

In contrast to Western countries, over decades since the late 1950s, the "rapid" rural-to-urban migration of the massive baby boomers was a great opportunity to the general welfare improvement based on (external) economies of scale in many cities of Asian absolute poverty countries (Mason and Kinugasa 2008; Douglass 2013). Despite such economic welfare improvements in "cities," however, their current "mass" retirement is, in turn, emerging as a huge diseconomy and a social welfare problem for both the urban and rural elderly, since the massive cohort generally did not devote much of time in providing for retirement (Giles et al. 2011; Ma and Deng 2013). At present, across urban to rural areas, such a lack of preparedness in insufficient social welfare provisions leads to the common problem of mismatch between the retirees' eligible age for pension benefits and the retirement age, especially in many Asian developing countries (Giles et al. 2011; Mason and Lee 2011).[1]

Regarding the greater insecurity of retirement plans for "rural" areas within a nation, however, there are few international exceptions because ageing rural baby boomers usually have continued to earn and save less for retirement regardless of countries (Macours and Swinnen 2005; Giles et al. 2011; Cho et al. 2008). Even in Europe, whose rural welfare and economy have been more advanced than other areas in the International Rural Ageing Project, there also has been much interest in the recent rural ageing and poverty as either a "global" challenge or a highlighted research area (Burholt and Dobbs 2012). Therefore, for both developed nations and developing countries whose income gaps between urban and rural areas are mostly greater, the insecurity of retirement plans needs to be differently addressed between urban and rural regions in a "common" perspective.

In particular, the common lack of post-retirement options over the world needs to be addressed analytically and normatively from the viewpoint of rural poverty, since many retirees are the "post-1945" baby boomers, who are more likely to fall into a (relative) poverty than the younger cohort. Recently, in the

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[1]For instance, it is recently reported that about 34% of men and 15% of women have access to pensions in the South Korean rural and urban areas (Giles et al. 2011). It is the lowest level of pension access among the OECD countries. However, in South Korea (hereafter to be referred as Korea), one of the fastest developed countries, there is no public support for the elderly boomers' retirement in their fifties. It is highly problematic that the discrepancy between the age of receiving pension benefits (e.g. 60 or later according to the year of birth) and the average age of retirement (e.g. 57.4 or about 53 including (pressurised) early retirement) spans from 5 to over 10 years.

international comparisons of farmland succession and retirement in England, Australia, Ontario, Quebec, Iowa, North Carolina, Jew Jersey, and Pennsylvania over years 1991 to 2010, Lobley et al. (2010) have showed that a lack of affordable housing and available loans for increasing old retirees and declining rural successors, as well as the ageing farmers' shortage of appropriate skills for other opportunities in retirement and the consequential lack of motivation to retire, became a significant rural problem. In the case of the Central and Eastern Europe, the ageing of declining agricultural labour has also been serious over the Czech Republic, Estonia, Slovakia, and Hungary, although the degree of rural poverty differs (Macours and Swinnen 2005). It is also an old story that the rural poverty in the US became a serious problem particularly regarding the inevitable intergenerational earnings transmission due to credit constraints (Barrett 2005). Along with the development of the FTA, international agricultural trades have recently emerged as significant threats to Asian countries such as China and Korea, whose massive rural population is ageing and relatively more poor than either their urban population or European rural elderly (Cho et al. 2008; Lin et al. 2012). All these international circumstances support the rationale of an improvement or innovation in providing post-retirement options through a new program for the rural elderly welfare and production, and the Korea's "housing pension" (HP) and "farmland pension" (FP) have shared such international awareness and policy effort.

In order to expand the post-retirement options (together with the HP[2] for urban areas), the FP, the lifetime mortgage of farmland for rural regions has been implemented by a public enterprise (the Korea Rural Community Corporation) in the representative Asian country of greater urban-rural gaps and massive post-1945 baby boomers to be potentially poor again. Although as of November 2013 less than 3000 elderly people have subscribed to it since January 2011, the 3-year cumulative number of its subscribers has exceeded the 3-year cumulative number of either the HP (1338) or the US Home Equity Conversion Mortgage (HECM) (1019) subscribers and its potential subscribers can further increase according to the real phase of the mass retirement of ageing rural baby boomers. Since many of the ageing and aged rural baby boomers are involuntarily self-employed on their small- to medium-scale farm because of a lack of other alternatives or labour force, the expansion of post-retirement options through introducing the FP may help them to sustain income at least above the level of the minimum living expenses despite their termination of work.

The elderly welfare approach rooted in the pioneered model of the FP, however, still requires a more realistic method for minimising the individual and social cost of welfare provisions in the real phase of ageing rural baby boomers' mass retirement. In this sense, an up-to-date actuarial model that minimises the following "seemingly-traded-off" costs or risks is important to the ageing rural baby boomers to retire or have just retired. For rural subscribers, the opportunity cost of the gradual handover of home ownership or the suspended production should also be considered in the actuarial model. For an insurance institution, the financial instability risk or the subscribers' longevity risk needs to be taken into account as well. In order to manage those risks in a simultaneous framework, as well as the FP variables such as land price changes, interest rates and mortality rates, any appropriate component of the household asset is to be conceptually and operationally introduced into the model as either a 'hedge' for insurance institutions or 'another liquidated asset' for rural subscribers.

If a rural household wants to stop producing in the FP plan, its opportunity cost includes the transacted or appraised value of the farmhouse to "live in" and

[2]For urbanised regions in Korea, the mismatch between the eligible age for pension benefits and the age of mandatory or (pressurised) early retirement is also even greater than in the Western countries. The average retirement age in Korean urban areas is the mid-fifties, while the OECD average is about 65 (Kim 2013). As of September 2013, in order to resolve this mismatch together with the government, more than 16 000 urban elderly people have subscribed to the lifetime mortgage of housing, which has been implemented by a public enterprise (the Korea Housing Finance Corporation) for improving the post-retirement welfare universally (unlike the social housing pension scheme for workers in social housing in the UK). Although the subscription rate to this housing pension (HP), which was launched in July 2007, showed gradual increases in past several years, recently it has shown more than 10% increase every month. Considering the recent retirement of the post-1945 baby boomers in urbanised areas, which has just been on track, the advance subscription to the HP has also become available to the fifties as well since June 2013. However, 75.9% of the HP subscribers are urban residents especially in the Seoul metropolitan area, whose income and housing values are much higher (KHFC 2013), as the US HECM users are mostly from urban areas with a higher income and house prices (Bishop and Shan 2008).

the farming building to "produce." Considering this potential value or capacity, farming buildings and farmhouses can be continuously used even after being renovated, remodelled or rebuilt, not to mention the farmland. For ageing rural baby boomers as the potential subscribers, therefore, a farming building or a house can be a component of its buyers' or rural migrants' comprehensive assets whose value is depreciated or even increased through renovation and (adaptive) reuse over the pension period. Unless they are abandoned, the value of farming buildings and houses still needs to be appropriately appraised.

As a cornerstone of this "farming-asset pension" (FAP) approach, this article examines and calibrates a pioneered model of estimating the payoffs for the FAP, which is to comprehensively integrate the components of the above farming assets into the FP in Korea. Considering farming buildings in addition to farmhouses as a standard farming asset component to be pensionable, this study calibrates a simple model to estimate the payoffs for the FAP. Since this FAP model considers the opportunity cost of not only "farmland" (real estate) but also "farming" (producing), it is expected to improve the rural welfare and rural economy (through the unionised farmers' systemized large-scale production after the division and integration procedure of handed-over pensioned farmland) more than the conventional public intervention in farmland via the price support, whose capitalisation resulted in a (potential) weakening of farming activity and a leakage of support outside of the farming and rural sectors as in the Czech Republic (Latruffe et al. 2008). Since the FAP model augments the social security measure of the FP for the rural elderly and, for the regional economy, productivity in its simultaneous framework, the exploratory analysis of simulated data on such a basic and common farming asset to be pensionable as farming buildings and farmhouses is expected to formulate policy implications of the regional economic revitalisation as well as the elderly welfare for other countries.

THE BACKGROUND OF THE "FARMLAND" PENSION

It was not until recently that equity release or reverse mortgage was noticed as a welfare instrument for funding retirement, not just an option for funding the home improvements or supplementing income in Europe and in the US. Recently, Chia and Albert (2005), Melanie (2008), Bertocchi et al. (2010) and Alonso et al. (2013) have begun to highlight equity release or reverse mortgage as an instrument for pension. Despite some international differences in mortgages, a new recognition of the importance of lifetime or reverse mortgage as a viable pension plan suggests the overall insecurity of the existing post-retirement plans. In particular, the mass retirement of the post-1945 baby boomers in these countries and in many others as well, necessitates a way of augmenting or turning around the existing models to which they have been resorted for preparing for retirement. Moreover, without an effective measure to prevent the longevity-driven funding shortfalls, the conventional lifetime mortgage may become vulnerable to a more serious longevity risk in the coming phase of population ageing, whereas the widespread of the house poor phenomenon over the world (Chiuri and Jappelli 2010; McConnell 2012; Bokhari et al. 2013) can also increase such vulnerability.

Facing the start-up mass retirement of its baby boomers as well, a line of previous studies on the FP (Cho et al. 2008; Yeo and Cho 2010; Kim et al. 2012), whose implementation has been facilitated after the successful administration of the HP (Table 1), have recently developed from Korea. Over the world, it is widely known that copious studies have addressed the mortgage and reverse mortgage of houses, but a line of FP studies from Korea are noticeable among them as an academic and policy movement toward ensuring the household pension income for the rural elderly. A recent outstanding increase in the number of yearly new subscribers to the Korean government's first reverse mortgage program and a continued decrease in their yearly mean age (Figure 1) are also positive factors for a potential increase in both HP and FP subscribers in Korea, which entered the ageing society in the year of 2000. To put it simply, the FP is the lifetime mortgage of farmland and is originally developed from the foundational study, Ha and Cho (1997), which dealt with the conceptual framework of the life-time housing model (LTHM).

Originally, the LTHM was suggested to integrate the mortgage and reverse mortgages of housing over an individual's lifecycle. Before retirement, a worker can gradually secure his or her homeownership through a mortgage loan from financial institutions. After retirement, over the schedule whose equity release or home equity conversion program is directly applied to the same subscriber, his or her (pension) income is secured through the same or affiliated institution's reverse mortgage or reversion of the same housing as well.[3] Although the determination of interest rates

Table 1. The number of yearly subscribers in the representative Korean and Western programs

Yeas after introduction	1	2	3	4	5	6	6-Year Total
HP (Korea, July 2007)	831	1 014	1 338	2 503	3 979	5 201	14 866
HECM (US, 1990*)	157	389	1 019	1 964	3 365	4 166	11 060

*The cumulative number of the HECM mortgages is 0.39 million as of February 2008, and presently is approximately one million (Haurin et al. 2013; HUD 2013a). According to Bishop and Shan (2008), the average HECM user continues to become younger.

and repayment methods should differ according to the market and institutional characteristics and welfare considerations, this integrative approach shed a light on the coupling of human life and asset cycles over a lifetime.

The FP is developed from the LTHM approach in order to ensure the extended provision of asset-based income options to the rural elderly over their lifetime and the economic feasibility of this social security program is also good. In the past, the out-migration from rural areas meant an unavoidable decrease in rural land value and labour. Recently, however, the improvement in land use and zoning systems and the replacement of human labour with productive agricultural machines or facilities are offsetting such a decline of labour on (handed-over) farmland in Korea and Europe (Douglass 2013; Forbord et al. 2014). With respect to land and farming assets, in particular, improved productivity and transportation now lead to increasing the rural land and asset demand by an increase in the "post-urbanisation" rural migrants who want to spend the rest of life in enjoying rural life rather than (physically) labouring in cities (Douglass 2013).

The rural land's trade off with the value of urbanised land is also a positive factor to such increased demand, because the FP subscribers can freely decide to work on their farmland for themselves or to retire while the farmland can be continuously cultivated by the rural migrants or employees (Cho et al. 2008). In addition, since the average urban worker in the third percentile (among five intervals) earns 3690 US dollars as the non-equalised monthly ordinary income (3035 dollars after taxes and other charges), which is 1070 dollars higher than the average rural worker's non-equalised monthly ordinary income in the second quarter of 2013, the same amount of payment can be better off for the rural elderly than the urban elderly with the HP. Of course, land values exceeding liabilities can be inherited or handed over in the FP scheme whereas liabilities exceeding land values will not be claimed against the subscriber's farmland under the general "non-recourse" principle. If the payoff values still exceed the minimum living

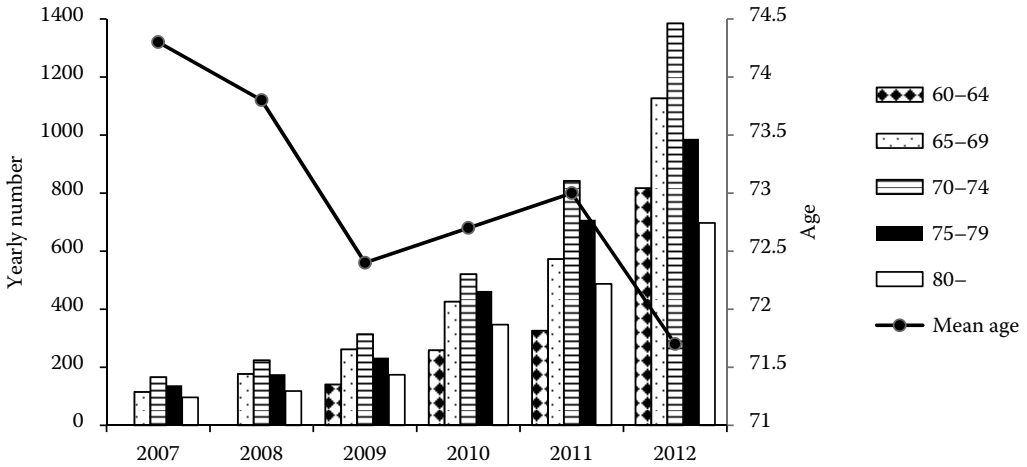

Figure 1. Yearly number of new HP subscribers and their yearly mean age

[3]The constraint that a subscriber should repay and be paid on the condition of the same housing as a mortgage and reverse mortgage needs to be systematically improved in terms of either residents' mobility or property value. The detailed programs and techniques for this systematic improvement will be discussed as a new model in the follow-up papers to this article.

expenses (e.g. per-household-member 570 US dollars monthly "regardless of ages") even after considering the proportion of ages 65 or above (e.g. 34.2%, 13.6% higher than the national average) and the more stable but lower growth trend of the farmland price, the lifetime mortgage of farmland will be a viable welfare and financial program.

Considering the circumstances above, the Korean government implemented the FP for rural areas since 2011 after the implementation of the housing pension (HP) in 2007. The actuarial model of basic annuity plans for managing the FP, which was developed in Cho et al. (2008), is as follows:

$$PVMIP = UP_0 + \sum_{t=1}^{T(a)} \frac{MIP_t \cdot P_{a,t}}{(1+i)^t} =$$

$$= \sum_{t=1}^{T(a)} \frac{max((OLB_t - L_t)Q_{a+t,}0) \cdot P_{a,t}}{(1+i)^t} = PVEL \quad (1)$$

where:

$PVMIP$ = present value of the total projected mortgage insurance premium

$PVEL$ = present value of the expected losses

UP_0 = up-front mortgage insurance premium at $t = 0$

$T(a)$ = the number of months left for the subscriber living until 100 years old

MIP_t = Projected monthly mortgage insurance premium at t:
$MIP_t = (OLB_{t-1} + PMT) \times m$
where:
PMT = Annuity payment (constant monthly payment)
m = % of monthly mortgage insurance premium

OLB_t = expected outstanding balance at t:
$OLB_t = (OLB_{t-1} + PMT + MIP_t)\ (1 + i)$

L_t = expected farmland value at t:
$L_t = L_0 \times (1 + g)^t$
g = Average farmland value rising rates

Q_{a+t} = probability of loan termination at age $a + t$

$P_{a,t}$ = loan survival probability for the subscriber living until age $a + t$

i = interest rates (discount rates)

In Equation (1), the main determinants or variables are g, i, Q_{a+t}, and $P_{a,t}$ under the condition that $PVMIP = PVEL$. While Q_{a+t}, and $P_{a,t}$ can be forecasted quite accurately based on the population estimates according to such widely adopted method as the cohort survival method, g and i have a stochastic characteristic that still needs to be appropriately controlled in the actuarial model. Prior to its exploratory analysis under the condition of $PVMIP = PVEL$, where comprehensive farming assets are considered as an equity to be released, this article discusses the method to operationally define such assets into the FAP actuarial model in the following section.

MODELLING THE "FARMING-ASSET" PENSION

Although the annuity plan which was formulated in Equation (1) is basic, it has a strong point as an extensible model to reflect variable conditions according to the financial, economic, and demographic changes. For instance, land price changes, interest rates, and survival probabilities can be adjusted by different statistical or probability assumptions and welfare modelling. Based on the previous analytical studies on the FP, in this section, this article suggests an extension of the basic model, which is developable as a basic annuity plan for "farming-asset" pension.

This study improves the existing "farmland" model that was analysed in Yeo and Cho (2010) and Kim et al. (2012). In order to derive managerial implications for appropriately liquidating the farmland asset, Yeo and Cho (2010) focused on the economic variable, e.g. field price change, and tried to make a long-term forecast of the rural land prices. The study compared the estimates of land price by the ARIMA (Autoregressive Integrated Moving Average) model and the actual value of the past time-series data in order to overcome the short-run applicability and deterministic limitation, and applied the anterior constraint of the results to the Monte Carlo simulation of the future price of the field whose pension income could be adjusted by Equation (1) under different probability assumptions. Both the estimated field value and the forecasted field value of the selected ARIMA (1, 0, 1) model were greater than the actual and future values whose standard deviations were also smaller. Its analytical results suggested the stochastic value of field price can be lower than its deterministic value in 20% out of 100%, which implied a need for further rigorous analyses and planning of that 20-percent risk.

Focusing on the financial aspect as well as economic considerations, Kim et al. (2012) then did an analysis to predict the risk which the lender bears according to the interest rate changes. Kim et al. (2012) found that the certificate of deposit (CD) rate is appropriate for building annuity plan to consider the coupling of stable and bearable characteristics of pension benefits (as one of the social security measures) with the rural elderly demand for a more repayable mortgage premium.

Table 2. Average interest rate and stability

	91-Day CD		3-Year GB		3-Year CB	
	2001–2010	2001–2012	2001–2010	2001–2012	2001–2010	2001–2012
Annual average rate (%)	4.78	4.09	5.25	4.52	6.18	5.42
Standard deviation	1.13	0.99	1.30	0.90	1.49	1.13
Theil's U^*	0.98		1.01		1.01	

*It is the positive square root of the following: % change in the predicted value minus % change in the actual value, which is divided by the squared value of % change in the actual value. If it exceeds unity, then the referenced value cannot be used for statistical forecasting.

Table 2 summarises the results that were analysed for the years 2001 to 2010 in Kim et al. (2012). The 91-day CD rate is the most stable as for its standard deviation (1.13), which is quite lower than the 3-year government bond (GB) and the 3-year corporate bond (CB), and its nominal rate is also much lower than the others. Let alone this stable and bearable characteristics, the Theil's *U* as a statistic to measure the precision of the ARIMA forecasting also shows that only the 91-day CD is lower than unity, which suggests its numerically better applicability than the other interest rates for the sake of statistical forecasting.

In addition, all the interest rates in Table 2 have recently decreased in their means and standard deviations, which proved the overall "low-interest" trend according to the U.S. quantitative easing after the subprime crisis. Moreover, the mass retirement of the baby boomers as a primary economic engine is now being on track and the world's lowest birth rate has been continuously recorded in Korea, so the unprecedented fast growth of the Korean economy or the asset value increase is not likely at least during the lifetime of the baby boomers. In reality, the most recent interest rates until the year of 2012 show this overall low-interest trend according to the post-subprime recession along with the baby-boomer engine's mass retirement, which in turn strengthens the necessity of low interest rates at least during their lifetime for the sake of the (rural) elderly welfare. From the viewpoint of realistic actuarial modelling in consideration of the viability or economic feasibility of the pension funds, however, such a lower interest rate is less appropriate and a hedge or collateral becomes more necessary. Considering this trade-off between lower interest rates and more secured pension benefits, the introduction of another liquidated asset like farming buildings enables rural subscribers to pay higher interests while the insurance institutions as well as themselves become better off in less risky scenarios.

Based on the findings in the previous studies of the FP above and the current socioeconomic conditions, this study proposes and basically tests an integrative actuarial model of the FAP (Equation 2). Together with the FP literature, the FAP also shares its approach to the coupling of asset and life cycles for welfare improvement with the LTHM. Its primary difference to the FP is that it is the reverse mortgage of farming assets, not just of farmland. In sum, the extension of mortgage to the farming assets other than farmland is considered regarding the following two reasons. First, for rural subscribers, it extends the scope or scale of the pension benefits the source of which is limited to farmland, while for the insurance institutions, it can be managed as an additional hedge. In the case of the HP, a (urban) house is a sort of simple collateral, which is usually without any (productive) attachment, and the annuity plan is applicable mainly to urbanised areas the house prices of which are higher. Meanwhile, in the case of the FAP, a house and a farming building on, around, or near farmland can be approached as a comprehensive rural asset. Second, such extension is also expected to help the "post-urbanisation" rural migrants to settle down (by renovating, remodelling, or adaptively reusing such facilities) so that they can actively participate in the large-scale and systematic production of "agribusiness" through their experience in urban businesses.

Mathematically, the actuarial model of this FAP is based on Cho et al. (2008) and incorporates a landowner's depreciable housing or building with farmland by introducing the term of "depreciated value at time *t*," denoted by *Dt* in the equation below:

$$PVMIP = UP_0 + \sum_{t=1}^{T(a)} \frac{MIP_t \cdot P_{a,t}}{(1+i)^t} = \sum_{t=1}^{T(a)} \frac{max((OLB_t - L_t - D_t)Q_{a+t,}0) \cdot P_{a,t}}{(1+i)^t} = PVEL \quad (2)$$

D_t = depreciated value of the farmhouse and/or building at *t*

Based on the basic annuity model of the FAP above, the following section is to deal with the operationalization of risk factors including the field price and interest rate changes, the loan survival and termination probabilities, and the depreciation rates. The analytical results of the calibrated FAP model are expected to formulate analytically derived policy implications for the post-urbanisation welfare for the rural elderly and rural economy in Korea and developing countries.

DATA AND ANALYSIS

The primary data source for the farming-asset actuarial model is from the statistical table provided by the Korea Land and Housing Corporation (KLHC). The original table summarises the percent change of the regional and national field price for the years 1987 to 2012. The original data is constructed quarterly until 2004 and made monthly since January 2005. Utilising this table, Kim et al. (2012) selected the Gyeongbuk Province whose 57 000 parcels of farmland can be estimated by its empirical data and whose farmland area is the largest among 17 Korean provinces.[4] The analysis in Kim et al. (2012), however, had some problem of precision because the quarterly figure was divided by 4, i.e., the number of one-seasonal months.

The monthly data of land prices

Instead, for a more precise result, this study used the most recent "monthly" data of the field price changes per se, e.g. for the years 2005 to 2012, rather than the quarterly data. In addition, as an improvement from Kim et al. (2012) and Cho et al. (2008), whose data is limited to the Gyeongbuk Province, this study uses the "national" farmland data. Since either the FP or the FAP is based mainly on the farmland or field which is mostly located in the least urbanised areas, its relative stability, notable in comparison to the HP and this stability, can be a strong point of the F(A)P the expected subscribers of which are the non-urban residents.

It is obvious that the farmland price is more stable than the housing price despite its lower growth rate over recent 8 years, and the farmland (field) price is not only more stable (except for Seoul) but also more growing than the land price. Figure 2 shows the percent changes in the time-series field prices of the nation and ones of Seoul – the most urbanised region as the capital the metropolitan area of which contains half of the national population within 11.8% of the national land. As the values in Table 3 and Figure 2 show, the standard deviation of the national field, i.e. farmland, the value of which is much lower than both the field and land prices of Seoul, is the lowest. This suggests that the national field price has been more stable than all else. In terms of the mean growth rate, the national field price is observed to have risen more than the Seoul's land price, but less than the Seoul's field price. Although the highest values are seen in the field price of Seoul, the sporadic (paddy) fields in the out-ring suburbs (in and around the greenbelt) are not statistically

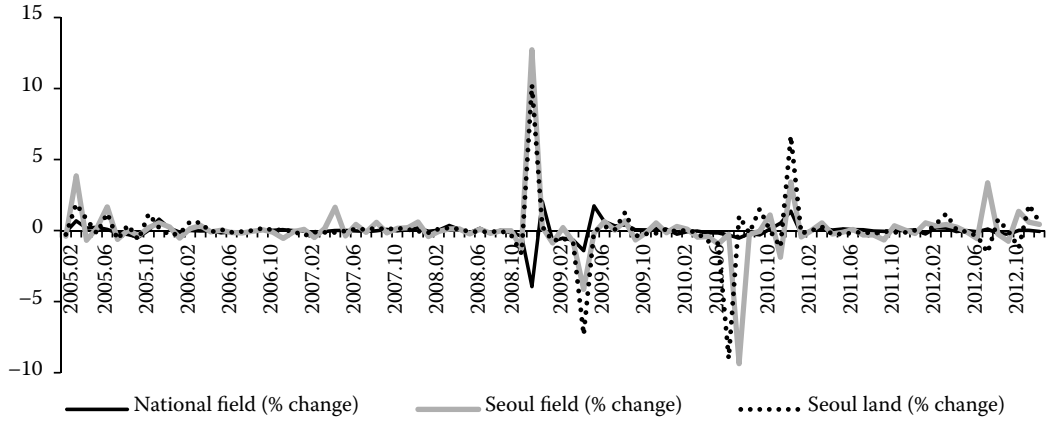

Figure 2. Percentage changes in the national and Seoul field (land) prices 2005–2012

[4]As of 2010, the Gyeonbuk Province shares 15% of the total national farmland, 5.9% of the regional production (national average: 2.7%), and 23.4% of the regional workers (national average: 7.0%) (KLHC 2013). Although the Gyeonbuk Province does not represent the whole country, these figures suggest that it can be a model region to which the analytical and practical application of the FAP annuity plan can be made, so that rural welfare and economic implications for other parts of the country are drawn from it.

Table 3. Descriptive statistics of % change in the monthly real estate price 2005 to 2012: FP vs. HP cases

Region	National			Seoul		
Type	field	land*	housing	field	land*	housing
Mean	0.273	0.188	0.324	0.521	0.243	0.340
Standard deviation	0.368	0.406	0.473	0.865	0.598	0.765

*Here land refers to the entire ground including fields

Source: KLHC (2013)

and empirically important in terms of an asset to be liquidated for pension.

The most critical fact is that the national field price growth, which is much more stable than the others, exceeds either the national or Seoul land price growth. This indicates the national field price's appropriateness as both a liquidated pension base for rural subscribers and an additional hedge for the insurance institutions. In Table 3, this pattern is manifest in the case of housing as the difference between the national and Seoul's housing price means is smaller and the difference between their standard deviations is overall larger than the land prices. This suggests that the housing prices are more variable and responsive to external changes than the land prices.

In light of the comparisons of the ARIMA estimation and the past time-series data in the previous section and detailed figures in Table 3 and Figure 2, the lower value than the minimum value of the 2005 to 2012 land growth rate (0.188), e.g. monthly 0.150%, was applied to the FAP actuarial model to manage future risks. Despite the highest stability, this lower monthly growth rate considers the fact that the percentage of ages 65 or above in the total rural population is 34.2%, while the one in the total national population is 10.6% as of 2009, and pooling cannot help but apply to rural areas only. In addition to such higher proportion of old people to receive much higher payments, it is also considered that the overall decreasing rate of the economic and real estate price growth over time has followed "the logistic curve" in the long run, along with trends of "accelerated" ageing and mass retirement (under overall economic and real estate recession after the sup-prime mortgage crisis). For instance, Figure 3 shows that over 1990 to 2012, the common trend of the vicennial per capita national income growth and the field price growth is found when the average field value in 1989 is set to be a base (100). In terms of the co-integration coefficient of the per capita GNI, the rescaled field value the whose computations were made by subtracting 100 from the original values and scaling 10^3 times (considering the base value of 100 and scale difference to per capita GNI examinable in the graph) shows 0.73. With the trend line to the national field price the goodness of which fit is over 0.97 in its quantic polynomial interpolation, this common trend suggests that the field price as the land price is likely to grow in a similar trend of the S-path, although the degree of similarity will depend on the multivariate variability, which can be further decomposed by the structural vector auto-regression (SVAR) or vector error correction (VEC) models, the endogenous variables of which need to be compared to one another or in the (counterfactual) cases with other exogenous variables.

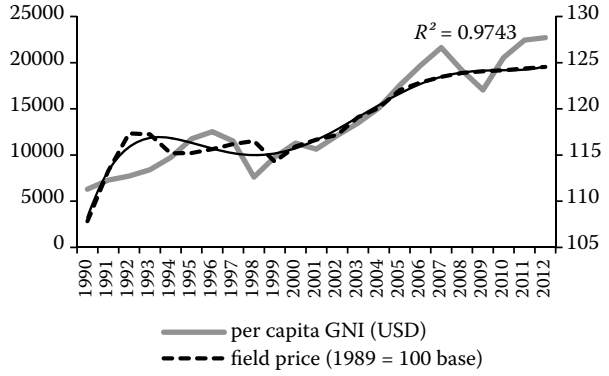

Figure 3. National per capita income and the average field price (right axis) with the trend line

The smaller variability of the farmland price, of course, is preferred regarding not only the statistical stability to minimise the financial risk but also the ageing rural residents' demand for a more bearable insurance premium, which can be enlarged according to the socioeconomic circumstances where the share of the elderly population is more peaked than ever. In addition, the huge difference of the population ageing between the urban and rural areas suggests that an increasing need for more accurate payoffs from the actuarial model with another liquidated asset like farming buildings in which the rural elderly's welfare preferences such as lower interest rates or insurance

premiums can be accommodated within the viable options provided by the "economical" insurance institutions (e.g. in Korea, a public enterprise) that can appropriately manage risks.

Monthly loan survival probability

The table of mortality rates released by the Korea National Statistical Office was used for estimating the monthly loan survival probability. In estimating the monthly loan survival probability, 20% is considered as other loan termination reasons except in the case of death as many HECM or lifetime mortgage models in the US or Europe adopt. The information is based on the number of survivors per 100,000 people in each age group in the mortality table to estimate the loan survival probability. It can be calculated through the following equation (Kim et al. 2012).

$$P_{a,t} = (S_{a,t}/S_{a,0})^{1+m} \quad (3)$$

$P_{a,t}$ = loan survival probability at t
$S_{a,t}$ = the number of survivors since age a until t
a = eligible age for the FAP = 65
t = years after the subscriber joins in the FAP
m = loan termination probability except in the case of death = 0.2

Regarding the FAP, the monthly loan survival probability when the subscriber joins the plan was set to be 1. The entry loan termination probability was set to be 0. At each age after the subscriber joins the FAP at the age of 65, the monthly loan survival probability was calculated as the number of survivors per 100 000 people at t, which is divided by the number of survivors per 100 000 people at the year when (s)he newly joins the FAP (t = 0). Considering other reasons except in the case of death, 1.2 times was applied to consider the loan termination probability, as 1.2 or 1.3 is usually applied in the standard lifetime mortgage or HECM models (Cho et al. 2008).

Monthly loan termination probability

The monthly loan termination probability was calculated by the following equation that calculates the estimated annual loan survival probability using Equation (3).

$$Q_{a+t} = L_{a,t} - L_{a,t+1} \quad (4)$$

As in Equation (4), the monthly loan termination probability at the age of 65 is the value that the loan survival probability at the age of 66 is subtracted from that at the age of 65.

Other basic variables applied to the model

In order to estimate the monthly payment (*PMT*), the basic variables in Table 4 were applied to the actuarial model and the trial-and-error method was used to find out whether the *PMT* meets the condition that *PVEL* equals to *PVMIP* or minimising the value that *PVEL* < *PVMIP*. This condition was mathematically given to calibrate the model that contains the asset- and life-contingent risk of the farming assets the depreciated values of which and the subscriber's longevity determine the probability of receiving the higher pension income, which is in turn constrained by the probability of the financial institution's minimising the expected loss.

As an up-front insurance premium, 2% of the farmland value was applied and 0.5% divided by 12 (months of the outstanding balance as monthly insurance premium) as the usual HECM model does. As discussed in the third section of this article, the average annual CD interest rate (4.78%) was applied based on the past data of the CD rate, with 200 basis points as a spread. This spread was intended for accommodating the population-ageing and the asset-contingent risk that may be enlarged than the one in the 2000s and for a ceiling that minimises the government's liability in the worst scenario. Because up to recently

Table 4. Basic variables applied to the actuarial model

Factors	Definition
Up-front mortgage insurance premium	2% of farmland value
Monthly mortgage insurance premium	$(OLB_{t-1} + PMT) \times 0.5\%/12$
Monthly interest rate	(Interest rate for the certificate of deposit + 200-basis-point spread)/12
Monthly loan termination probability	Loan survival probability at t – Loan survival probability at t+1
Monthly loan survival probability	(Loan survival probability)$^{1.2}$

the 110-basis-point spread has been applied to the HP the average of which values are much higher and the bare interest of which follows the 91-day CD rate, the 200-basis-point spread was considered as a "tolerance interval" for accommodating the greater financial risk than the risk contingent upon the national economy, whose variability in interest should be figured out in the real phase of the "super-aged" society where the loss of massive economic engines and further social security demand will occur from 2026 in Korea (Kim 2013). In terms of mathematical modelling, a seemingly more ideal method is to stochastically predict the potential variability based on estimating the past stability of the CD rates, but the stochastic forecasting of interests has not been precise especially in the long term (Yeo and Cho 2010; Kim et al. 2012). This cornerstone research, therefore, is to focus on serving as the first step to introduce the "depreciated farming assets" into the standard actuarial model, by applying the constraints based on the data of past monthly interest and with the future land price simulations in the first place to the augmentable FAP model. Regarding the calculation of the loan survival and termination probabilities, the values of the Complete Life Table of the National Statistical Office of Korea were applied per se.

Depreciation method

The depreciation method to be used in estimating the future asset price was the straight line method. This method is most fundamental and widely used in the Modified Accelerated Cost Recovery System, the present tax depreciation system in the US, which is similar to elsewhere. Under the assumption of no critical difference between the American and Korean rural houses' natural and physical durability, the criterion of the straight line method was applied to this study. In analyses, the depreciated value of the property at the end of the mortgage contract was set 0. The entry value of the farmhouse and/or farming buildings was set at USD 20 000 (approximately the equivalent to 20 000 000 in Korean won, depending on the exchange rate).

RESULTS AND DISCUSSION

The payoff value was estimated using the Newton-Raphson method for the entry year of 65, 75, and 85. Considering the average value of rural housing as specified in the Census of Agriculture, Forestry, and Fishery 2010, the entry price of housing and/or building was set at USD 20,000 and the entry price of farmland was set at USD 100 000, whose average monthly growth rate was set at 0.15%. Following the integrative estimation of the ARIMA model and the Monte Carlo simulation in Yeo and Cho (2010), the farmland price change itself was simulated using the Monte Carlo method under the assumption of the "truncated" normal distribution. This condition is meant for reflecting the stable farmland price's lower but rarely a negative monthly growth rate as observed in Figure 2, while the values of the random variable, the growth of which is to be according to the compound rate without a negative value, were constrained to be positive and 0.005×10^{-4} as the threshold upper bound over the average,[5] e.g. monthly 0.15%. In Yeo and Cho (2010), this truncated distribution method showed a much higher predictability than the case under the assumption of the non-truncated log-normal distribution, as well.

The results are summarised in Table 5. As discussed in Kim et al. (2012), the results show different *PMT* values according to interest rates and entry ages. This level of *PMT* values are all above, for example, 65-year-old person's rental income of land per 100 m^2 but below his or her earned income from labouring according to Kim et al. (2012). As expected, the payoff values under the 200-basis-point spread turn out to be increasing over ages in the analysis with the constraint that *PVEL* equals to *PVMIP* or minimising the value that $PVEL < PVMIP$.

The payoff values for ages 75 and 85 turn out to be exceeding the minimum living expenses in Korea, which are presently per-household-member 570 US dollars monthly "regardless of ages," while the one for the age 65 did not. As expected, the FAP payments exceed the FP payment whose entry price of farmland was set at USD 100 000 (not including the value of any farmhouses or farming buildings) for the entry ages 65 and 75. For the entry age of 85, the FAP payments are relatively small than the case of entry age 75 when nominally 585 dollars are multiplied by 25/15 years, because of the "depreciated" farming building (USD 20 000) the value of which can be appropriately adjusted according to depreciation over the pension period and the adequate appraisal of the entry value. In this exploratory analysis, the payoff values are the results in the case of 6.78% interest rate per annum, so the lower monthly an-

[5]In this analysis, it is a cut-off value around which the land price can begin to exponentially rise.

Table 5. Payoff values of the PMT for the entry ages of 65, 75, and 85: The FAP vs. FP cases

Entry age	65		75		85	
	FAP	FP	FAP	FP	FAP	FP
Monthly annuity payment (USD)	279.591	246.982	585.285	419.374	765*	757.379

*This solution is still variable under the iteration of 10,000, while the others are the converged values. In the case of the HP, the expected outcomes are 217, 348, and 597 dollars, respectively, for the entry ages 65, 75, and 85, and the same condition but the HP interest, e.g. 1.1% plus the CP rate, according to the HP official website. Outcomes can also be further estimated under different conditions through the computerised system at http://www.hf.go.kr/hfp/pension/simulator/mix_search.jsp?menuId=22561.

nuity payment in the case of a more prescriptive, welfare-driven policy interest rate of more or less 4% per annum is expected to support the rural elderly more effectively.

Figure 4 illustrates the comparative values of the land price and the expected outstanding balance in the FAP model. The land price surpasses the outstanding balance after 280 months, which means that about 23 years later, the insurance institution will be better off. Since the interest rates are intentionally constrained to the level at which the longevity and financial instability risks over rural areas are manageable in this analysis, the break-even point will change if the welfare-driven policy interest rate of more or less 4.0% is applied. Above all, the results per se far exceed the recent US case of a representative reverse mortgage to be pensionable, which is being provided by the private mortgage institutions, e.g. the Longbridge Financial. This US case's monthly payment in Moeller (2013) turned out to be less than 394 dollars, 492 dollars, and 709 dollars, respectively for ages 65, 75, and 85 for a home with no mortgage valued at 120 000 dollars. Considering that the US per capita GDP is 49 965 dollars while the Korean per capita GDP is 22 590 dollars in 2012, Korea's model to minimise the rural elderly poverty and to increase the welfare in rural areas through implementing the FP and potentially the FAP is seen to be quite successful.

CONCLUSION AND POLICY IMPLICATIONS

In this article, the conceptual and analytical backgrounds of the FAP model have been discussed with regard to the previous studies on the retiring elderly's welfare and especially on the ageing rural baby boomers, whose post-retirement security matters could have been out of reach of any private or public programs if the government had not implemented such programs as the FP. Since the percentage of ages 65 or above in the rural population in Korea is 34.2% and is by 13.6% higher than its national average, at least in terms of the normative policy the FP for the rural elderly is seen to be more necessary than the HP for the urban elderly. With an exploratory analysis of the simulated data that integrates the farmhouses and farming buildings with farmland into a comprehensive farming asset to be liquidated for the rural elderly, this study addresses the basic components and analytics in the FAP actuarial model as an innovation.

Although the FAP model results showed that the Korean rural elderly in the entry age of 85 (and 75) become better off (far) than the representative US

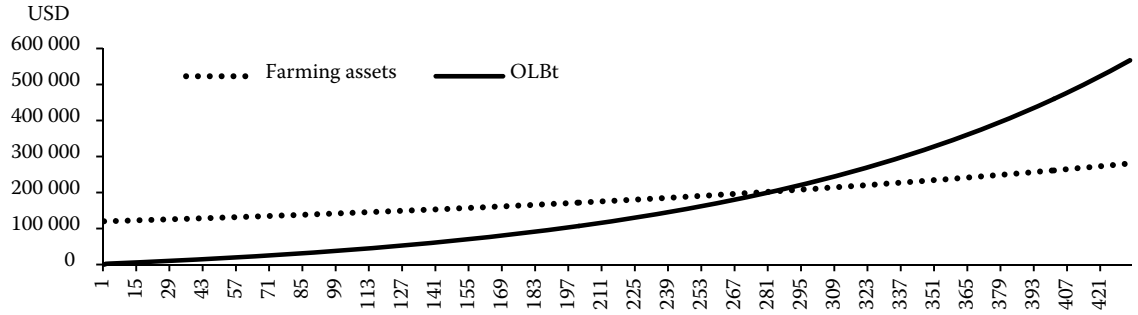

Figure 4. Comparison of the farming asset price (dotted) and the expected outstanding balance

1 = the first month of the reverse mortgage contract at the entry age 65

pensionable reverse mortgage, despite the consideration of the income difference in the two Western and Eastern countries. The British and Australian equity release schemes, which are managed mainly by private institutions under the control of the Financial Services Authority, are presently more private than Korea's HP and F(A)P. Despite the public approach to the rural elderly welfare, the F(A)P still turned out to be better off than the representative US cases while many existing equity release programs reveal some problems as seen in the recent mass withdrawal of the mortgage equity in Australia (Haffner et al. 2013). In other countries such as Central and Eastern European countries, whose farmland in general was more public and has been differently privatised (Bański 2011) or differently supported regarding either prices or areas and inputs (Latruffe et al. 2008) across countries or regions, the farmland liquidation by a public institution (e.g. in Korea, the Korea Rural Community Corporation) – that can facilitate the cooperation between producers as renters or buyers hoping for being (new) owners to participate in the scale production on the newly divided and integrated farmland – can be one of the better programs for an effective capitalisation and social welfare improvement.

However, the FAP model needs to be improved in order to manage or diversify various risks as yet. Regarding the longevity risks, it needs to consider such varied payment methods as "age-adjusted" or "graduated" (Ma and Deng 2013) pension contribution rates according to the age-variant need of ageing subscribers. In the case of the HP, the number of new subscribers has increased since the introduction of yearly increasing or decreasing (3%) rates according to ageing in 2008 and the application of 70% of the initial monthly payment after the first 10 years in 2012. In the US, the introduction of the HECM Saver program, whose initial mortgage insurance premium is lowered to the level of 0.01%, has also led to an outstanding increase in the number of the HECM subscribers in 2011 together with the HECM for the Purchase Program. However, the HECM, let alone the HECM Saver and the HECM for Purchase, is presently not in a good financial condition since the subprime crisis, and the British mortgage markets are also in a similar condition (Wilcox and Perry 2013). This leads to the HUD policy that since September 30, 2013 the subscribers, who take out more than 60% of the proceeds during the first 12 months or at closing, are required to pay a 2.5% (HUD 2013b) premium, whereas the HECM program subscribers who take out (less than) 60% may pay a 0.5% premium.

In order to minimise the financial instability risk, under the general "non-recourse" principle, the pooling methods in the F(A)P need to be improved or diversified in consideration of the British and US programs' strengths and weaknesses in risk management. A flexible adjustment of monthly (not yearly) insurance premium, which can be appropriately made according to the varying needs of the ageing baby boomers, can also lower both the financial instability and the longevity risks if precise estimations are made. Depreciation methods also need to be further elaborated and the survival probability still needs to be calculated differently at a lower level of analysis if possible and updated according to the recent data and techniques. Finally, incentives like an appropriate level of tax abatements and "take-out" options that are applicable to the transfer of real estate or property and the exemption of other relevant duties or charges will facilitate the recognition of the lifetime mortgage or the reverse mortgage of residential or farming assets as a viable pension instrument. Above all, since the "break-even" point can be changed by introducing different rates of interest or discount together with land price change and depreciation, the optimal point for benefiting both the rural elderly and the financial institutions in charge should be reached by more rigorous modelling with well-specified constraints.

In comparison to the FP, HP, or the Western lifetime or reverse mortgages, it is obviously advantageous to the FAP that the producing capacity of farming buildings as well as farmland can be sustained or increased even after its hand-over to rural migrants or large-scale producers. The exploratory analysis of the FAP payoffs in this article is expected to serve as the first step to understand such an advantage as a potential source for improving both the rural elderly welfare and the rural economy through the "adjustable" and "extensible" FAP model. In the case of sales per square metre in the follow-up models, for instance, an owner can decide to voluntarily continue working on (some of) his or her farmland even when (s)he receives pension benefits, so the forgone productivity itself does not necessarily need to be considered in an individual perspective. However, it still needs to be considered in the model that productivity at a "regional" level can still be increased through the comprehensive and large-scale management policy after systematically dividing and re-integrating the handed-over farmland in this so-called "farming-asset pension" perspective. Therefore, in order to develop the FAP model to

a level of cornerstones toward the comprehensive pension system of farming assets that can contribute to improving the welfare of rural regions where the "post-urbanisation" workers have just begun to return, it can be said that the constraint problems examined in this study need to be continuously solved for managing the FP and FAP efficiently and effectively and eventually for restructuring the old-fashioned rural land management and for revitalising the stagnant rural economy as well.

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Contact address:

Cho Deokho, Daegu University, Gyeongsan 712-714, South Korea
e-mail: chodh@daegu.ac.kr