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# Forecasting of Farmland Value Increasing Rate and Estimation of Monthly Payment of Farmland Pension Considering the Regional Differences

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# 지역적인 차이를 고려한 농지가격상승률예측 및 월평균 농지연금 지급액 추정

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**국문초록** : 한국은 2050년까지 주요 선진국 중에서 고령화가 가장 심각한 사회로 전환되게 될 것으로 예상된다. 기대여명의 증가와 저 출산은 고령화를 더욱 악화시키며, 이는 심각한 사회문제로 발전하게 될 것이다. 이와 같은 문제를 해결하기 위해 한국정부는 2008년에 도시지역에는 주택연금제도를 도입하였으며, 2011년에는 세계 최초로 농촌지역을 대상으로 농지연금제도를 도입하였다. 그렇지만 이와 같은 제도는 설계 당시부터 복지상품이라기 보다는 장기적으로 손실과 수익의 균형에 초점을 둔 금융상품으로 개발되어 실질적으로 노인들에게 크게 인기를 얻지 못하였다. 따라서 본 연구는 농지연금제도를 활성화시켜, 농촌노인들에게 보다 더 많은 혜택을 주기 위해 지역 토지시장을 감안하여 지역별 농지가격상승률을 예측하고 연금액을 산출하였다. 또, 지금까지 사용한 년 혹은 분기별 감정가 대신에 월별, 지역별 실거래 가격을 모형에 적용하여 지역 토지시장, 고령화 수준 등 지역 여건에 부합하는 연금액을 산출하였다. 할인율자료도 가장 안정적인 3년 만기 국고채 수익률을 활용하여 미래농지가격을 예측하고, 이를 유동화하여 월 생활자금으로 지급되도록 하였다. 특히 농지규모가 가장 많고, 고령화 정도가 심각하여 농지연금의 잠재적 수요가 가장 높을 것으로 예상되는 경상북도와 전라남도를 사례지역으로 선정하고, 이를 전국평균과 비교하여 지역적인 차이도 함께 분석하였다. 이를 위해 농지가격 및 이자율 시계열 자료의 안정성을 검정하고, 장기농지가격을 예측하였다. 이를 활용하여 경북, 전남, 전국의 노인들의 월평균 지급액을 추정하였다. 분석결과 정책의 잠재적 수요가 가장 높은 두 지역이 가장 낮은 금액이 지급되는 것으로 추정되어 이는 또 다른 지역불균형을 초래할 수 있는 것으로 평가되었다.

**Key words** : Actuarial Model, Aging Society, Farmland Pension, Long-term Forecasting, Reverse Mortgage

## I. Introduction

By 2050 South Korea (here after Korea) will become the most aged society among advanced economies, with nearly four out of every ten Koreans who are 65 years or over, due to low birthrate and the rapidly aging nation. With more senior citizens and fewer babies, workers with an age between 15 and 64 will have to offer support to more elderly people. Currently every 100 Korean workers are providing support for 15 senior citizens. However, by 2050, it is expected that this number will increase drastically, every 100 employees offering support for 72 senior citizens, number which is much higher than the predicted average of 45 by Organization for Economic Co-operation and Development (OECD) (http://www.

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koreatimes.co.kr/www/news/biz/2010/05/123_48264.html: 2015.01.15).

In order to solve these severe social problems, Korean government introduced from 2008 the reverse mortgage system on the housing and from 2011 the reverse mortgage system on the farmland for the elderly 65 or over. The reverse mortgage system was initiated for the first time in the United States (Higgins & Folts, 1992; Cho & Ha, 1997). Instead of making monthly payments to a lender, as with a traditional mortgage, the lender makes payments to the borrower. The person is not required to pay back the loan until the home is sold or otherwise vacated. As long as he lives in the home, he is not required to make any monthly payments towards the loan balance, but he must remain current on his property taxes and homeowners insurance (Cho et al., 2008; 2009). The life time housing program, through the integration of the mortgage and reverse mortgage systems, was established for the first time by Cho & Ha (1997). In this way, starting from 2008 the Korean government employs the housing reverse mortgage, which is called Housing Pension (HP). Also, for the first time in the world, Cho et al., (2008) and Ma et al., (2008) established the farmland reverse mortgage for the rural elderly, which is called Farmland Pension (FP) and which represent a loan available to farmland owners who are 65 years or older. It enables them to convert part of the farmland equity into cash for the living cost. This product was conceived as a mean to help retirees, with limited income through liquidating the farmland, to cover basic monthly living expenses. In order to liquidate the farmland equity and measure the monthly payment amount for land owners, it is very important to forecast exactly the future farmland value and interest rates.

The Korean government has utilized the publicly assessed farmland value in liquidating the farmland equity until now. However, this method becomes recently arguable, because this value assessed by government is relatively lower than appraisal or transaction values. It means that, the monthly payment amount is relatively lower than that by any other farmland value, such as, the transaction and the monthly appraisal estimation value. Especially, the rural areas such as Gyeongbuk and Junnam provinces, which are mainly composed of farmland land, meet some problems in liquidating the farmland, due to the fact that, the values of farmland and the farmland values increasing rate are relatively very low. It means that the amounts of payment through the liquidation of farmland are also moderately low. And then the Korean government should search some complementary policy alternatives to reflect regional characteristics and to maintain the quality of life for the rural areas.

The goals of this study are to forecast the values of dryfield and ricefield and to measure the amount of monthly payment by FP considering the regional differences. At first, this paper uses the monthly data on dryfield, ricefield and interest rate, even though in the previous researches were used the quarterly and yearly data, which also consider the difference of farmland value among regions (Cho et. al., 2009; Yeo & Cho, 2010), because the pension payment is implemented by the monthly base, the farmland values being different from region to region. Secondly, it reviews the reverse mortgage actuarial model and land value forecasting to choose the basic key variables. Thirdly, it analyzes the trend of three time series data and tests their stationarity. Finally, it estimates the amounts of monthly payment considering the regional differences, since the land values differ from region to region.

## II. Reverse Mortgage System and Farmland Value Forecasting

### 1. The Concept of Reverse Mortgage System

In a conventional mortgage, the homeowner makes a monthly payment to the lender. After each payment, the homeowner's equity increases by the amount of the principal included in the payment. In a reverse mortgage, a homeowner is not required to make monthly payments. If payments are not made, interest is added to the loan's balance. Although the "rising loan balance can eventually grow to exceed the value of the home," "the borrower (or the borrower's estate) is generally not required to repay any additional loan balance in excess of the value of the home (http://en.wikipedia.org/wiki/Reverse_mortgage: 2014. 09.10). The concept of reverse mortgage is theoretically very simple, but it is very diverse in its terms and payment conditions (Boehn & Ehrhardt, 1992). A reverse mortgage is a home loan that provides cash payments

based on home equity. In rural area the farmland reverse mortgage, or for short, Farmland Pension (FP) is applied to the liquidation of farmland equity for the rural elderly landowners (Cho et. al., 2008). Korea, in particular in the rural areas, has rapidly turned to an ageing nation. This circumstance has resulted in the deterioration of the agricultural industry, affected agricultural productivity and its international competitiveness. Furthermore, the Free Trade Agreement (FTA) also has made worse the industrial bases of the agricultural sectors (Choi & Cho, 2010). However, HP could not contribute to improve the quality of life of the rural elderly, since their housing values are relatively very low. Therefore, Cho et. al., (2008), at first, built the farmland reverse mortgage system in order to solve the problem of the lack of living costs of rural elderly, using the farmland equity which the rural elderly owns. As a result, in 2011, the Korean government introduced FP for the rural elderly. However, their monthly incomes remain relatively very low, due to the fact that, the farmland values are assessed relatively low (Choi & Cho, 2010).

In the rural area, farmland equity constitutes most of the non-pension wealth of the rural elderly; as well that housing equity in the urban area does most of the non-pension wealth of the urban elderly. The key issue of FP is how to tap this farmland equity for the monthly income without selling the farmland (Cho & Ma, 2004). The monthly payment amount highly depends upon three key factors, such as, the life expectancy, interest rate, and the farmland price (see Eq.1). The life expectancy and interest rate might be similar irrespective of the area. However, the value of farmland differs from location to location. Accordingly, the value forecasting of farmland represents the most important factor in deciding the monthly payment for the rural elderly people. Therefore the long and appropriate forecasting of farmland value is the main issue in settling down of the Farmland Pension (FP).

## 2. The Actuarial Model of Farmland Pension and Forecasting Model of Farmland Value

Farmland is the primary source of wealth for many agricultural producers, and its value plays an important role in farmland financing plan. However, the issue of long-term land value forecasts makes future planning difficult (Christopher et. al., 2013). Especially the Korean rural elderly have some difficulties in farm financing planning for their living costs because of the lack of publicly available land evaluation system. The actuarial model of basic annuity plans for managing the FP, developed by Ma et. al., (2007; 2008) is as follows:

$$PVMIP = UP_0 + \sum_{t=1}^{T(a)} \frac{mip_t \cdot P_{a,t}}{(1+i)^t} = \sum_{t=1}^{T(a)} \frac{max((OLB_t - L_t)q_{a+t},0) \cdot P_{a,t}}{(1+i)^t} = PVEL$$

Eq.1

where

$PVMIP$ = *Present value of total projected mortgage insurance premium*
$PVEL$ = *Present value of expected losses*
$UP_0$ = *Up-front mortgage insurance premium at t = 0*
$T(a)$ = *The number of months left for the borrower living until 100 years old*
$mip_t$ = *Projected monthly mortgage insurance premium at t*:
= $mip_t = (OLB_{t-1} + PMT) \times m$
= *where PMT = The annuity payment* (*constant monthly payment*);
*m = Percent 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*
$q_{a+t}$ = *The probability of loan termination at age a + t*
$p_{a,t}$ = *Loan survival probability for the borrower at age a living until age a + t*
$I$ = *Interest rates* (*discount rates*).

Like in Eq.1, the present value of the total payment amount of FP, which is monthly and continuously provided until the future time (N), should be the same with the present value of farmland value at the future certain time (N), when the payment is terminated. And then forecasting the future farmland value is the most important key factor in estimating the monthly annuity along with the interest rate. In general, the land value decision model can be estimated using the present value model. Cash inflow which occurs in future can be considered as net rent and the basic model of land value can be defined as Eq. 1(Cho et. al., 2009; Yeo & Cho, 2010).

$$P_0 = \sum_{t=1}^{\infty} \frac{R_t}{[(1+r_1)(1+r_2)...(1+r_t)]} \quad \text{Eq. 2.}$$

where

$P_0$ = the present value of the end of 0 year

$R_t$ = the estimated net rent of the end of t year

$r_t$ = the real discount rate during t time period

If the real interest rate is fixed during the t period, Eq. 2 can be simplified like Eq.3.

$$P_0 = \sum_{t=1}^{\infty} \frac{R_t}{(1+r_1)^t} \quad \text{Eq. 3.}$$

The present value model might represent a suitable explanation of long term land value, because it is based on the rational expectation for the future. However, this model cannot explain the shorter change of land value since of speculation bubbles, time-varying discount rates, and short term fads (Burt, 1986). The long term forecasting model of land value also is based on the present value model. The change of land value at the future certain time (N) depends upon the change rate of land value () and discount rate (). The present value model on the land value at the certain time (n) can be presented like equation 3 (Ma & Cho, 2003; Cho et. al., 2009; Yeo & Cho, 2010).

$$PV = \frac{FP_N}{\prod_{t=1}^{N}(1+r_t)} = \frac{FP_0\prod_{t=1}^{N}(1+g_t)}{\prod_{t=1}^{N}(1+r_t)} = FP_0\prod_{t=1}^{N}\frac{(1+g_t)}{(1+r_t)} \quad \text{Eq. 4.}$$

Where

$PV$ = the present value at the future certain time (N).

$PV_0$ = Level of farmland value at time(0)

$PV_0$ = Level of farmland value at the future certain time(M)

$g_t$ = the increasing rate of farmland value at the time period(t)

$r_t$ = the discount rate at time period(t)

Eq. 4 forecasts the farmland value, which change rate of farmland value at the certain time N is reflected and this forecasted value is discounted by the cumulated return rate at the time N. This method calculates the present value of farmland.

In Eq.4, $\frac{(1+g_t)}{(1+r_t)}$ is the net discount ratio and it can be presented as $\frac{1}{(1+k_t)}$, and is the net discount rate. The net discount ratio = $\frac{(1+g_t)}{(1+r_t)} = \frac{1}{(1+k_t)}$ Eq.5.

In order to forecast the long term farmland value, the previous time series of net discount ratio and net discount rate should be stationary. In that case, the historical mean values of these two values can be utilized in forecasting the future land value.

## 3. Reviews of Previous Studies

Cho & Ha (1997) introduced the reverse mortgage system for the first time in Korea by building the life-time housing model through the integration of mortgage system and reverse mortgage one. After their research, several scholars (Lim & Cho, 1999; Cho, 2000; Kim, 2000; Ma & Cho, 2003; Cho & Ma, 2004; Cho et al., 2004; Cho & Ma, 2006; Kang & Lee, 2006; Cho & Ma, 2007; Ma et. al., 2008; Cho et. al., 2009; Choi & Cho, 2010; Yea & Cho, 2010; Park & Cho, 2014) research the reverse mortgage system. However, this program is not popular until now, due to several reasons, such as, the long term forecasting of land value, interest rate, loan termination rate, asset succession to the children, etc.

Especially the long term forecasting of farmland (dry field and rice one) is a key subject of this program, because it is directly related with the amount of monthly payment. The forecasting of farmland value mainly focused

on the short-term forecasting. Park & Park (2001), Shon et. al., (2002) established the short-term forecasting model. Their studies focused on the one or two year forecasting of housing and land markets. Ma & Cho (2003), Cho et. al., (2009) and Yeo & Cho (2009) established the long-term forecasting model of real estate prices for building the reverse annuity mortgage system. However, most studies used the year or quarter bases data, even though the annuity payment is monthly implemented. And there are some mismatches between the available data and the payment annuity. In order to solve those problems, this study uses the monthly data in forecasting the farmland value and interest rate considering the regional differences.

## III. The Trend of Farmland Values, Interest Rates and Their Stationarity Analysis

### 1. Data and Analysis Method

As in the previous description, in order to build the farmland reverse mortgage system, the farmland values and interest rates should be forecasted in long-term aspects. In order to do that, at first, the stationarity on the change rate of the previous farmland value and interest rate should be tested. This study uses the monthly value index data of nationwide farmland values, and data of Gyeongbuk and Junnam, which are the most aged provinces in Korea (see Figure 1). These areas also have the largest potential FP demanders, because they have the largest number of farming elderly among provinces. Farmland basically is composed of dryfield and ricefield. This data set was provided by Ministry of National Land and Transportation for a period of 116 months from January 2005 to August 2014. Because the transaction of farmland does not often occur in the real world, instead of using the Company Bond interest rate (Cho et. al., 2009), this study uses the monthly interest rate data of Three Year National Bond, provided by the Bank of Korea for the same period of time, as indicated above. In particular this study uses the monthly data, considering the monthly payment of farmland pension, in order to maintain the consistency of analysis and to get more robust outcomes.

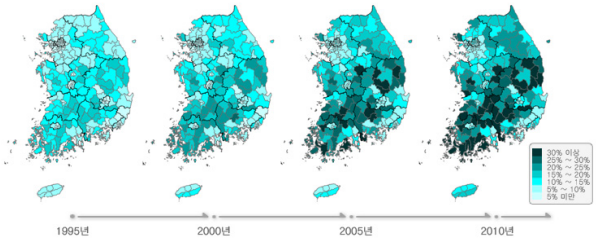


Figure 1. The Population Rates of Age 65 or More among Regions
Source: http://sgis.kosat.go.kr/publicsmodel:2015.04.20

To forecast the future farmland value, the above three (dryfield, ricefield and interest rate) time series data should be stationary. In order to test the stationarity, unit root test should be implemented for these time series data. Unit root test is composed of two stages. At first, this study tests the unit root on the change rate of farmland (dryfield and ricefield). After that, it calculates the net discount rate using data on the change rates of farmland and interest rate. And the first-difference is used for stabilizing the time series in case that it is non-stationary. The unit root test is, as follows:

1) $H_0 : \delta = 0$ or $\beta = 1$ (Existence of Unit root)
2) $H_0 : \delta \neq 0$ or $\beta \neq 1$ (No unit root)

Hypothesis 1) notes the existence of unit root because the null hypothesis is not rejected. As a result, the time series data is non-stationary. In other words, in case that the null hypothesis is rejected, time series is stationary. The rules of decision making are, as follows: in case that ADF test statistics > MacKinnon critical values, null hypothesis is not rejected and unit root exists; in case that ADF test statistics MacKinnon critical values, null hypothesis is rejected and unit root does not exists. This paper only notes the DF test because PP test also shows the similar results (Kim & Jang, 2006; Lee et. al., 2005).

### 2. The Trend Analysis of Time Series Data and Unit Root Tests

The standard month of value index is the September 2012 and its index is 100. For the research period the monthly mean value index of dryfield and ricefield are

Table 1. The Summary Statistics of the Monthly Value Index of Farmland and Three Year Nation Bond

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Dryindex* | 116 | 94.004 | 6.571 | 76.755 | 102.449 |
| Riceindex** | 116 | 94.417 | 6.113 | 78.429 | 101.666 |
| MIR*** | 116 | 0.334 | 0.077 | 0.212 | 0.497 |

* the monthly value index of dryfield (the standard year: Sept. 2012)
** the monthly value index of ricefield
*** the monthly interest of Three Year National Bond

94.004 and 94.417, like in the Table 1. And its standard deviations are 6.571 and 6.113 individually. The mean value index of ricefield is higher than that of dryfield, but its standard deviation of dryfield are slightly higher than those of ricefield. Such results are similar with those of previous studies (Cho et. al., 2009; Yeo & Cho, 2010). The monthly mean value of the change rates of Three Year Nation Bond (TYNB) is 0.334 percent.

### 1) Stationary Test of Value Indexes of Dryfield and Ricefield

The Figure 2 shows the farmland (dryfield and ricefield) value indexes from January 2005 to August 2014. The standard index is 100 in September 2012. Farmland values continuously are increased for the research periods, except the U.S. subprime mortgage crisis period. It coincided with the U.S. recession of December 2007 – June 2009. The right side of y axis is the value index of dryfield, its left side is that of index of ricefield. X axis is the research period. Both lines continuously increased, apart from the interruption period of subprime mortgage.

We can guess the stationary or non-stationary of time series variable by drawing the line graph. Figure 3 notes that the first difference time series of value indexes of dryfield and ricefield are continuously waved according to the time change except an outlier (Cho et. al., 2008; 2009). This outlier comes from the U.S. subprime mortgage crisis. Korean farmland market is also no exception. (http://en.wikipedia.org/wiki/Subprime_mortgage_crisis:2014.03.20). However, this paper does not consider this short-term recession, because this study focuses on the long-term land value forecasting. And then this paper implements the unit root test to figure out more specifically the stationary of these time series.

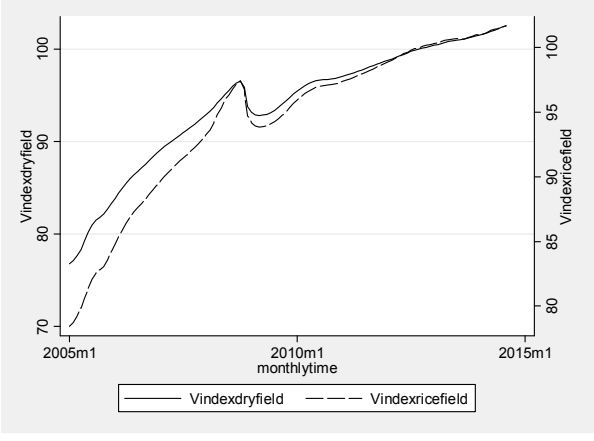


Figure 2. The Change of Value Indexes of Farmland (Vindexdryfield* and Vindexricefield**)
Source: This value index data is provided by the MNLT
*The value index of dryfield
**The value index of ricefield

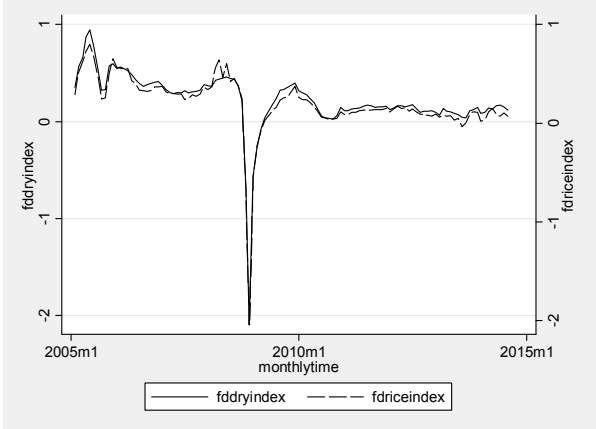


Figure 3. The First Difference Time Series Value Indexes of Farmland Value (fddryindex* and fdriceindex**)
*fddryindex: the first difference of value index of dryfield
**fdriceindex: the first difference of value index of ricefield

In order to forecast the long-term farmland value, at first, the stationarity on the change rates of the farmland value index and interest rate should be tested. This study uses the monthly value indexes of nation-wide farmland values (dryfield and ricefield) which are provided by Korea Appraisal Board for a period of 116 months (about 10 years) from January 2005 to August 2014. Test statistics of dryfield in Table 3 notes -4.054 and this absolute value is higher than critical values at 1 percent point level. Therefore the null hypothesis of first difference dryfield time series is rejected and unit root does not exist.

This paper notes the same results in case of the inclusion of constant term and trend. In consequence the dryfield time series is stationary at 1 percent level. Table 2 also identifies the result of unit root test for the ricefield. This time series is stationary, because the null hypothesis of dryfield time series is rejected at 1 percent level. In other words, test statistic (-4.182) of first difference ricefield is higher than critical values in terms of the absolute value. We can also reject the null hypothesis using MacKinnon approximate p-value. Variable dryfield and ricefield can reject the null hypothesis at 1 percent significant level. It concludes that two time series variables are stationary (Kim & Chang, 2006; Min & Choi, 2014). And then these historical mean values can be utilized in forecasting the future farmland value.

### 2) The Stationary Test of Three Year Nation Bond (TYNB).

Many studies used the interest rates of the Company Bond or Negotiable Certificate of Deposit in forecasting real estate value (Cho et. al, 2009; Ma &Cho, 2003; Ma et. al., 2008). However, this paper uses the interest of TYNB because this interest is more stable than other interests. Eventually transaction of farmland does not often occur in the real market, comparing with other market goods. This paper draws the graph of the monthly change rates of TYNB to figure out the stationarity of time series data. The figure 3 shows the trend of change rates of interest rates. The change rate of the monthly interest of TYNB has increased at the beginning stage and gradually decreased after that period. And it notes the non-stationarity of time series data. However, its first difference is oscillated around the mean value like in Figure 4.

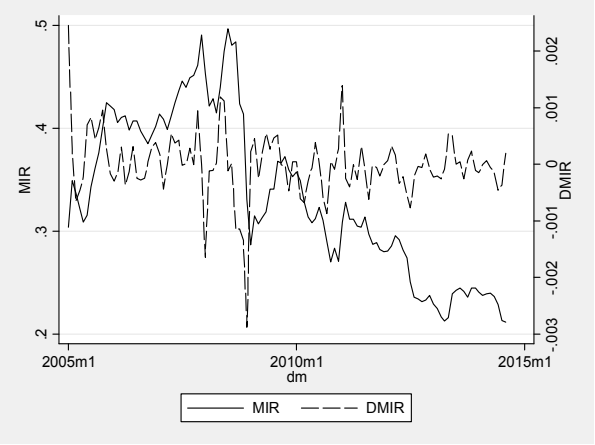


Figure 4. The Monthly Change Rates of Three Year Nation Bond (MIR* and DMIR**)
Source: The monthly change rate of TYNB which is provided by the Bank of Korea (2014).
*MIR: the monthly interest rate of TYMB
**DMIR: the first difference of the monthly interest rate of TYMB

Test statistics of TYNB in Table 4 notes -0.725 and this absolute value is smaller than critical values at 10 percent point level (-2.579) in terms of the absolute value.

Table 2. Dickey-Fuller Unit Root Test

| fddryindex | | Test Statistics | 1% Critical Value | 5% Critical Value | 10% Critical Value |
|---|---|---|---|---|---|
| MacKinnon approximate p-value for Z(t)=0.0012 | Z(t) | -4.052 | -3.505 | -2.889 | -2.579 |
| fdriceindex | | Test Statistics | 1% Critical Value | 5% Critical Value | 10% Critical Value |
| MacKinnon approximate p-value for Z(t)=0.0007 | Z(t) | -4.182 | -3.505 | -2.889 | -2.579 |

Table 3. Unit Root Test on the Change Rates of TYNB

| Dickey-Fuller Unit Root Test (MIR) | | Test Statistics | 1% Critical Value | 5% Critical Value | 10% Critical Value |
|---|---|---|---|---|---|
| MacKinnon approximate p-value for Z(t)=0.8402 | Z(t) | -0.725 | -3.505 | -2.889 | -2.579 |
| Augmented Dickey-Fuller Unit Root Test(DMIR) | | Test Statistics | 1% Critical Value | 5% Critical Value | 10% Critical Value |
| MacKinnon approximate p-value for Z(t)=0.0000 | Z(t) | -8.169 | -3.505 | -2.889 | -2.579 |

Therefore the null hypothesis of TYNB is not rejected and unit root exist. Therefore, this study implements the first difference method. As a result, Table 3 shows that the absolute value of t-statistic (-8.169) is higher than critical values at 1 percent point level. The first difference of change rates of TYNB is the stationary time series.

### 3) The Stationary Test of Net Discount Ratio

In order to forecast the long-term farmland value, the time series of net discount ratio should be stationary. In that case, the historical mean value of these two values can be utilized in forecasting the future land value like in Eq.5. Figure 5 notes that the net discount ratios of dryfield and ricefield are likely shown stationary, because they show stable variations around mean value according to the time change. However, this paper implements the unit root test in order to figure out specifically the stationarity of time series data.

The stationary tests of net discount ratio (Dnetratio and Rnetratio) of dryfield and ricefield are implemented. The null hypothesis is rejected at 1 percent point level irrespective of time lag, and then unit root is not existed. We can conclude that two time series are stationary. It also means that the regression coefficients are significant. Following Eq.4, the mean net discount ratios of dryfield and ricefield are each 0.938 and 0.918 for the research period. These analysis results mean that time series of the net discount ratios are normal and stationary. And the historical mean values can be used in forecasting the long-term farmland value.

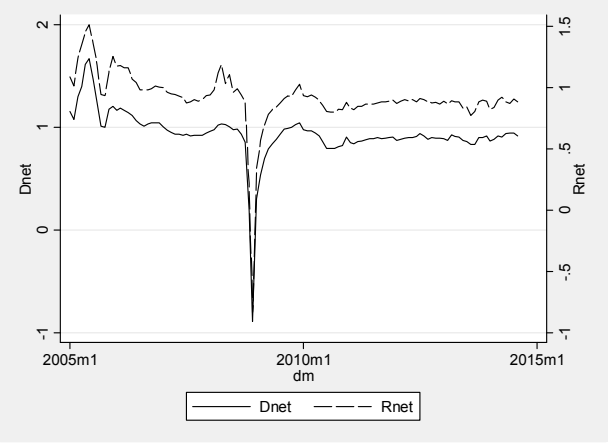


Figure 5. The Net Discount Ratio of Dryfield and Ricefield (Dnet* and Rnet**)
*The net discount ratio of dryfield
**The net discount ratio of ricefield

Table 4. Dickey-Fuller Unit Root Test on the Net Discount Ratio

| Dnetratio | | Test Statistics | 1% Critical Value | 5% Critical Value | 10% Critical Value |
|---|---|---|---|---|---|
| MacKinnon approximate p-value for Z(t)=0.0011 | Z(t) | -4.055 | -3.505 | -2.889 | -2.579 |
| Rnetratio | | Test Statistics | 1% Critical Value | 5% Critical Value | 10% Critical Value |
| MacKinnon approximate p-value for Z(t)=0.0005 | Z(t) | -4.287 | -3.505 | -2.889 | -2.579 |

**4) Estimation of Net Discount Rate**

In Table 5, the monthly increasing rates of dryfield and ricefield are 0.254 percent and 0.228. That of dryfield is slightly higher than that of ricefield. This result is the similar to those of the previous studies (Ma & Cho, 2003; Cho et al., 2009). The monthly and yearly increasing rates of Three Year National Bond are 0.334 and 4.008 percent points. These values are higher than those of dryfield and ricefield. It means that, the increasing rates of real estate in the rural areas are lower than those of interest rates of financial market such as CD, Company Bond and TYNB. The monthly net discount rates (Dnrate and Rnrate) of dryfield and ricefield are each 0.094 and 0.105 at the same period. The values of farmland in rural areas are relatively lower than those of urban housing value (Ma & Cho, 2003).

The key factors in forecasting the farmland value are the stationary of net discount ratio and net discount rate data. We can forecast the long term land value using the historical means if those two past time series are stationary. Table 6 suggests the monthly increasing rates of dryfield, ricefield and TYNB. The dryfield and ricefield increases 0.255 and 0.228 percent per month for the analysis period. These results show that the price of real estate like farmland is stabilized downward. The increasing rates of interest of TYNB are 0.334 percent points individually. Table 5 also presents the increasing rates of dryfield and ricefield and interest rate of TYNB.

**5) The Estimation of Present Value of Dryfield and Ricefield at the Future Certain Time (N)**

Eq.4 can be simplified like Eq.6 if the net discount ratio time series ((1+g)/(1+r)) of dryfield and ricefield are stationary. This forecasting model (estimation of present value) can use the historical mean value of net discount ratio for estimating the values dryfield and ricefield (Ma & Cho, 2003).

$$PV(D,R) = CV_0\left(\frac{1+g}{1+r}\right)N = CV_0\left(\frac{1}{1+d}\right)N \qquad \text{Eq.6}$$

Where

PV(D, R) = the present value of the value of dryfield (D) or ricefield (R) at the future certain time (N)

CV0=the value level of dryfield or ricefield at the current time (t=0)

$g$ = the average increasing rate of dryfield or ricefield

$r$ = the average earning rate

$d$ = the average net discount rate

Based upon Eq. 6, we can easily estimate the PV(D, R) using the data in Table 6.

**6) The Estimation of Monthly Payment Amount (pmt) Considering the Regional Difference.**

Farmland values and their increasing rates differ from region to region. As in the previous description, this paper selected two different regions where are the most agricultural oriented regions and the most aged ones in order to compare with pmt of national level. Eventually these two areas have the larger farmland areas with the more potential demanders on the FP. Therefore, the analysis results can give us some policy implications in order to improve the FP system. Table 6 notes the historical mean values of increasing rates of farmland and interest rates for estimating the monthly payment (pmt) considering three different increasing rates of farmland value among the regions (see Eq.1).

Table 5. Statistical Summary of Time Series Data of Farmland Values and Interest Rates

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Dryfield | 116 | 0.2546 | 0.3514 | -2.186 | 1.196 |
| Ricefield | 116 | 0.2281 | 0.3344 | -2.111 | 0.991 |
| MIR | 116 | 0.3341 | 0.0775 | 0.2117 | 0.4967 |
| Dnetratio | 116 | 0.9380 | 0.2482 | -0.8912 | 1.6689 |
| Rnetratio | 116 | 0.9178 | 0.2328 | -0.8348 | 1.5131 |
| Dnrate | 116 | 0.0936 | 0.5066 | -2.1221 | 4.2377 |
| Rnrate | 116 | 0.1053 | 0.4427 | -2.1979 | 3.4752 |

Table 6. The Mean of Increasing Rates of Time Series Data of Farmland Values (2005.1~2014.8) and Interest Rates

| | National Level | Junnam | Gyeongbuk |
|---|---|---|---|
| dryfield | 0.2546 | 0.1629 | 0.1675 |
| ricefield | 0.2281 | 0.1193 | 0.1713 |
| MIR | 0.3341(monthly) / 4.008(yearly) | | |

To estimate the differences of pmt considering the regions, we apply 2% of farmland value as up-front insurance premium, and 0.5% divided by 12 months of outstanding balance as monthly insurance premium (see Eq.1). This study uses the monthly increasing rates (0.3341) of TYNB and also utilizes the monthly increasing rates of dryfield and ricefield in Table 6. Table 7, 8 and 9 notes the pmts of research areas at age 65, 75 and 85 who own the 100,000,000 won of farmland. The pmts of Junnam and Gyeongbuk are lower than average pmts of national level. It means that, the land values in these areas are lower than in any other area, under the condition that other variables are the same among regions. Especially pmts of Junnam area have the lowest amount among regions, even if the pmt difference between Gyeongbuk and Junnam provinces is relatively small. It means that the FP can cause the income inequality among the regions, even if the farmland value is the same among the regions. And then there is a need to another complementary policy to solve the difference of quality of life for the rural elderly among regions.

## V. Conclusion

Korean society already became in 2013 a so-called "aged society", only 13 years after its designation as an "aging society". In an aging society, people who are 65 years or older make up over 7 percent of the population, while in an aged society this number exceeds 14 percent. One of the reasons of this rapid pace of Korea's aging is

Table 7. Estimates of pmt by age (farmland value=100,000,000 won, farmland types=dryfield and ricefield) of national level

| | | AGE | UP | M | PMT | PVMIP | PVEL | NL |
|---|---|---|---|---|---|---|---|---|
| National level | dryfield | 65 | 2% | 0.5%/YEAR | 275,215 | 2335787.1 | 2335766.7 | -20.4 |
| | | 75 | 2% | 0.5%/YEAR | 445,973 | 2409791.4 | 2409791.3 | -0.2 |
| | | 85 | 2% | 0.5%/YEAR | 794,214 | 2476511.5 | 2476502.9 | -8.6 |
| | ricefield | 65 | 2% | 0.5%/YEAR | 253,367 | 2310464.2 | 2310402.3 | -61.9 |
| | | 75 | 2% | 0.5%/YEAR | 421,830 | 2388473.6 | 2388452.0 | -21.6 |
| | | 85 | 2% | 0.5%/YEAR | 768,325 | 2461471.8 | 2461463.9 | -7.9 |

UP: Up-front insurance premium
M: Monthly insurance premium

Table 8. Estimates of pmt by age (farmland value=100,000,000 won, farmland types=dryfield and ricefield): Junnam Province

| | | AGE | UP | M | PMT | PVMIP | PVEL | NL |
|---|---|---|---|---|---|---|---|---|
| Junnam province | dryfield | 65 | 2% | 0.5%/YEAR | 207,950 | 2257823.5 | 2257814.4 | -9.1 |
| | | 75 | 2% | 0.5%/YEAR | 369,336 | 2342122.5 | 2342117.5 | -5.0 |
| | | 85 | 2% | 0.5%/YEAR | 709,760 | 2427449.7 | 2427439.7 | -10.1 |
| | ricefield | 65 | 2% | 0.5%/YEAR | 182,155 | 2227925.8 | 2227871.5 | -54.3 |
| | | 75 | 2% | 0.5%/YEAR | 337,857 | 2314327.1 | 2314289.0 | -38.2 |
| | | 85 | 2% | 0.5%/YEAR | 672,951 | 2406066.3 | 2406053.5 | -12.8 |

Table 9. Estimates of pmt by age (farmland value=100,000,000 won, farmland type=dryfield and ricefield): Gyeongbuk Province

| | | AGE | UP | M | PMT | PVMIP | PVEL | NL |
|---|---|---|---|---|---|---|---|---|
| Gyeongbuk province | dryfield | 65 | 2% | 0.5%/YEAR | 210,479 | 2260754.8 | 2260734.8 | -19.9 |
| | | 75 | 2% | 0.5%/YEAR | 372,353 | 2344786.4 | 2344775.2 | -11.2 |
| | | 85 | 2% | 0.5%/YEAR | 713,217 | 2429458.0 | 2429456.4 | -1.6 |
| | ricefield | 65 | 2% | 0.5%/YEAR | 213,041 | 2263724.2 | 2263706.2 | -18.0 |
| | | 75 | 2% | 0.5%/YEAR | 375,396 | 2347473.3 | 2347433.6 | -39.7 |
| | | 85 | 2% | 0.5%/YEAR | 716,692 | 2431476.7 | 2431465.7 | -11.0 |

the low birthrate (about 1.16 births per woman aged 15 to 49). The population under 15 years old decreased by 6.8 percent during the past five years. In 13 years, when the baby boom generation will be included in the population aged 65 or older, the pace of aging will accelerate. We can predict that economic and social problems will become serious. Until now, there have been seven adults per two children and one aged person. However, from now on, statistics predict, those who are working will decrease, while those who receive support from others will increase (http://english.hani.co.kr/arti/english_edition/e_business/126854.html: 2015.01.15).

The increases of life expectancy and number of old people cause serious social problems, such as the lack of the living costs and the life stabilization of the elderly people, especially of the rural elderly. In order to solve these problems, the Korean government introduced in 2011 the farmland reverse mortgage system (FP). FP is a farmland loan that provides cash payments based on farmland equity. It is a program which liquidates the farmland for the rural elderly in order to pay the monthly based annuity. This study tried to build the long term forecasting model of values of dryfield and ricefield for promoting the Farmland Pension, which is the most important factor in estimating the monthly payment annuity considering the regional differences. This study selected Gyeongbuk and Junnam provinces where are the most aged and agricultural oriented areas. It examined the stationary of the monthly farmland value index time series data for a period of 116 months from January 2005 to August 2014, provided by the Ministry of National Land and Transportation. Because the transaction of farmland does not often occur in the real world, instead of using the Company Bond interest rate (Cho et. al., 2009), this study used the monthly interest rate data of TYNB, provided by the Bank of Korea for the same period of time, as indicated above. Particularly this study used the monthly data on the farmland value and interest rate time series, considering the regional differences. This paper estimated the monthly payment amount of farmland pension at age 65, 75 and 85 who own the 100,000,000 won of farmland value in order to get more robust outcomes, instead of the quarterly or yearly based data like the other researches.

The analysis results notes several meaningful outcomes. The farmland value and interest rate showed the downward stabilization trends. There is also noted that the value index of dryfield is higher than that of ricefield in general. Moreover, this study figures out that, the first difference data of monthly value index time series data are stationary through the unit root tests. Farmland value index is continuously increased, although the increasing rate time series data are not stationary, however its first difference is stationary. The change rate of the monthly interest of TYNB has also increased at the beginning stage and gradually decreased after that period. And it notes the non-stationary of time series data; however its first difference is oscillated around the mean value. In summary, the first difference time series data of value indexes of dryfield and ricefield and the first difference of the monthly interest rates also are stationary at one percent level. These results will decrease the risk of FP for both, its provider and borrower, because the future value changes are relatively stationary.

The analysis results suggest several empirical and policy implications. At first, stationarity of time series increases the possibility of the statistical utilization of monthly farmland value data in forecasting the future farmland. In other words, we can easily estimate the future farmland value using the historical mean data, because time series data are stationary. Second, in this paper, for the first time, was used directly the monthly data in forecasting the future farmland value, instead of the quarter or year based data, because the FP is paid on monthly bases. Third, the stationarity of TYNB instead of the utilization of Company Bond and Certificate Deposit increases the forecasting possibility of farmland values at the future certain time (N) without using the complicate forecasting model. However, until now, FP program discloses some problems. The aged and poor areas get less pmt, comparing with that of national average level. It means that the original goal of FP to solve the lack of living costs of the rural elderly cannot be achieved throughout the FP. The rich area gets more pmt and the poor area (Gyeongbuk and Junnam provinces) earns less pmt in the course of implementation of the FP program. It accelerates the income difference of the elderly among regions. Especially the pmts of Junnam and Gyeongbuk are significantly lower than the one at the national level. It means that, the land values in these areas are lower than in any other area under the condition that, other variables are the same among regions (see Eq.1).

Especially pmt of Junnam is the lowest among regions, even if the pmt difference between Gyeongbuk and Junnam provinces is relatively small. The FP program cannot solve the regional disparity of the monthly income among region and rural elderly. Therefore this paper suggests some other policy alternatives, such as farming and income supporting programs for the poor rural elderly in order to overcome the regional differences of payment amount of FP.

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