Pricing Unemployment Insurance in Iran

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Abstract

Employees are always concerned about losing their jobs, or in other words, losing their income resources. For this purpose, governments require strong protection system to cover these concerns. The Unemployment Insurance (UI) program can be used to achieve this goal.

Based on article five of Iranian unemployment Insurance law, premium is 4% of employee's salary while employer and government contributions are 3% and 1%, respectively. So, there are great concerns about the financial pressure on the government regarding implementation of this law.

In this paper, we price UI based on the insurance history of employee and the duration of unemployment. We use the Weibull distribution for finding duration of unemployment, and finally equivalence principle is applied to find the fair UI premium rate. Our findings indicate that the UI rate is less than 4% which is lower than current UI rate in Iran set by law. Consequently, government contribution can be eliminated, which will result in reduction of government concerns over the required budget.

Keyword(s): *Unemployment Insurance, Equivalence Principle, CAPM, Weibull distribution, Iran's UI scheme, Job search theory.*

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1. Introduction

The unemployment insurance is one of the most important services which can be provided for employed people since there is always a probability of losing their job. To protect and support people who are unemployed or who are looking for a job, every government should have some appropriate program. So, unemployment compensation is a social program designed to replace part of lost earnings of people with prior work experience. Unemployment Insurance (UI) programs vary quite a bit because of specific concerns in every country or region. UI provides benefits to persons who are unemployed without any fault of their own, are ready, willing and able to work, and are actively looking for a job.

Since unemployment insurance was created in 1935, it has expanded into a broad, employer-based program that aims to help stabilize the overall economy and protect the unemployed from major financial disruptions. There are four major types of unemployment compensation programs around the world, namely, compulsory unemployment insurance, voluntary unemployment insurance, unemployment subsidy, and firing fee. The compulsory unemployment insurance is the most commonly-used program worldwide. In most countries unemployment insurance (UI) is nationalized, and people who work are required to pay a compulsory insurance premium (contribution). In fact, most unemployment insurance schemes charge a flat percentage of a worker's income earned between some minimum and maximum levels.

In Iran, people who are subject to the Social Security Law shall be entitled to the rules and regulations of the present Law. Retired, totally disabled, self-employed and the voluntary insured and foreigners residing in Iran are excluded from this law. According to this law, an unemployed person is defined as an insured person ready to work, made unemployed due to reasons other than his or her own fault.

Based on article five of Iranian unemployment Insurance law, premium (which will be called contribution rate from this point forward) is four percent of employee's salary and must be paid by his employer and the government. Employer and government contributions are 3% and 1% respectively.

There have been great concerns about the financial pressure on the government regarding implementation of this law. In response to the above mentioned concerns, in this research we are going to calculate the fair contribution rate. If results show that the optimal contribution rate is less than or equal to three percent, then government contribution can be eliminated and reduce the financial pressure of implementing the law.

The main question of this research: what is the optimal contribution rate? To answer this question, we construct the following hypothesis:

The optimal UI rate calculated in this paper is less than the current 4% UI rate set by law in Iran.

This paper is organized as follows:

In section 2, we present a review of the literature in deriving actuarially fair unemployment insurance contribution rate, the level and length of unemployment insurance benefits, job search theory, and effect of unemployment duration.

In section 3, we describe the equivalence principle, CAPM based model, and modeling unemployment duration using Weibull distribution.

Finding the unemployment duration, and deriving the actuarially fair premium with respect to the unemployment duration and the risk return of the market and insurance company with empirical data will be presented in section 4.

The conclusion and suggestions are provided in the last section.

2. Literature Review

The original contribution of the search theory was the theoretic approach to the analysis of unemployment spells duration and dispersion of incomes. Theory of job search uses the tools of sequential statistical decision theory for the typical worker's problem to find a job in a decentralized labor market.

Bronars (1985) derived actuarially fair unemployment insurance

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premiums using a theoretical model of a regulated private market for unemployment insurance. Fair premiums are derived using the capital asset pricing model under the assumption that insurance firms borrow and lend in the capital market to finance benefit payments. Then, Bronars obtained the empirical estimates of betas and fair premiums for the US unemployment insurance.

Meyer (Meyer 1990) tests the effects of the level and length of unemployment insurance benefits on unemployment duration. The paper tests the effects of the level and length of UI benefits on unemployment durations. Higher UI benefits are found to have a strong negative effect on the probability of leaving unemployment. However, the probability of leaving unemployment rises dramatically just prior to when benefits lapse. When the length of benefits is extended, the probability of a spell ending is high in the week benefits were previously expected to lapse.

Launov et al. (Launov 2004) investigate whether the extension of the entitlement to unemployment benefits in the mid-80s can explain the increase in the unemployment rates of unskilled and elder workers in western Germany. They found that for unskilled workers the extension of the entitlement period has significantly contributed to the changes in their search behavior. Unemployment rate for the unskilled predicted by the model shifts from 10.3% to 15.1% which almost completely matches the 9.2 % to 16.4 % increase of the same rate observed in the data.

Mehmet Taşçi (2005) examines the determinants of unemployment duration for the first-time jobseekers in Turkey. He uses raw data from the Household Labor Force Surveys of 2000 and2001. He uses the grouped duration approach and finds that first-time female jobseekers are less likely to find a job compared to male jobseekers. Urban resident males are more likely to find a job compared to rural resident ones. Increases in education level do not seem to decrease the hazard for both males and females.

Krueger Mueller (2008) studied the Job Search and Unemployment Insurance. This paper provides new evidence on job search intensity of the unemployed in the US, modeling job search intensity as time allocated to job search activities. He finds that across the 50 states and D.C., job search is inversely related to the generosity of unemployment benefits. In addition, job search intensity for those eligible to UI increases prior to benefit exhaustion.

Hwei-Lin Chuang and Min-Teh Yu (2010) studied the pricing of unemployment insurance in Taiwan. This study incorporates the survival analysis of unemployment duration into the insurance pricing framework to measure the fairly-priced premium rate for Taiwan. Their results suggest the fair premiums range from 0.2041% to 0.2436% under the 1999-2002 scheme, and from 0.1388% to 0.1521% under the 2003-2009 scheme for various possible levels of average unemployment duration in Taiwan, and they are all lower than the current UI premium rate of1%.

Biagini and Widenmann (2012) worked at Pricing of unemployment insurance products with doubly stochastic Markov chains. They provide a new approach for modeling and calculating premiums for unemployment insurance products. The innovative modeling concept consists of combining the benchmark approach with its real-world pricing formula and Markov chain techniques in a doubly stochastic setting. They described individual insurance claims based on a special type of unemployment insurance contracts, which are offered in the private insurance market. The pricing formulas are first given in a general setting and then specified under the assumption that the individual employment-unemployment process of an employee follows a time-homogeneous doubly stochastic Markov chain. In this framework, formulas for the premiums are provided depending on the P-numeraire portfolio of the Benchmark approach. Under a simple assumption on the P-numeraire portfolio, the model is tested on its sensitivities to several parameters. With the same specification the model's employment and unemployment intensities are estimated on public data of the Federal Employment Office in Germany.

3. Theoretical Foundation

In order to calculate the UI rate, we use different financial and statistical models. In this part we provide explanations about the models used in this paper.

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– CAPM Model

We consider CAPM (Capital Asset Pricing Model) as the base insurance pricing model. Specification of the Weibull distribution is used to estimate the unemployment duration. We then set up our formulae to determine the actuarially fair contribution rate for the UI program.

The fairly-priced insurance contribution requires that the present value of premium income ($PV(I)$) equal the present value of loss payments ($PV(L)$). This corresponds to the equivalence principle. Fairley (1979) introduced this pricing approach in the property-liability insurance literature for the first time. He applied the CAPM to derive risk-adjusted rates of return for property-liability insurers.

Important extensions of the Fairley model by Myers and Cohn (1981) and Hill and Modigliani (1987) provide empirical evidence on its reliability and stability. Bronars (1985), Beenstock and Brassee (1986), and Blake and Beesnstock (1988) have applied the CAPM-based framework to study unemployment insurance with different focuses.

We can express the present value of the expected contribution rate (I) and expected loss (L) as follows:

$$PV(I)=PV(L) \tag{1}$$

$$PV(I) = \sum_{n=0}^{N} I_n/(1+R_f)^n \tag{2}$$

$$PV(L) = \sum_{n=0}^{N} L_n/(1+E(R_L))^n \tag{3}$$

Where n=0,1,…,N , I_n denotes the expected contributions received at time n , L_n denotes the expected losses paid at time n , R_f denotes the risk-free rate of interest , and R_L denotes the risk-adjusted return from CAPM for whole insurance field in all insurance companies. That is, R_L has the following relationship with the market:

Portfolio returns, R_m.

$$E(R_L) - R_f = \beta\,(E(R_m) - R_f) \tag{4}$$

– Weibull distribution

We apply Weibull distribution in Unemployment Duration. The probability density function of Weibull distribution is

$$f(t) = \lambda p(\lambda t)^{p-1} exp(-(\lambda t)^{p})$$

The instantaneous hazard rate is $(t) = \lambda p(\lambda t)^{p-1}$, an increasing, constatnt, or decreasing function of t, as p is greater than, equal to, or less than unity. This property is interesting when the Weibull distribution is used as a waiting time distribution because it determines whether the probability of an event occurring in the period between t and $t+\Delta t$ is an increasing, constant, or decreasing function of the elapsed time t.[1]

One of the reasons for the widespread use of the Weibull is its capacity for dealing with *duration dependence:* the extent to which the conditional hazard of the event of interest occurring is increasing or decreasing over time. Weibull model allows the extent of duration dependence to vary according to a specified set of covariates. Therefore, it is an appropriate distribution for unemployment duration.

While calculating the benefit payment, we need to estimate the average duration for the claims paid. As unemployment duration has the problem of incomplete spells, it is inappropriate to use the statistical average of the unemployment duration in calculating the benefit payment.

To estimate the completed unemployment duration, a survival analysis derived from the job search theory should be applied. We will describe the procedure for calculating the benefit payment as follows:

Let T denote unemployment duration, $T \in (0,\infty)$, and $f(t)$ be the probability density function of T. The probability that the unemployment duration is less than t can then be expressed as:

$$F(t) = Pr(T \leq t) = \int_{0}^{t} f(t)dt \tag{5}$$

Where $F(t)$ denotes the cumulative density function of T. For an individual who has been unemployed for t periods, the conditional probability that he will leave the unemployed status (either transit to

1. Carr, J. (1978). A comparative study of the duration of unemployment of young and middle-aged men.

the employed or out-of-labor-force status) at time t, is defined to be the hazard function ($h(t)$) and can be written as:

$$H(t)\, dt = Pr(t<T\leq t+dt \backslash T>t) = f(t)/S(t) \tag{6}$$

where $S(t)$ is the survival function defined to be:

$$S(t) = Pr(T \geq t) = \int_t^{\infty} f(t)dt\ ,\ S(0) = 1\ , S(\infty) = 0 \tag{7}$$

As the Weibull distribution is most commonly used to describe unemployment duration in the literature (see Lancaster 1979, Lynch 1985, Moffitt 1985), Atkinson and Micklewright 1991), Hunt 1995, and Chuang 1999), we assume that the unemployment duration here follows the Weibull distribution in calculating the benefit payment of the UI program.

The hazard function and the survival function corresponding to the Weibull distribution are:

$$S(t) = exp(-(\lambda t)^p) \tag{8}$$

$$h(t) = f(t)/S(t) = \lambda p(\lambda t)^{p-} \tag{9}$$

where p is the shape parameter, which determines the shape of the distribution, and λ is the scale parameter, which measures the time unit. The probability density function for the Weibull distribution can be derived from the survival function, and the expected value of the unemployment duration can then be given as:

$$f(t) = \lambda p(\lambda t)^{p-1} exp(-(\lambda t)^p) \tag{10}$$

$$E(t) = \int_0^{\infty} tf(t)dt = \int_0^{\infty} t\lambda p(\lambda t)^{p-1} exp(-(\lambda t)^p)\ dt \tag{11}$$

The expected value of the Weibull distribution can be written as:

$$E(t) = \frac{1}{\lambda}\Gamma(\frac{1}{p} + 1) \tag{12}$$

Also the variance can be written as:

$$Var(t) = \frac{1}{\lambda^2}[\Gamma(\frac{2}{p} + 1) - \Gamma(\frac{1}{p} + 1)^2] \tag{13}$$

We use *E(t)* and *Var(t) to* calculate the scale parameter (λ), and the shape parameter (p).

– Application to Iran UI scheme

Table 1states the duration of unemployment benefit in Iran with respect to the insurance history and marital status:

Table 1. Iran's UI scheme.

Insurance history (months)	**Maximum benefit duration with respect to the marital status (months)**	
	Married	**Single**
12 to 24 months	9	6
25 to 60 months	12	9
61 to 90 months	15	12
91 to 120 months	18	15
121 to 150 months	21	18
151 to 180 months	24	21
181 to 210 months	28	24
211 to 252 months	32	27
More than 253 months	36	30

According to the rules implemented in the UI program in Iran, the benefit payment amount is 70% for the first 6 months, 60% for the second 6 months, and 50% for the third 6 months of the claimant insured earnings. For married insured, this amount increases by 10% in each period.

Duration of the benefit payment

Based on the above information, we can derive the expected duration of the benefit payments for a representative claimant as:

For a single person:

$$
\begin{aligned}
D = \alpha_1 * &\left\{ \sum_{t_1=1}^{180} \left[t_1 * \lambda p(\lambda t_1)^{p-1} * \exp(-(\lambda t_1)^p) \right] + \sum_{t_1=181}^{\infty} \left[180 * \lambda p(\lambda t_1)^{p-1} * \exp(-(\lambda t_1)^p) \right] \right\} \\
+\alpha_2 * &\left\{ \sum_{t_2=1}^{270} \left[t_2 * \lambda p(\lambda t_2)^{p-1} * \exp(-(\lambda t_2)^p) \right] + \sum_{t_2=271}^{\infty} \left[270 * \lambda p(\lambda t_2)^{p-1} * \exp(-(\lambda t_2)^p) \right] \right\} \\
+\alpha_3 * &\left\{ \sum_{t_3=1}^{360} \left[t_3 * \lambda p(\lambda t_3)^{p-1} * \exp(-(\lambda t_3)^p) \right] + \sum_{t_3=361}^{\infty} \left[360 * \lambda p(\lambda t_3)^{p-1} * \exp(-(\lambda t_3)^p) \right] \right\} \\
+\alpha_4 * &\left\{ \sum_{t_4=1}^{450} \left[t_4 * \lambda p(\lambda t_4)^{p-1} * \exp(-(\lambda t_4)^p) \right] + \sum_{t_4=451}^{\infty} \left[450 * \lambda p(\lambda t_4)^{p-1} * \exp(-(\lambda t_4)^p) \right] \right\} \\
+\alpha_5 * &\left\{ \sum_{t_5=1}^{540} \left[t_5 * \lambda p(\lambda t_5)^{p-1} * \exp(-(\lambda t_5)^p) \right] + \sum_{t_5=541}^{\infty} \left[540 * \lambda p(\lambda t_5)^{p-1} * \exp(-(\lambda t_5)^p) \right] \right\} \\
+\alpha_6 * &\left\{ \sum_{t_6=1}^{630} \left[t_6 * \lambda p(\lambda t_6)^{p-1} * \exp(-(\lambda t_6)^p) \right] + \sum_{t_6=631}^{\infty} \left[630 * \lambda p(\lambda t_6)^{p-1} * \exp(-(\lambda t_6)^p) \right] \right\} \\
+\alpha_7 * &\left\{ \sum_{t_7=1}^{720} \left[t_7 * \lambda p(\lambda t_7)^{p-1} * \exp(-(\lambda t_7)^p) \right] + \sum_{t_7=721}^{\infty} \left[720 * \lambda p(\lambda t_7)^{p-1} * \exp(-(\lambda t_7)^p) \right] \right\} \\
+\alpha_8 * &\left\{ \sum_{t_8=1}^{810} \left[t_8 * \lambda p(\lambda t_8)^{p-1} * \exp(-(\lambda t_8)^p) \right] + \sum_{t_8=811}^{\infty} \left[810 * \lambda p(\lambda t_8)^{p-1} * \exp(-(\lambda t_8)^p) \right] \right\} \\
+(1-\alpha_1-\alpha_2-\alpha_3-\alpha_4-\alpha_5-\alpha_6-\alpha_7-\alpha_8) * &\left\{ \begin{array}{l} \sum_{t_9=1}^{900} \left[t_9 * \lambda p(\lambda t_9)^{p-1} * \exp(-(\lambda t_9)^p) \right] \\ + \sum_{t_9=901}^{\infty} \left[900 * \lambda p(\lambda t_9)^{p-1} * \exp(-(\lambda t_9)^p) \right] \end{array} \right\}
\end{aligned}
$$

where D denotes the expected duration of benefit payment.

α_1 is the probability that the individual has 12 to 24 months of insurance history, α_2 is the probability that the individual has 25 to 60 months of insurance history, α_3 is the probability that the individual has 61 to 90 months of insurance history, α_4 is the probability that the individual has 91 to 120 months of insurance history, α_5 is the probability that the individual has 121 to 150 months of insurance history, α_6 is the probability that the individual has 151 to 180 months of insurance history, α_7 is the probability that the individual has 181 to 210 months of insurance history, α_8 is the probability that the individual has 211 to 252 months of insurance history, and $(1-\alpha_1-\alpha_2-\alpha_3-\alpha_4-\alpha_5-\alpha_6-\alpha_7-\alpha_8)$ is the probability that the individual has an insurance history of more than 253 months.

For a married person we have:

$$
\begin{aligned}
D = {} & \alpha_1 * \left\{ \sum_{t_1=1}^{270} \left[t_1 * \lambda p(\lambda t_1)^{p-1} * \exp(-(\lambda t_1)^p) \right] + \sum_{t_1=271}^{\infty} \left[270 * \lambda p(\lambda t_1)^{p-1} * \exp(-(\lambda t_1)^p) \right] \right\} \\
& + \alpha_2 * \left\{ \sum_{t_2=1}^{360} \left[t_2 * \lambda p(\lambda t_2)^{p-1} * \exp(-(\lambda t_2)^p) \right] + \sum_{t_2=361}^{\infty} \left[360 * \lambda p(\lambda t_2)^{p-1} * \exp(-(\lambda t_2)^p) \right] \right\} \\
& + \alpha_3 * \left\{ \sum_{t_3=1}^{450} \left[t_3 * \lambda p(\lambda t_3)^{p-1} * \exp(-(\lambda t_3)^p) \right] + \sum_{t_3=451}^{\infty} \left[450 * \lambda p(\lambda t_3)^{p-1} * \exp(-(\lambda t_3)^p) \right] \right\} \\
& + \alpha_4 * \left\{ \sum_{t_4=1}^{540} \left[t_4 * \lambda p(\lambda t_4)^{p-1} * \exp(-(\lambda t_4)^p) \right] + \sum_{t_4=541}^{\infty} \left[540 * \lambda p(\lambda t_4)^{p-1} * \exp(-(\lambda t_4)^p) \right] \right\} \\
& + \alpha_5 * \left\{ \sum_{t_5=1}^{630} \left[t_5 * \lambda p(\lambda t_5)^{p-1} * \exp(-(\lambda t_5)^p) \right] + \sum_{t_5=631}^{\infty} \left[630 * \lambda p(\lambda t_5)^{p-1} * \exp(-(\lambda t_5)^p) \right] \right\} \\
& + \alpha_6 * \left\{ \sum_{t_6=1}^{720} \left[t_6 * \lambda p(\lambda t_6)^{p-1} * \exp(-(\lambda t_6)^p) \right] + \sum_{t_6=721}^{\infty} \left[720 * \lambda p(\lambda t_6)^{p-1} * \exp(-(\lambda t_6)^p) \right] \right\} \\
& + \alpha_7 * \left\{ \sum_{t_7=1}^{840} \left[t_7 * \lambda p(\lambda t_7)^{p-1} * \exp(-(\lambda t_7)^p) \right] + \sum_{t_7=841}^{\infty} \left[840 * \lambda p(\lambda t_7)^{p-1} * \exp(-(\lambda t_7)^p) \right] \right\} \\
& + \alpha_8 * \left\{ \sum_{t_8=1}^{960} \left[t_8 * \lambda p(\lambda t_8)^{p-1} * \exp(-(\lambda t_8)^p) \right] + \sum_{t_8=961}^{\infty} \left[960 * \lambda p(\lambda t_8)^{p-1} * \exp(-(\lambda t_8)^p) \right] \right\} \\
& + (1-\alpha_1-\alpha_2-\alpha_3-\alpha_4-\alpha_5-\alpha_6-\alpha_7-\alpha_8) * \left\{ \begin{array}{l} \sum_{t_9=1}^{1080} \left[t_9 * \lambda p(\lambda t_9)^{p-1} * \exp(-(\lambda t_9)^p) \right] \\ + \sum_{t_9=1081}^{\infty} \left[1080 * \lambda p(\lambda t_9)^{p-1} * \exp(-(\lambda t_9)^p) \right] \end{array} \right\}
\end{aligned}
$$

Fairly-Priced Premium Rate (Y)

Combining the CAPM-based insurance pricing framework and the weibull specification, we express the present value of the expected benefit payment ($PV\ (L_0)$) as follows:

$$
PV\ (L_0) = 0.8 * W * U * \left\{ \sum_{t=1}^{D} \left[1/\exp\left[t * (R_f' + \beta * (E(R_m') - R_f')) \right] \right] \right\} \quad (16)
$$

Where $R_f^{'}$ and $R_m^{'}$ are the monthly returns and L_0 denotes the expected benefit payment to a representative individual. Term W denotes the insured monthly earnings and U is the unemployment probability.

Assuming a representative individual works and pays the premium for 30 years in his/her lifetime, then the present value of the expected premium income ($PV(I)$) received from the representative individual is expressed as:

$$PV(I) = \sum_{t=0}^{30} \left[(Y * W) / \exp\left[t * R_f \right] \right] \tag{17}$$

Where Y denotes the premium rate.

The fairly-priced UI premium can be derived by solving Y by equating $PV(L_0)$ and $PV(I)$.

– The Measurement of parameters

Based on equations (14) to (17), we have grouped the parameters in our model into three types. The first type is related to the unemployment situation, such as the parameters (p and λ) of the Weibull distribution and the unemployment probability. The second type describes the insurance characteristics of the UI program, such as the proportions of insured workers with various years of insurance history. The third type includes variables and parameters of the capital markets, such as the systematic risk coefficient (β), risk-free rate of interest, and the rate of return of market portfolio.

The sources and measurements of parameters used in our model are reported in table 2. The parameter values of the Weibull distribution were calculated by solving the mean and variance formulae simultaneously based on the estimated values of means in recent literature and variance of simulated data.

Table 2. Sources of Parameter and Measurement

Parameters	Measurement	Data Sources
Shape parameter (p) of Weibull distribution	Solved from mean and variance formulae of Weibull distribution.	Mean values are taken from recent literatures and variance is computed from simulated data.
Scale parameter (λ) of Weibull distribution	Solved from mean and variance formulae of Weibull distribution.	Mean values are taken from recent literatures and variance is computed from simulated data.
Unemployment probability (U)	Proportion of previously employed workers who become unemployed in the current years.	Reported with Census Center (Statistical Center of Iran).
Proportion of insured workers with 12 to 24 months insurance history(α_1)	Proportion of person with 10 to 24 years old in Economically active population.	Reported with Census Center (Statistical Center of Iran) in Iran Statistical Year Book.
Proportion of insured workers with 25 to 60 months insurance history (α_2)	Proportion of person with 25 to 29 years old in Economically active population.	Reported with Census Center (Statistical Center of Iran) in Iran Statistical Year Book.
Proportion of insured workers with 61 to 90 months insurance history(α_3)	Proportion of person with 30 to 34 years old in Economically active population.	Reported with Census Center (Statistical Center of Iran) in Iran Statistical Year Book.
Proportion of insured workers with 91 to 120 months insurance history(α_4)	Proportion of person with 35 to 39 years old in Economically active population.	Reported with Census Center (Statistical Center of Iran) in Iran Statistical Year Book.
Proportion of insured workers with 121 to 150 months insurance	Proportion of person with 40 to 44 years old in Economically active population.	Reported with Census Center (Statistical Center of Iran) in Iran Statistical Year Book.

history(α_5)		
Proportion of insured workers with 151 to 180 months insurance history(α_6)	Proportion of person with 45 to 49 years old in Economically active population.	Reported with Census Center (Statistical Center of Iran) in Iran Statistical Year Book.
Proportion of insured workers with 181 to 210 months insurance history(α_7)	Proportion of person with 50 to 54 years old in Economically active population.	Reported with Census Center (Statistical Center of Iran) in Iran Statistical Year Book.
Proportion of insured workers with 211 to 252 months insurance history(α_8)	Proportion of person with 55 to 59 years old in Economically active population.	Reported with Census Center (Statistical Center of Iran) in Iran Statistical Year Book.
Systematic risk coefficient (β)	1.Takenfrom recent literatures. 2.The estimated value of β for The whole insurance company.	1.reported from Sepahan Bank[1]. 2.Estimated using daily data from Tehran Stock Exchange.

– Assumptions

Because of data lack, we have made some assumptions which are presented as follows:

A person aged

1. 10 - 24 has 12 - 24 months of insurance history. So α_1 can be calculated by this assumption.
2. 25 - 29 has 25 - 60 months of insurance history. So α_2 can be calculated by this assumption.
3. 30 - 34 has 61- 90 months of insurance history. So α_3 can be calculated by this assumption.

1. Sepahanbank. from http://www.sepahanbank.ir.

4. 35 - 39 has 91 - 120 months of insurance history. So α_4 can be calculated by this assumption.
5. 40 - 44 has 121 - 150 months of insurance history. So α_5 can be calculated by this assumption.
6. 45 - 49 has 151 - 180 months of insurance history. So α_6 can be calculated by this assumption.
7. 50 - 54 has 181 - 210 months of insurance history. So α_7 can be calculated by this assumption.
8. 55 - 59 has 211 - 252 months of insurance history. So α_8 can be calculated by this assumption.

4. Aged 60 and older has 253 and more months of insurance history.

5. Numerical Illustration

In this section, we apply the previously discusses methods to the real data. First we calculate the β of Insurance industry with respect to the Market using CAPM with real data. Then, we find unemployment duration (D) by considering Weibull distribution, and use the results to calculate the UI rate (Y). Finally, we show the effect of changing the value of some parameters in Y.

– Finding β of Insurance Industry

We have two amounts for β.

1. β which is stated in Sepahan Bank report and is 13%.
2. β that we calculate in the following section. So we need the below data:

R_L :Risk-adjusted return for whole insurance field in all insurance companies. Source: Tehran Stock Exchange.

R_m :Market-portfolio returns. Source: Tehran Stock Exchange.

R_f:Risk-free rate of interest. R_f= 15% reported by Central Insurance of Iran.

Using CAPM model introduced in chapter 3, we have the following equation (equation 4 in chapter 3):

$E(R_L)$ - R_f= β ($E(R_m)$ - R_f)

For calculating β, we regress the R_L on R_m .

The result shows that the β is equal to 27%.

Consequently, to calculate the UI rate, we consider two scenarios, the first one based on ***β=13%*** and the second one based on ***β=27%***.

– Duration of Benefit Payment (D)

Finding the parameters of Weibull distribution

To calculate these parameters, it's necessary to have a mean and variance of unemployment duration or the duration of finding a job for an unemployed person.

Salehi-Isfahani and Egel (2010)[1] found that the mean duration of joblessness for men and women is 15 and 37.5 months, respectively.

To find the variance of unemployment duration, we have to simulate the value in this range. For this reason, we consider the total economically active population in Iran which is 23,469,000 people[2]. The total men in economically active population are 19,840,000 people (84% of whole active population) and the total women are 3,629,000 people (16% of whole active population). So the mean duration of unemployment is calculated as follows:

Mean duration of unemployment = (0.84 * 15) + (0.16 * 37.5) = 18.6 months

The simulated variance is equal to 166 months.

Let mean and variance in (12) and (13), stated in chapter 3.

By solving these two equations, the shape parameter (p) and the scale parameter (λ) of Weibull distribution will be as follows: p= 8.01, λ= 0.0018

1. Egel, D. and D. Salehi-Isfahani (2010). "Youth Transitions to Employment and Marriage in Iran. Evidence from the School to Work Transition Survey.", "Middle East Development Journal 02(01): 89-120."
2. Statistical Yearbook of Iran.

Calculating the duration of benefit payment (D)

As we have seen in chapter 3, according to the unemployment scheme in Iran, we can divide people based on their marital status. However, we only consider married people. Although maximum duration of benefit payment for married people is greater than that of single people, both groups pay the same contribution rate. In fact, we consider the worst scenario for calculating D (maximum value for D). Then we can compare the rate for the worst scenario with the current rate which is set by law.

The parameters and their value for this purpose are calculated as follows:

$\alpha_1 = 0.262$, $\alpha_2 = 0.173$, $\alpha_3 = 0.137$, $\alpha_4 = 0.12$

$\alpha_5 = 0.1$, $\alpha_6 = 0.077$, $\alpha_7 = 0.05$, $\alpha_8 = 0.03$

$p= 8.01$, $\lambda= 0.0018$

Let these values in (15)

D = 393

This amount shows that the duration of benefit payment is 393 days, in other words, the duration of benefit payment (D) for married people is about 13 months.

- **Calculating the Fairly-Priced contribution rate (Y)**

As we expressed in chapter 3, we apply equivalence principle to find the fair premium. So we have to find the present value of the expected benefit payment ($PV(L_0)$) and the present value of the expected premium income ($PV(I)$) of insurance company.

- **Calculating the present value of the expected benefit payment ($PV(L_0)$)**

$$PV(L_0) = 0.8*W*U*\left\{\sum_{t=1}^{D}\left[1/\exp\left[t*(R_f^{'} + \beta*(E(R_m^{'}) - R_f^{'}))\right]\right]\right\}$$

As expressed by equation (16), we need the monthly returns.

Note: Suppose the annual interest rate is i . For calculating m-thly payment of interest rate, we have

$1+i=(1+i^{(m)}/m)^m$

So we have

$1+R_f=(1+R_f^{'})^{12}$

Where $R_f^{'}$ is monthly risk free rate.

Let $R_f = 0.15$, so we can write last equation as

$1+0.15=(1+R_f^{'})^{12}$

$R_f^{'}=0.011$

Now we are going to calculate the probability of losing the job for a person in a specific year. For this purpose, we consider the number of people who lose their jobs in a year and divide this value by total workers in the beginning of the year.

From the report of Social Security Organization of Iran, we calculate this amount as follows:

Total number of employed people is 20,476,000 people, and number of people who have lost their jobs is 409,525 people.

So we have

U = (number of people who have lost their job)/(whole employed people)

$U=409{,}525/20{,}476{,}000=0.02$

This value shows that there is a probability of 2% for every employed to lose his/her job.

The value of 0.8 in the equation denotes the benefit amount of the insured earnings.

As we previously explained, this amount is 70% for the first 6 months, 60% for the second 6 months and 50% for the third 6 months in case of a single insured. In case of a married insured, this amount is 80% for the first 6 months, 70% for the second 6 months and 60% for the third 6 months.

- Why do we apply 80% for this amount?
- Since this value is greater than the other, in both single and married cases, we consider the worst case for our calculation, and the measure of Y based on this amount is the maximum Y that can be calculated.

By considering this amount for benefit payment and the maximum duration of benefit payment, the value of Y that we are going to calculate is the maximum amount of Y, and in any other case for insured status and period of benefit payment, the amount of Y is more or less than this amount of Y.

In the final step, we consider the two values of β. The first β is 13% stated in Sepahan Bank, and the other is 27% that we calculate in 4-3-2 using CAPM model.

Now we calculate Y based on the two values of β.

Through equating (16) and (17), we derive the fairly-priced UI premium (Y).

The parameters and their measures that we need are:

$D=13$, $U=0.02$, $R_f = 0.15$

$R'_f = 0.011$, $E(R'_m) = 0.022$

1- β =0.13 :
$Y = 0.0268$
In other words the UI premium rate is 2.68%.

2- β =0.27 :
$Y = 0.0266$
In other word the UI premium rate is 2.66%.

As we can see in this part, we find that the fair premium rate is less than the current premium rate in Iran which is 4%.

Considering the fact that 2.68% or 2.66% is the maximum premium rate, it's probable that the fair premium rate be more or less than this value.

- **Changing the value of Parameters**

In this section we are going to show the effect of changing some parameters on the premium rate.

Table 4. Fair Premiums (Y) under Alternative Values of the Shape Parameter (p) of Unemployment Duration Distribution β =0.13

P	***D (Months)***	***Y (%)***
5	12.51	2.496
5.5	12.62	2.5
6	12.7	2.521
6.5	12.81	2.5433
7	12.9	2.591
7.5	12.97	2.6412
8.01	*13*	*2.68*
8.5	13.6	2.6881
9	13.73	2.6899
9.5	13.81	2.6954
10	13.94	2.6981
10.5	13.99	2.6999
11	14.5	2.87

– The fair premiums for the base case are in boldface.

The estimated unemployment duration (***d***) and fair premiums both increase along with ***p*** **.**

Table 5. Fair Premiums (Y) under Alternative Values of Hazard Rate Parameter (λ) β =0.13

Λ	D (Months)	Y (%)
0.0006	16.1	3.24
0.0008	15.8	3.068
0.0010	15.5	3.066
0.0012	15.1	3.065
0.0014	14.7	2.878
0.0016	14	2.877
0.0018	***13***	***2.68***
0.0020	12.6	2.496
0.0022	11.9	2.31
0.0024	11.3	2.30
0.0026	10.7	2.11
0.0028	10.1	2.10
0.0030	9.6	1.90

– **The fair premiums for the base case are in boldface.**

A higher value of hazard rate indicates that the unemployed are more likely to transit into employment. The hazard rate should therefore, be negatively related to the estimated unemployment /payment duration (***d***) and fair premiums (***Y***). Alternative values of *λ* have different effect on the values of fair premiums.

Table 6. Fair Premiums (Y) under Alternative Values of Unemployment Probability (U) β =0.13

U	Y (%)	U	Y (%)
0.008	1.07	***0.02***	***2.68***
0.01	1.34	0.022	2.95
0.012	1.61	0.024	3.22
0.014	1.88	0.026	3.49
0.016	2.15	0.028	3.76
0.018	2.41	0.03	4
		0.032	4.3

– **The fair premiums for the base case are in boldface.**

A higher value of unemployment probability leads to more unemployed workers, higher expected benefit payments, and higher fair premiums. The unemployment probability should therefore be positively related to the fair premiums (***Y***) .

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Table 7. Fair Premiums (Y) under Alternative Values of βRisk β =0.13

β	***Y (%)***
0.00	2.71
0.05	2.70
0.13	***2.68***
0.15	2.679
0.18	2.678
0.21	2.672
0.25	2.66
0.30	2.65
0.35	2.64
0.40	2.63
0.45	2.62
0.50	2.61
0.55	2.60

– The fair premiums for the base case are in boldface.

A higher value of risk-adjusted discount rate for UI payments leads to a lower fair premium. The β risks could therefore be negatively related to the fair premium.

6. Summary, Conclusion and Suggestion

– Summary

The principal purpose of the unemployment insurance (UI) program is to provide workers with a safety net in the event that they lose their job. However, some worry that unemployment insurance benefits may inhibit unemployed workers from vigorously looking for or accepting a new job.

This study, for the first time, introduces the survival analysis of the unemployment duration to the unemployment insurance pricing model to measure the fair premium rate of unemployment insurance in Iran.

A Weibull distribution is adopted to estimate the average unemployment duration in computing the expenditure of UI benefits. For this purpose, we use the mean and variance of the Weibull distribution to measure the related parameters.

The CAPM-based insurance pricing framework is then applied to compute the fairly-priced premium rate for the UI program.

– Conclusion

Since we have two amounts for β, we found two rates for UI based on real data. First we consider the case of married people, because the UI rate for this case is greater than the case of single people. And in the case of married people, we consider the greatest benefit payment amount of the claimant's insured earnings, which is equals to 80% of insured earning. So the fair premium rate calculated is the maximum amount of UI rate.

For case of $\beta=0.1$, the fair premium rate is equals to 0.0266 and for the case of $\beta= 0.27$, this rate is equals to 0.0268.

As we can see, the fair premium rate that we calculated is much less than 4% which is the premium rate that government considers for UI premium rate in Iran.

If the insured is single, this rate is less than 0.0266(or 0.0268) . And if the insured is married and we consider the scheme of UI in Iran, this rate is much less than 0.0266(or 0.0268), too.

The simulation results indicate that the fair premiums increase with $\boldsymbol{p}$, the hazard rate has negative relation with the fair premiums($\boldsymbol{Y}$) , the unemployment probability has positive relation with the $\boldsymbol{Y}$, and the $\boldsymbol{\beta}$ risk has negative relation with the $\boldsymbol{Y}$.

– Suggestion

The government believes the unemployment insurance scheme is costly to the state, and the government share (1 percent) imposes high financial pressure.

According to the results of this research, the required UI premium rate is much less than 4% announced by government. Hence, we can drop government contribution, and receive only the 3% employee contribution which covers the plan expenses. Consequently, the plan can be operational without imposing any financial distress on the government.

References

1. Atkinson, A. B. and Micklewright, J., 1991. Unemployment Compensation and Labor Market Transitions: A Critical Review. *Journal of Economic Literature*, 29(4), pp. 1679-1727.
2. Beenstock, M. and Brasse, V., 1986. Using options to price maturity guarantees. *Journal of the Institute of Actuaries* (1886-1994), 113(1), pp. 151-166.
3. Biagini, F. and Widenmann, J., 2012. Pricing of unemployment insurance products with doubly stochastic Markov chains. *International Journal of Theoretical and Applied Finance*,15(04).
4. Blake, D. and Beenstock, M, 1988. The stochastic analysis of competitive unemployment insurance premiums. *European Economic Review*, 32(1), pp.7-25.
5. Bronars, S.G.,1985. Fair pricing of unemployment insurance premiums. *The Journal of Business*, 58(1), pp.27-47.
6. Chuang, H.L. and Min-Teh,Y.U., 2010. Pricing unemployment insurance-An unemployment-duration-adjusted Approach. *ASTIN Bulletin*, 40(2), pp.519-545.
7. Cozzi, M., 2012. Optimal unemployment insurance in GE: A robustcalibration approach. *Queen's Economics Department WorkingPaper* ,1272.
8. Egel, D. and Salehi-Isfahani, D. ,2010. Youth transitions to employment and marriage in Iran: Evidence from the school to work transition survey. *Middle East Development Journal*, 02(01), pp. 89-120.
9. Fairley, W. B. ,1979. Investment income and profit margins in property-liability insurance: Theory and empirical results. *The Bell Journal of Economics*, 10(1), pp. 192-210.
10. Hill , R. D.M.F.,1987. The Massachusetts model of profit regulation in non-life insurance. *Fair Rate of Return in Property-liability Insuranc*, pp. 27-51.
11. Lancaster, T. and Nickell, S.,1980. The analysis of re-employment probabilities for the unemployed. *Journal of the Royal Statistical Society*, Series A (General), 143(2), pp.141-165.
12. Launov, A., Wolff, J. and Klasen, S., 2004. Unemployment benefits and unemployment rates of low-skilled and elder workers in West Germany: A search equilibrium approach. *IZA Discussion*, 1161.

13. Meyer, B. D., 1990. Unemployment insurance and unemployment spells. *Econometrica*, 58(4), pp.757-782.
14. Moffitt, R., 1985. Unemployment insurance and the distribution of unemployment spells. *Journal of Econometrics*, 28(1), pp. 85-101.
15. Mueller, A. B. K. A., 2008. Job Search and Unemployment Insurance: New evidence from time use data. *CEPS Working Paper*, 175.
16. Myers, S. C. a. R. A. C., 1981. A discounted cash flow approach to property-liability insurance regulation. in: *Cummins and Harrington* (eds.), *Fair Rate of Return in Property-Liability Insurance,* Boston:Kluwer-Nijhoff Publishing.
17. Sepahanbank <http://www.sepahanbank.ir>.
18. TAŞÇI, H. M., 2005. Determinants of unemployment duration for the first-time job-seekers in turkey. *Administrative Sciences*, 3(2), pp.184-206.