Aggregate Effects of Social Security Reform in 2008

by Alparslan Tuncay

Submitted to the Social Sciences Institute
in partial fulfillment of the requirements for the degree of
Master of Arts

Sabancı University
August 2011

AGGREGATE EFFECTS OF SOCIAL SECURITY REFORM IN 2008

APPROVED BY

Asst. Prof. Dr. Remzi Kaygusuz ....
(Dissertation Supervisor)

Asst. Prof. Dr. İnci Gümüş ....

Asst. Prof. Dr. Şerif Aziz Şimşir ....

Acknowledgements

First of all, I would like to thank to my thesis advisor Remzi Kaygusuz, who spares great amount of his valuable time to guide me. Working with him gave me great insight about the process of scientific research.

I also would like to thank to the members of my thesis jury to examine my thesis and to make valuable comments.

Lastly, I would like to thank to "TUBITAK", The Scientific & Technological Research Council of Turkey for their financial support as scholarship.

AGGREGATE EFFECTS OF SOCIAL SECURITY REFORM IN 2008

Alparslan Tuncay
Economics, M.A. Thesis, 2011
Supervisor: Remzi Kaygusuz

Abstract

Keywords: overlapping generations, retirement age, social security reform

In this study, we investigate the effects of social security reform in 2008 on aggregate variables.We focus only on to the change in retirement age of this reform by leaving the other structural and administrative changes aside. Our main results are as follows: (i) social security reform has a great positive effect on capital accumulation; (ii) aggregate labor supply in efficiency units increases while mean labor hours remain relatively costant; (ii) social security tax rate to balance the budget of social security system decreases dramatically.

2008 YILINDA YAPILAN SOSYAL GÜVENLİK REFORMUNUN ETKİLERİ

Alparslan Tuncay
Economi Yüksek Lisans Tezi, 2011
Tez Danışmanı: Remzi Kaygusuz

Özet

Anahtar Kelimeler: emeklilik yaşı, kesişen nesiller, sosyal güvenlik reformu

Bu çalışmada, 2008 yılında yapılan sosyal güvenlik reformunun toplam değerler üzerindeki etkilerini inceledik. Sosyal güvenlik reformunun getirdiği idari ve diğer yapısal değişiklikleri bir kenara bırakarak, sadece bu reformun emeklilik yaşı ile ilgili getirdiği değişikliğin etkilerini göz önüne aldık. Temel sonuçlarımız şunlardır: (i) sosyal sigortalar reformu sermaye birikimi üzerinde önemli miktarda pozitif etki meydana getirmektedir; (ii) bireylerin çalışmaya ayırdığı ortalama vakitte belirgin bir değişiklik olmazken, verimlilik birimi cinsinden toplam işgücü arzı artmaktadır; (iii) sosyal sigortalar bütçesini dengeleyen işgücü üzerinden alınan sosyal güvenlik vergi oranında önemli bir düşüş meydana gelmektedir.

TABLE OF CONTENTS

LIST OF FIGURES

1 Introduction

Issues surrounding the social security system have invoked public interest with the shift regarding retirement policy in 1993. With that change, the former retirement age 60 for men and 55 for women was abolished and replaced with a requirement of 25 years of contribution for men and 20 years of contribution for women to receive retirement benefits. For example, a woman, who starts to work at 20 years old, can get retirement benefits when she reaches age 40. By taking into consideration that average life expectancy is about 74 years in 2008 in Turkey according to Turkstat estimates, this change means that an individual can get retirement benefits for more than 30 years on average in return for their participation to labor force for about 23 years on average. However, the situation for developed countries is the exact opposite, such as people in the United States have a life expectancy of 78 years in 2008 according to OECD (2011) estimates but individuals are eligible to retirement at age 65. This shift in retirement policy in 1993 has brought about detrimental perterbations in social security system budget within a few years and the necessity of reform in social security system seemed as inevitable. Eventually in 2008, the government carried out a drastic reform on social security system and the retirement age was established as 65 to restore the actuarial balance of the social security.

The reform of social security system in 2008 includes change in administrative structure of social security institutions, introduction of universal health care and changes in the parameters of pension schemes in addition to the change in retirement age. In this paper, we focus only on to the change in retirement age of this social security reform. We take the policy, which had been enacted in 1993 and requires 25 years of contribution for men and 20 years of contribution for women, as the benchmark economy and calibrate the model parameters according to this policy. Then, we introduce the change in retirement age of the reform in 2008 to the model and compute the changes on aggregate variables with respect to the benchmark economy. Then, we evaluate and discuss the aggregate effects of this reform. For ease of reference, we prefer to use alternative policy in stead of the change in retirement age in 2008 and bencmark policy rather than the shift in retirement policy in 1993.

We develop an applied general equilibrium model, consists of overlapping generations 81-period lived individuals facing mortality risk. At any point in time, there is a continuum of individuals. Private credit markets are closed by assumption. During their working years, individuals face stochastic productivity shocks and they can supply labor elastically up to the mandatory retirement age. They can receive retirement benefits as they reach the early retirement age, which is the earliest age that an agent can retire. Once they get retired, they cannot get back to work in the rest of their life. Individuals in our economy save through private asset holdings in order to provide for old-age consumption and to insure against future income fluctuations. After retirement, individuals rely on private savings and social security benefits which is a function of their past labor earnings. Social security benefits are financed through a payroll tax on labor. Individuals are heterogeneous with respect to their age, asset holdings, employment status, productivity shock and past labor earnings. With open economy assumption, factor prices are completely determined by market forces. We specify the optimization problem of the individuals as a finite-state, finite-horizon, dynamic program and use numerical methods to compute equillibria under former policy as a benchmark economy and latter policy as an alternative economy.

Several findings has emerged from this study. First, increase in early retirement age has a great effect on capital accumulation, output, labor supply and saving rates. As pointed out in the text, this is a consequence of the significant decrease in agents' future earnings. Agents are bereft of significant amount of their future income, therefore they need to increase their savings in order to support future consumption. From another point of view, individuals tend to accumulate assets when they supply labor and they tend to spend their savings after they get retired. Social security system makes a transfer from workers to retirees and so it tends to decrease savings by shifting resources from potentially high savers to retirees who save less. With the increase in retirement age, the amount of transfers from high savers to less savers reduces dramatically. Hence, the role that social security system plays in the economy, which has a negative effect on individuals' savings and labor supply, diminishes. Therefore, savings and labor supply increases at a considerable amount. Second, the decrease in social security tax rate, to balance the budget of social security, is of considerable magnitude. The reasons behind this finding are great decrease in the sum of whole retirement benefits and increase in labor supply.

The paper is organized as follows. Section 2 discusses the related literatures. Section 3 describes the model in detail. Section 4 contains the calibration process. Section 5 presents the results from our bencmark and alternative economy and their comparison. Finally, section 6 concludes.

2 Related Literature

This paper builds upon a series of papers that grow out of discrete-time overlapping generations models first introduced by Auerbach and Kotlikoff (1987). Hubbard and Judd (1987) extend Aeurbach and Kotlikoff framework by introducing borrowing restrictions and lifetime uncertainty. İmrohoroğlu,

İmrohoroğlu and Joines (1995) add uncertainty about labor earnings to the model. All three papers explore the role of social security system on aggregate variables of the economy and they evaluate impacts of some quantitative fiscal policies.

İmrohoroğlu and Kitao (2010) allows for endogeneous decisions in both benefit claming and labor force participation and they study how these refinements on the setup affect the impact of a reform in the U.S. economy.

Ventura (1999) explores quantitatively the general equilibrium implications of flat tax reform. The novelty in his formulation is the introduction of endogeneous labor supply together with progressive forms of taxation.

3 Model

3.1. Demographics

The model economy consists of overlapping generations of finitely lived individuals who may live through age N, the maximum possible life span. At each period, a continuum of agents are born. Agents face random survival according to an age-to-age survival probabilities $\{\psi_t\}_{\mathrm{t}=1}^{\mathrm{N}}$, where ψ_t is the probability of surviving from age $t-1$ to t, conditional on being survived at age $t-1$. The population grows at a constant rate n . The share of age-t individuals in the population is denoted by μ_{t} and it is independent of the time. Hence, the demographic structure of the economy is stable.

3.2. Preferences

At each period, individuals are endowed with one unit of time that can be used for either leisure or market work. They maximize the expected, discounted lifetime utility

$$E[\sum_{j=1}^{N} \beta^j (\Pi_{i=1}^{j} \psi_i) u(c_{j,t}, 1 - l_{j,t})]$$

where β is the subjective discount factor, $c_{j,t}$ and $l_{j,t}$ denote consumption and labor supply of an age-j individual at time t. The utility function is assumed to take the form

$$u(c,l) = \frac{[c^v (1-l)^{(1-v)}]^{(1-\sigma)}}{(1-\sigma)} - \phi I_{\{l>0\}}$$

where v is the coefficient of consumption in the composite good, σ is the coefficient of risk aversion and ϕ is the cost for labor participation.

3.3. Social Security

The government operates a pay-as-you-go pension system similar to the current Turkish system. It taxes working individuals' labor income at a fixed rate, θ, and provides benefits to retirees. Individuals can not begin to receive retirement benefits unless they supply labor for at least $R_e - 1$ years, where R_e is the earliest age an individual can retire. From now on, we call R_e as early retirement age. The retirement benefit is an increasing function of individual's past labor earnings, so individuals can increase their retirement benefit by increasing years of work, but not to the point that they supply labor for more than $R_m - 1$ years, where R_m is the mandatory retirement age[1]. If an individual supply labor for $R_m - 1$ years, he will get retired in the next year for sure. Once an individual gets retired, he cannot get back to work and supply labor for the rest of his life.

[1] In the Turkish social security system, there is not a mandatory age requirement to enforce individuals to retire. However, individuals tend to not supply labor when they get old. Hence, determining a reasonably high mandatory retirement age doesn't affect the decisions of individuals but decreases computational burden in a great amount.

The retirement benefit is a weighted sum of individuals' past labor earnings. For an agent who supply labor for R years, where $R_e \leq R \leq R_m$, the retirement benefit is such that

$$\sum_{i=1}^{R} \gamma_i \hat{w} e(z,i) \widehat{l_i}$$

where $\hat{w}e(z,i)\widehat{l_i}$ is the labor earning at period i, which is explained in the next section in detail. γ_i is the replacement rate of period i. The retirement benefit is fixed for an agent through retirement.

3.4. The Individual Constraints

Each period, individuals, who work in previous period and are below mandatory retirement age, R_m, face a productivity shock, $e(z,j)$, which combines productivity effect of age j with idiosyncratic shock z. The shock z follows a first-order Markow process with transition probabilities $p(z',z)$. Shocks for age 1 are recieved according to the probability measure $q\left(z\right).$

Agents in this economy are born with no assets. Let $c_{j,t}$, $l_{j,t}$ and $a_{j+1,t+1}$ are consumption, labor and asset choices of individual of an age-j agent. Then the budget constraint facing an individual can be written as

$$(1+\tau_c)c_{j,t}+a_{j+1,t+1} \leq \; a_{j,t}(1+r_t(1-\tau_k))+(1-\theta)w_t e(z,j)l_{j,t}+TR_t+ben-T_{j,t}$$

where $a_{j,t}$ is asset holding at age j and time t, w_t is the wage rate and r_t denotes interest rate, θ is the social security tax, τ_c is the consumption tax, τ_k is the flat capital tax rate, ben is the social security benefit which is zero before the retirement and equal to retirement benefit through retirement, TR_t is the lump-sum transfer of accidental bequests and $T_{j,t}$ is the income tax.

Although agents are assumed to know the survival probabilities, they don't know the exact time of the death. Therefore, they can leave assets behind when they experience early death. We assume that these assets are equally distributed among all of the survivers in a lump-sum fashion.

Agents are not allowed to borrow, but they are able to accumulate assets through saving to smooth consumption across time. This constraint can be stated as

$$a_{j,t} \geq 0$$

Agents who can live through N periods, the maximum possible lifespan, will choose not to carry over any assets to the next period,

$$a_{j+1,t+1} = 0 \; if \;\; j = N.$$

3.5. Fiscal Policy

The government consumes in every period the amount G and finances its expenditures by taxing consumption, capital and labor earnings. The tax procedure is applied in a way that mimic the current tax structure in the Turkey. The flat tax rates is used for consumption at rate τ_c and the capital (asset) income is taxed through the flat capital tax rate τ_k. On the other hand, there is a progressive income tax in which tax rate is increasing with respect to the income level. Let $I_0, I_1, ..., I_M$ be the income thresholds with corresponding marginal tax rates $\tau_1, \tau_2, ..., \tau_M$. An agent's income subject to taxation is its labor income. Hence, an age-j agent with income $I = w_t e(z, j) l_{j,t}$, with $I \; \epsilon \; (I_{m-1}, I_m]$, pays the amount

$$T(I) = \tau_1(I_1 - I_0) + \tau_2(I_2 - I_1) + ... + \tau_m(I_m - I_{m-1})$$

3.6. Technology

The production technology of the economy is given by a constant returns to scale Cobb-Douglas function

$$Y = F(K, LX) = AK^{\alpha}(LX)^{(1-\alpha)}$$

where $A>0$, α $\epsilon(0,1)$ is capital's share of output, K and L are aggregate capital and labor inputs, respectively. X is the technology level, which grows at a constant rate g. The aggregate capital stock is assumed to depreciate at the rate δ.

3.7. Individual's Problem

We restrict ourselves to a comparison of steady states and do not consider transiton paths. So, we can dispense with time subscripts on all variables. Also, for computational purposes we transform the variables so as to remove the effects of technological growth and population growth. The aggregate variables G, K and Y, which grow at the steady state due to both population and technological growth, are detrended from both. Aggregate labor, L, is detrended from population growth at steady state. Transfers, taxes and benefits are detrended from tecnological growth. The individual variables a, c and factor price real wage detrended from growth. Hence the transformations are as follows:

$$\hat{Y} = Y/(NX),\ \hat{K} = K/(NX),\ \hat{G} = G/(NX),\ \hat{L} = L/N,\ T\hat{R} = TR/X,$$

$$\widehat{T} = T/X,\ b\widehat{e}n = ben/X,\ \widehat{a} = a/X,\ \hat{c} = c/X,\ \hat{w} = w/X,\ \hat{l} = l,\ \hat{r} = r$$

With these transformations, individuals are denoted by a state vector $x = \{\widehat{a}, z, j, h, b\}$,where $\widehat{a}$ denotes current asset holding , z denotes corresponding idiosyncratic productivity shock, j denotes age, h is an indicator that takes a value 1 if an individual has already applied for retirement benefit in previous periods and takes a value 2 otherwise, b is the social security benefit an individual gets in this period if he has already applied or if he applies in this period to retirement.

At the beginning of each period, individuals learn their productivity shock and so their state x, then make an optimal decision of $\{\widehat{c}, \widehat{l}, \widehat{a}'\}$,where $\widehat{c}$ denotes consumption, $\widehat{l}$ labor and $\widehat{a}'$ asset holding to next period and they decide to retire if they are allowed to do.The choice is made under uncertainty of survival to future periods and future productivity shocks. The retirement decision determines the indicator h' and labor decision determines retirement benefit b' for next period. Then, conditional on the survival, at the beginning of next period with the realization of the productivity shock z', agents can enter the next period with new state vector $x' = \{\widehat{a}', z', j+1, h', b'\}$.

We compute the individuals' problem recursively. Let $V(x)$ be the value function of an individual in state x is given by

$$V(x) = \max_{(\widehat{c},\widehat{l},\widehat{a}',h')} u(\widehat{c}, 1-\hat{l}) + B(1+g)^{[v(1-\sigma)]}\psi_{j+1}E[V(x')]$$

subject to

$$(1+\tau_c)\widehat{c}+\widehat{a}'(1+g) \leq \widehat{a}(1+\hat{r}(1-\tau_k))+(1-\theta)\hat{w}e(z,j)\widehat{l}+T\hat{R}+b\widehat{e}n-\widehat{T}(\hat{w}e(z,j)\widehat{l})$$

$$\widehat{c} \geq 0, \qquad \widehat{a}' \geq 0$$

$$b' = b + \gamma_j \hat{w} e(z,j)\hat{l})$$

$$h' = \left\{ \begin{array}{ll} \{1,2\} & \text{if} \quad h = 2 \\ 1 & \text{otherwise} \end{array} \right\}$$

$$\hat{l} = \left\{ \begin{array}{ll} [0,1] & \text{if} \quad h' = 2 \\ 0 & \text{otherwise} \end{array} \right\}$$

$$b\hat{e}n = \left\{ \begin{array}{ll} b & \text{if} \quad h' = 1 \\ 0 & \text{otherwise} \end{array} \right\}$$

where $T(\hat{w}e(z,j)\hat{l})$ denotes the income tax for given labor income.

3.8. Stationary Equilibrium

In this model, agents are heterogenous at any time with respect to their productivity shock, asset holdings, age, employment status and past labor earnings. The concept of equilibrium follows Stokey and Lucas(1989).

Definition: A stationary competitive equilibrium consists of individual's decision rules $\{a^*, c^*, l^*, h^*\}$ for each state x, law of motion of b^* for each state x, factor prices $\{w, r\}$, government policy variables $\{G, \tau_k, \tau_c, \theta\}$ and income tax paid T for each state x, early and mandatory retirement age $\{R_e, R_m\}$, a lump sum transfer of accidental bequests TR, aggregate capital K, aggregate labor L, social security transfers ben^* for each state x, and the measure of individuals $\{\lambda(x)\}$ that satisfy the following conditions :

1) Individuals' decision rules solve the recursive optimization problem defined in the previous section.

2) Factor prices are determined competitively, i.e $r = F_1(K,L) - \delta$ and $w = F_2(K,L)$.

3) The capital and labor market clears.

$$K = \sum_x a^*(x)\lambda(x)/(1+n)$$

$$L = \sum_x we(z,j)l^*(x)\lambda(x)$$

4) The goods market clears.

$$C + K' + G = F(K,L) + (1-\delta)K,$$

where $C = \sum_x c^*(x)\lambda(x)$ and $K' = (1+g)\sum_x a^*(x)\lambda(x)$

5) The lump sum transfer is equal to the amount of assets left behind.

$$TR = \sum_x a^*(x)(1+r)(1-\psi_{j+1})\lambda(x)/(1+n)$$

6) Social security system's budget is balanced.

$$\theta wL = \sum_x ben^*(x)\lambda(x)$$

7) Government budget constraint is satisfied.

$$G = Kr\tau_k + C\tau_c + \sum_x T(we(z,j)l^*(x))\lambda(x)$$

8) The measures are consistent with individual behaviour.
For $j \geq 1$ and for any $x' = \{a', z', j+1, h', b'\}$ and $x = \{\widehat{a}, z, j, \widehat{h}, \widehat{b}\}$,

$$\lambda(x') = \sum_{x:\ a^*(x)=a',\ h^*(x)=h',\ b^*(x)=b'} p(z,z')\lambda(x)$$

4 Calibration

This section describes the calibration process of the benchmark economy. The parameters of the bencmark model are determined in order to reflect the situation of Turkish economy for early nineties. The model period is set equal to one year.

4.1. Demographics

Agents are born at a real-time age 20 and they can live through at maximum N=81 periods, up to the real-time age 100. The sequence of survival probabilities are calculated in a two steps. As a first step, survival probabilities $\{\psi_t\}_{\mathrm{t}=1}^{50}$ are calculated via the projected population estimates by Kocaman (2002) for years 1995 and 2000. Since the estimates of population are using 5-year cohorts, linear interpolations are used to obtain survival probabilities for all possible ages. As a second step, due to the absence of population estimates for cohorts at age greater than 70, survival probabilities $\{\psi_t\}_{\mathrm{t}=51}^{81}$ are determined to follow the pattern of initial survival probabilities and to match the exact population share of older cohorts as a sum in the population of society. The population growth, n, is set equal to 0.024 as the average growth rate of population for the period 1960-1990.

4.2. Preferences

The parameter of risk aversion, σ, is set equal to 2, which is in line with the existing literature. According to Turkstat 1994 Household Budget Survey, individuals, at ages between 20 and 45, devote 49 hours to work in a week, out of unsleeping time which is 112 hours for a week. The coefficient of consumption in the composite good, ν, is determined to match the fraction of time devoted to work.

The discount factor, β, is determined endogenously to match the capital to output ratio, which is estimated as 2.48 for the period 1972-1992 by Cihan (2002).

The cost for labor participation, ϕ, is determined to match the share of older cohorts or younger cohorts in work force in the literature. We rather choose to target the ratio of specific cohorts since the model overestimate the participation of young generations to workforce and the age of starting work varies among individuals in real life in contrast to our model economy. The cost for labor participation is determined endogenously to match the ratio of individuals at model age between 10 and 20 to individuals at model age between 30 and 40 in labor force.

4.3. Technology

There seems to be a wide range of estimates for capital share of output, α, in the literature[2]. Also, TURKSTAT estimates are highly volatile even in following years[3]. Therefore, in the absence of a consensus for the parameter, it should be better to calculate an estimate via the estimates for other countries. Gollin (2002) estimates an average for highly diversed 32 countries for nineties and it can be a good measure for Turkey as a developing country, so it is set equal to 0.528.

Following the Cooley and Prescott methodology, the depreciation rate for capital is selected in order to match the ratio of total investments to total capital. Cihan (2002) estimated total investments and total capital for years between 1972 and 2000. The ratio of total investments to total capital is

[2] Cihan (2002) estimates capital share of output as 0.53, however Alper (2004) use 0.35.

[3] Turkstat estimates capital share of output for years 1988, 1991, 1995 and 2001 as 0.63, 0.53, 0.61 and 0.49 respectively.

calculated as 0.94 for the period 1972-1992, hence depreciation rate, δ, is set equal to 0.0436.

The growth rate of technology, g, is set equal to 0.0265 as the average growth rate of output between 1960-1990.

4.4. Social Security

In the benchmark economy, the replacement rates are such that[4]

$$\gamma_i = \left\{ \begin{array}{c} 0.035 \quad \text{if } i \leq 10 \\ 0.02 \text{ if } 10 < i \leq 25 \\ 0.01 \text{ if } i > 25 \end{array} \right\}$$

The social security tax rate, θ, is set endogenously to exactly balance the budget of the social security system. In other words, in any period the sum of deductions from workers' labor income is equal to sum of social security benefits of retired individuals.

With the change in the social security law in 1993, women were eligible to retirement after 20-years of work and men were eligible after 25 years of work. The early retirement age, R_e, is taken to be 24 for the benchmark economy by taking into account the shares of genders in the labor force[5]. The mandatory retirement age, R_m, is set equal to 52[6].

[4] These rates are used in Emekli Sandığı, a branch of the social security system in Turkey, until the social security reform in 2008.

[5] Women compose a slightly more than 30% of labor force as an average for years 1988-1992.

[6] Turkstat 2005 Household Budget Survey shows that there is no one in labor force at age greater than 70. Also, in our simulations with great number of agents, there is no one supply labor at model age greater than 50. Therefore, setting mandatory retirement age equal to 52 is not a constraint on agents' decisions.

4.5. Taxes and Government Consumption

Consumption tax rate, τ_c, is set endogenously to match an average value of the ratio of total tax burden on consumption and services to output, which is 0.0498 for the period 1992-1995. Similarly, the flat capital tax rate, τ_k, is chosen endogenously to match the total corporate tax to output, which is 0.0104 for the period 1992-1995.

The taxation of income is more involved as shown in Table 1, where income bendpoints $I_0, I_1, ..., I_M$ are expressed in multiples of average household labor income, Φ[7]. Average household labor income is determined endogenously in the model. Marginal tax rates are slightly different for undeveloped regions from the tax rates in the table. However, those regions compose less than 10% of output in Turkey and so it has a negligible effect.

Taxable Income	Marginal Tax Rate
0,0.45Φ	0.25
0.45Φ,0.9Φ	0.3
0.9Φ, 1.8Φ	0.35
1.8Φ, 3.6Φ	0.4
3.6Φ, 7.2Φ	0.45
7.2Φ and over	0.5

Table 1: Income tax schedule in model economies

[7] The income bendpoints and the average household labor income are taken from Turkstat Budget Survey for 1994.

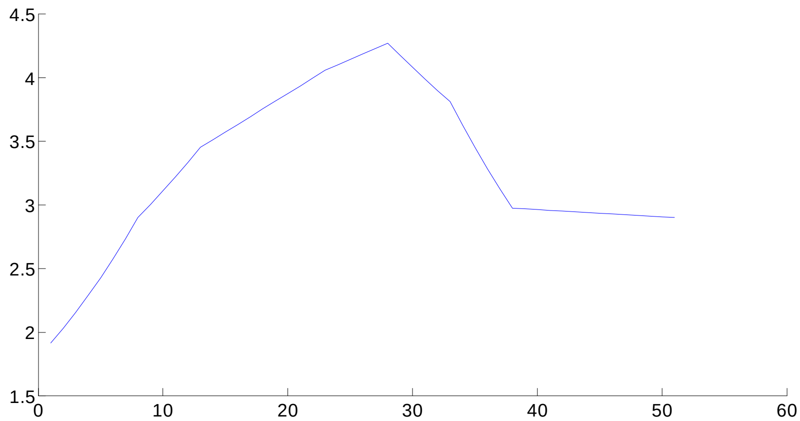

Figure 1: Efficiency profile with respect to model age

4.6. Stochastic Structure of Wages

We calibrate the productivity function, $e(z, j)$, under the assumptions that wages have a stochastic structure and it also follows a regression to the mean process. Since w is constant at all ages and all states, calibration of the productivity function is equal to the calibration of wage. Let y_j and $\overline{y}_j$ denote the log market return and the mean log market return of an age-j agent . Then, the idiosyncratic shock will be $z = y_j - \overline{y}_j$ and the productivity function takes the form $e(z, j) = e^{(z+\overline{y}_j)}$.Then, the market return to labor follows the regression to the mean process for all 1< $j \leq R_m$:

$$y_j - \overline{y}_j = \gamma(y_{j-1} - \overline{y}_{j-1}) + \varepsilon_j$$

with ε˜$N(0, \sigma_\varepsilon^2)$ and for $j = 1, y_1$˜$N(\overline{y}_1, \sigma_{y_1}^2)$.

The mean log market returns for each age group are calculated from Turkstat 2005 Household Budget Survey as hourly labor earnings[8]. Figure 1 shows average log market returns with respect to age.

Then, we need to select values for remaining parameters of the wage process, $(\gamma, \sigma_{\varepsilon}^2, \sigma_{y_1}^2)$. In the absence of the data of persistence and magnitude of shocks to market returns, we calculate a wage Gini coefficient for earners ages between 20 and 65, which is 0.355 from Turkstat 2005 Household Budget Survey. We create an artificial sample of workers by using mean log market returns and different values for parameters $(\gamma, \sigma_{\varepsilon}^2, \sigma_{y_1}^2)$. We make a great number of iterations with great number of workers to match the wage Gini coefficient. Eventually, we set $y = 0.98$, $\sigma_{y_1}^2 = 0.16$ and $\sigma_{\varepsilon}^2 = 0.02$.

We approximate a normally distributed log market return process with a Markow chain by using Tauchen's (1986) procedure. A spread parameter 5 is used and the shock z takes 21 values that are located evenly in the log scale and symmetrically around zero , as such -5σ_{y_1} to 5σ_{y_1}.Probabilities $q(z)$ of receiving a particular shock at age 1 are computed directly from normal distribution $N(0, \sigma_{y_1}^2)$.The transition probabilities, $p(z, z^{|})$, are obtained similarly.

5 Findings

5.1 Benchmark economy

Table 2 shows basic statistics for the benchmark economy. These results are important so that they are compared with alternative policy in the next section.

[8] Linear interpolations are used to obtain average log wages for all possible ages.

K	K/Y	*Saving rate*	L	*Mean hours*	*Discount rate*
5.8	2.48	%12.67	1.1	0.45	0.996

Soc. sec. tax rate	w	*Ave. reti – rement age*	*Participa – tion ratio*	r	*Gov. share in output*
%19	1.0	30	0.543	%16.9	0.31

Table 2: Descriptive Statistics for Benchmark Economy

The social security tax rate is required to be %19 to balance the budget of social security system in benchmark economy, which seems to be very less than what we expect. In current Turkish social security system, whole deductions from labor earnings amount to %33.5 of labor earnings. However, approximately %25 of these deductions are used for health expenditures, which is not covered in this model. Also, our model assumes that individuals pay their social security liabilities at each period regularly. However, in real life the government cannot collect social security taxes completely. It has declared an amnesty for who had not paid social security taxes more than ten times in last twenty years. These tax amnesties include not only reduction in interest charged for late payment but also reduction in main liabilities of tax payers. Therefore these decrease the revenues of social security system at a great amount and the government keeps social security tax higher to compensate this loss.

Average retirement age is 30 in the benchmark economy which corresponds

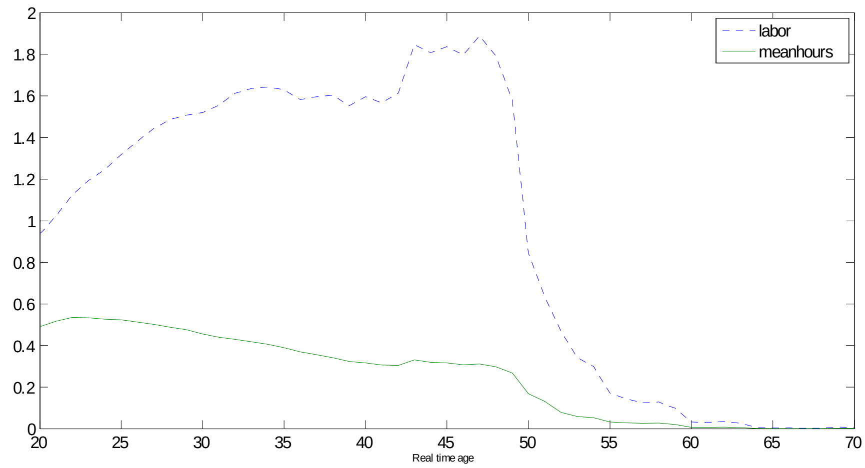

Figure 2: Age-labor supply profile and age-mean hour profile

to age 49 in real life, which is very close to the estimates of Social Pension Agency for early nineties[9].

Figure 2 shows the connection between age and labor earnings, and the connection between age and mean hours devoted to work. Average labor earnings rises with age and starts to fall at about average retirement age, reflecting the efficiency profile. The path of mean hours slopes down from the beginning, the decrease is slow up to the point that efficiency of workers starts to decline. Then, the decrease is getting faster with decreasing efficiency of hours supplied to work and thus average labor earnings decreases dramatically from that point. These profiles are plausible. Turkstat household budget survey in 2005 shows that average labor earnings peaks at ages between 45 and 50, then starts to decline.

[9] According to Social Pension Agency (SSK) estimates, average retirement age is 50 for 1992, 49 for 1993, 50 for 1994,1995 and 1996.

5.2 Alternative policy

In the alternative economy, we increase the early retirement age from 24 to 47. Although social security reform in 2008 make a change in the parameters of pension system, the replacement rates are left unchanged since we try to evaluate only the effects of the change in retirement age. Also, as in the benchmark economy, we balance the budget of social security system and the budget of government. The social security tax rate is set endogeneously to balance the budget of social security sytem. We keep consumption and capital tax rates constant, and endogenously set income tax rates to set the government share in output equal to the rate found for the bechmark economy. The demographic structure of the economy is left unchanged. By using the parameters, found in the calibration of the bencmark economy, we solve the steady state equilibrium as an alternative policy. Since we assume open economy, factor prices are same with benchmark economy.

Table 3 shows descriptive statistics for the alternative policy.

K	*K/Y*	*Saving rate*	*L*	*Mean hours*	*Discount rate*
10.76	3.05	%15.6	1.21	0.458	0.996

Soc. sec. tax rate	*w*	*Ave. reti – rement age*	*Participa – tion ratio*	*r*	*Gov. share in output*
%4	1.0	46	1	%16.9	0.31

Table 3: Descriptive Statistics for Alternative Economy

An important finding is that increase in early retirement age has a significant effect on capital accumulation and labor supply. As shown in table 3, capital income ratio, net saving rate[10], output and aggregate labor increase substantially with respect to the benchmark economy. For instance, aggregate capital stock increases by about %85.5, capital income ratio increase by about %23, net saving rate increases by 2.93 percentage points and labor supply increases by about %10. The main reason lies behind this finding is agents are become deprived of great amount of future income with the increase in early retirement age and they need to save more to compensate this dramatic decrease in their future income. In the alternative policy, the sum of whole retirement benefits is one fourth of the sum of whole retirement benefits in benchmark economy.

From another perspective, the social security system makes a transfer from workers to retirees. Since workers tend to save more than retirees and retirees tend to consume more than workers, social security system makes a negative effect on aggregate savings and individuals' labor supply. The increase in early retirement age decreases the amount of transfers from worker to retirees substantially. Therefore, the role of social security system in the economy diminishes, so its negative effect on savings and labor supply.

Aggregate mean hours stay around the levels previously found for benchmark economy and the participation to the work force for individuals between age 23 and 46 become almost twice of the previous case. This indicates that the increase in participation rate of individuals between age 23 and 46 to the workforce is the reason of the increase in aggregate labor supply.

Postponing the early retirement age by 23 years, from model age 24 to 47, increase average retirement age from 30 to 47. Since the burden of retirement

[10] Net saving rate is computed as $[(1+n)(1+g)-1]K/Y$.

benefits dramatically decrease and revenues from labor earnings increase, the social security tax rate to finance the retirement benefits substantially decreases from %19 to %4. This tax rate seems too low to balance the social security budget of the government by looking at high deficits with high social security tax rate in current situation despite the reform on social security system on 2008. However, since the changes in social security system doesn't affect the current workers' retirement situation, the transition from benchmark economy to alternative economy requires a great amount of time. With the elimination of current workers from labor force, which is about 46 years, the economy converges about to the alternative economy.

6 Concluding remarks

In this paper, we develop an applied general equilibrium model to examine the actuarial consequences of the social security reform and the main findings are discussed in the previous section. In this section, we focus on some extensions of our analysis conducted in this paper.

First, in this paper we restrict ourselves to the effects of reform on some aggregate variables by comparing steady states. The distributional effects of this reform are not analyzed, which is an important measure of performance of the reform. Extension of the model to include cross-sectional distributions of earnings, income and wealth would shed light on this question. The changes in earnings gini, wealth gini, income gini and median to mean ratios of income and wealth would be good indicators of distributional effects of the reform.

Second, medical expenditures are not covered in our present formulation. Medical expenditures make up considerable part of total expenditures of the social security system and with the projected increase in medical spending, it will play a bigger role on Turkish social security system in near future. Extending model to cover medical expenditures by giving agents health shocks in each period makes analysis more realistic and may affect the results in this paper.

7 References

[1] Alper, Y. S. Imrohoroglu and S. Sayan, 2004, Reform in the Turkish Pension System: The Present Situation and Alternative Strategies Ahead, TUSIAD Report, İstanbul.

[2] Auerbach, A. J. and L. J. Kotlikoff, 2007, Dynamic Fiscal Policy. Cambridge: Cambridge University Press.

[3] Cihan, C., Ş. Saygılı, and H. Yurtoğlu, 2002, Capital accumulation, growth and efficiency in Turkish economy : 1972-2000. State Planning Organization Report, no: 2665, Ankara.

[4] Cooley, T., E. Prescott, 1995, Economic growth and business cycles. In: Cooley, T. (Ed.), Frontiers of Business Cycle Research. Princeton University Press, Princeton, NJ.

[5] De Nardi, M., S. Imrohoroglu and T.J. Sargent , 1999, Projected U.S. Demographics and Social Security, Review of Economic Dynamics 2(3), 576-615.

[6] Gollin, D. (2002), Getting Income Shares Right. Journal of Political Economy, 110, 458-474.

[7] Huang, H., S. İmrohoroğlu, and T.J. Sargent, 1997. Two computations to fund social security. Macroeconomics Dynamics 1, 7-44.

[8] Hubbard, R. G. and K. Judd, 1987, Social security and individual welfare: Precautionary saving, borrowing constraints, and the payroll tax. American Economic Review 177(4), 630-646.

[9] İmrohoroğlu, A., S. İmrohoroğlu, and D. Joines, 1995, A life cycle analysis of social security. Economic Theory 6(1), 83-114.

[10] Imrohoroglu, A., Imrohoroglu, S. and D. Joines , 2000, Computational Models of Social Security: A Survey, in Computational Methods for the Study of Dynamic Economies, R. Marimon and A. Scott, eds., Oxford University Press, Oxford.

[11] İmrohoroğlu, S. and S. Kitao, 2010, Social Security, Benefit Claiming and Labor Force Participation: A quantitative general equilibrium approach. Federal Reserve Bank of New York, Staff Report 436.

[12] Kocaman, T., 2002, Population Projection Methodologies, State Planning Organization Report, Ankara.

[13] OECD, 2011, OECD Health Data 2011, OECD, Paris.

[14] Stokey, N.L., Jr. R.E. Lucas, 1989, Recursive Methods in Economic Dynamics, Cambridge: Harvard University Press.

[15] Tauchen, G., 1986, Finite State Markov-Chain Approximations to Univariate and Vector Autoregressions, Economics Letters 20, 177-181.

[16] Turkish Statistical Institute (Turkstat), 1994, Household Budget Survey. Data diskettes Turkstat, Ankara.

[17] Turkish Statistical Institute (Turkstat), 2005, Household Budget Survey. Data diskettes Turkstat, Ankara.

[18] Ventura, G., 1999, Flat Tax Reform: A Quantitative Exploration, Journal of Economic Dynamics and Control 23, 1425-1458.