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Abstract

A new private pension scheme where the government makes direct contributions to the retirement accounts has been effective in Turkey since 2013. In this paper we examine the quantitative impacts of this new individual retirement system on the saving rate, capital stock and the long-run welfare of the individuals. We build a multi-period OLG model and simulate an economy with a pension scheme similar to the one in Turkey. Our simulation results reveal that the introduction of this private pension scheme increases the net saving rate by 0.27 percentage points. 23.9 percent of the increase in individual retirement assets constitutes incremental saving. The impact of the new system on physical capital stock is a 15.6 percent rise. According to our long-run welfare analysis, an unborn individual prefers to be born into the economy with individual retirement accounts (IRAs). Our results also suggest that cutting down the fees charged on individual retirement accounts generates a considerable improvement in net saving rate and the stock of physical capital.

Keywords: Household Saving, Fiscal Policy, Private Pension Accounts
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1 Introduction

Private pension system exists in many developing (Argentina, Brazil, Bulgaria, Chile, Colombia, Hungary, Malaysia and etc.) and developed countries (U.K., U.S.A., Denmark, Netherlands). The practice of the system differs along various dimensions among these countries. In some cases, assets accumulated in private pension accounts are the only source of income during retirement. There are also countries where the public social security system and private pension scheme coexist in the economy. Having an individual retirement account is voluntary in some countries whereas in others it is held mandatory by the government. There are also different incentive tools to encourage participation of the individuals to the system. Common applications are tax-favored schemes where the government levies lower capital income taxes or pays tax return on the assets accumulated in individual retirement accounts.[1]

Turkey has recently joined the group of countries with a voluntary private pension scheme. The objective of this paper is to analyze quantitatively the impacts of the new private pension scheme on the Turkish economy. Different from the existing examples of private pension systems, the incentive mechanism in the Turkish case is the direct government contributions to the savings in IRAs. The government matches the individual's contributions to these accounts up to a certain level. In that sense it is a unique policy whose possible macroeconomic impacts need to be studied thoroughly. Both private and public pension systems coexist in Turkey.

The main motivation behind introducing the private pension system is stated by the Undersecretariat of Treasury as increasing the welfare of retirees, easing the bur-

[1] Argentina, Brazil, Bulgaria, Chile, Colombia, Costa Rica, Croatia, Estonia, Hungary, Malaysia, Russia are countries where a mandatory private pension system exists along with a public pay-as-you go system. In Mexico and Bolivia mandatory private pension system replaced the public social security system. In Czech Republic, the United States, South Korea participating to the individual retirement system is voluntary.

den of the current social security system on the government, enhancing the availability of long term funds in the public sector and making a positive contribution to sustain a low-inflation and high-growth economy. As these goals reveal, the newly designed and enacted private pension scheme embraces long-term structural changes in Turkish economy. On the other hand, the extra burden it levies on the government budget can not be neglected. We aim to assess the long-run implications of the new system on the economy by building a general equilibrium life-cycle model. The model environment closely replicates the current form of the private pension scheme in Turkey. As a quantitative exercise we simulate our model and compare the net saving rate, physical capital stock and other key macro variables in the private pension economy with a benchmark case where there are no private pension accounts.

The impacts of private pension system on net saving and physical capital accumulation have been analyzed in the literature for different countries. Numerous empirical papers use the U.S. data and present mixed evidence of the saving impact of tax-favored retirement accounts. Venti and Wise (1986, 1987, 1990, 1991) and Skinner and Feenberg (1990) find significant positive impact of IRAs on the overall level of saving. Gale and Scholz (1994), Attanasio and DeLeire (1994) and Özel and Yalçın (2013) report smaller but still positive impacts of the private pension system on net savings.

In addition to these empirical papers, there are other studies which examine private pension schemes by simulating a general equilibrium model. İmrohoroğlu et al. (1998) construct a model economy which corresponds closely to the main institutional features of individual retirement accounts in the U.S. during the early 1980s. Kitao (2010) analyzes the effects of the current IRA policy in the U.S. along with alternative retirement and saving policies on the saving and labor supply decisions of individuals and their welfare levels. Fehr et al. (2008) make a similar analysis for Germany. Attanasio and DeLeire (2002) analyze the effects of the individual retirement accounts on total savings of the U.K. economy.

The novelty of our paper is that we model an economy where the savings in individual retirement accounts are matched by the government. The policy of matched savings has not been used by any other country as a tool to encourage participation of individuals to the private pension scheme. In that regard, the contribution of this paper to the literature is twofold. Firstly, we are assessing the impact of private pension scheme with a new type of incentive mechanism other than tax advantages. In addition, our paper examines the impact of the new system on Turkey which is an emerging economy with a young population, a generous public social security system and a declining saving rate.[2]

Individual retirement accounts with tax benefit and government contribution offer individuals an alternative tool to utilize their savings. The individuals get the opportunity to earn higher returns on assets held in these accounts conditional on keeping their savings in IRAs for a certain period of time. However the positive impact of higher return on savings might be suppressed due to the general equilibrium effects of the new system on the equilibrium prices and rates. These general equilibrium effects work through changes in tax rates, interest rates and wages in the economy. The contributions provided by the government result in a considerable rise in the budgetary expenditure that has to be financed by increasing taxes. In Turkey, it has been a common practice to raise consumption taxes or introduce new consumption taxes whenever budgetary expenditures rise. Higher consumption tax rate is one factor that encourages saving in the economy. Besides this the initial increase in savings leads to a rise in physical capital stock that generates a rise in wages and a reduction in interest rates.

[2] Total savings as a fraction of GDP fell from 18 percent in 2000 to 12 percent in 2013. This decline is even more striking for private saving rate that came down from 21.8 percent to 9.7 percent during the same period.

Higher wages reinforce the increase in savings whereas the decline in interest rates subdues it. The overall impact of the new policy on net saving and total assets of the economy is ambiguous and depends on the interaction between these effects.

The quantitative results from our model show that moving from a benchmark economy to one where the government makes direct contributions, a 15.6 percent rise in physical capital stock occurs. Net saving rate is higher by 0.27 percentage points compared to the benchmark case with no individual retirement accounts. A certain fraction of assets in IRAs and government contribution accounts are diverted from ordinary accounts. We compute this fraction as 76.1 percent. The remaining 23.9 percent constitute incremental saving. The system is financed by 6.97 percentage points increase in consumption tax rate. We also measure the welfare effects of the new system on unborn individuals. According to our computations, an unborn individual always prefers the IRA economy to the benchmark. In order for unborn individuals to be indifferent between the two economies, the consumption levels in the IRA economy need to be permanently reduced by 6.9 percent.

To understand how the financing method changes the impacts of the individual retirement accounts, we repeat the same exercise using labor and capital income taxes as a tool to clear the government budget. Higher labor income taxes reduce the disposable income hence the savings of individuals. Our results verify this negative impact. In an economy where the individual retirement system is financed with labor income taxes, the net saving rate and physical capital stock increases by 0.14 percentage points and 8.19 percent respectively. These are smaller increases compared to the economy where the government budget balance is maintained by raising consumption taxes. The impact of the system is weakened even more when capital taxes are used as a financing tool. Raising the tax rate applied to regular assets discourages individuals from investing in these assets. Overall we observe a remarkable shift of assets from regular accounts to individual retirement accounts and a significantly lower increase in capital stock (3.16 percent) and net saving rate (0.06 percentage points) in this economy.

Based on our conjecture that fees charged by financial firms have significant distortionary effects, we also simulated an IRA economy with no fees. Results from this simulation approve our conjecture and suggest that eliminating these fees, it is possible to achieve an increase in saving rate and physical capital stock that is almost twice the increases we get in an IRA economy with fees.

One of the main reasons for introducing this matched retirement savings program is to stimulate private savings in the economy. As an alternative to the current individual retirement system we experiment a subsidized capital tax rate policy. In this policy experiment we reduce capital tax rates until we obtain a rise in capital stock that is equal in magnitude to the one we observe in the baseline IRA economy financed with consumption taxes. Despite the fact that the rise in net saving rate, capital stock and total consumption are the same in these two economies, the permanent increase in consumption that an individual enjoys moving from the benchmark economy to the subsidized capital tax rate economy is lower than the one we get with the baseline IRA economy. The reason underlying this difference is that consumption increases are enjoyed during later stages of the life cycle in the former economy whereas in the latter individuals enjoy higher consumption levels at younger ages that have higher present discounted values.

Before reporting and discussing our results in more detail we provide some details about the current application of the individual retirement system in Section 2. Section 3 explains the model economy. In Section 4 we discuss the calibration of the model and results of our simulation exercises and Section 5 concludes.

2 Individual Retirement Accounts

A voluntary private pensions system was first introduced in 2003 in Turkey. The system was modified in 2013. At the initial phase between 2003 and 2013, the incentive to contribute was provided by tax reductions. Individuals were allowed to deduct their total contributions from their annual gross taxable income. Although there was an increase in both the number of contributors and the amount of funds accumulated in the individual retirement accounts, the performance of the tax-favored individual retirement scheme was not deemed as satisfactory.[3] This resulted in a change in the incentive mechanism of the private pension system in 2013.

In the current version, anyone who is older than 18 is allowed to accumulate assets through the system regardless of his employment status. The savings added to individual retirement accounts are matched with a 25 percent direct government contribution. These contributions are accumulated in a separate account and the annual total amount is capped at 25 percent of the annual gross minimum wage. Upon an individual's decision to exit the system, capital income taxes are levied on the assets accumulated in both the individual and government accounts. The tax rate levied and the fraction that an individual is allowed to withdraw from government account depend on his age and the number of years he contributed to the individual retirement system. If an individual contributes for 3 years or less, he cannot withdraw any assets from the government account. At the end of 3 years, he is eligible to withdraw 15 percent of the amount accumulated in this account. This percentage increases to 35 percent at the end of 6 years and 60 percent at the end of 10 years if the contributor has not reached age 56 yet. If the individual contributes to his individual retirement account for 10 years or more

[3]The number of contributors was 0.015 million in December 2003. This number increased to 3.13 million in December 2012. The total contributions increased from 5.86 million TL to 16.177 billion TL (in nominal terms) during the same period. Source: http://www.egm.org.tr.

and is at least 56 years old, he has the right to withdraw all the assets accumulated in the government account.

In addition to direct government contributions, there are tax incentives provided in the new system. Capital income taxes are applied to the total return on the assets in both government and individual accounts. For contributors who stay in the system for less than 10 years, the tax rate is 15 percent. If the tenure of the contributor is 10 years or more, the rate falls to 10 percent. If this individual is also at least 56 years old, the tax rate is further reduced to 5 percent.

The savings in IRAs are invested in different types of funds with various risk and return. These funds are operated by financial firms that charge some fees in return for their services. The first fee is a management fee that is immediately applied to the periodic contributions as they are deposited in IRAs. The second one is an operation fee charged daily on the total amount accumulated in individual retirement accounts. The maximum rate for the management fee is determined by the government as 2 percent of the individual's contributions. There is also a cap on the operation fee that varies according to the type of the fund. For instance the maximum annual fee a financial firm can charge on a fund consisting of only government bonds is set to 1.91 percent.

Since the enactment of the new system in 2013, the number of contributors have increased from 3.1 to 5.2 million and the total contributions by individuals have risen from 16.2 to 36 billion TL.[4] Although we observe these increases, the long-run impacts of the system require further investigation. In particular, it is important to analyze how the total assets accumulated in the economy are affected by the new mechanism. As mentioned in the results of İmrohoroğlu et al. (1998), individual retirement accounts might lead to a shift of savings from ordinary accounts, therefore it is essential to ana-

[4]These figures reflect the changes between January 2013 and February 2015. See Pension Monitoring Center's website http://www.egm.org.tr for updated statistics.

lyze the impacts of the system on total assets and net saving in the economy. The model explained in more detail below provides the necessary environment for conducting such kind of analysis.

3 Model

The model consists of households, government, goods-producing firms as well as financial firms which operate the private retirement accounts of individuals.

3.1 Households

3.1.1 Population Structure

The economy is populated by overlapping generations of ex-ante identical individuals. In each period a new generation is born and the probability of survival from age j to age $j+1$ is ψ_{j+1}. Individuals retire at age j^* and die after age $\bar{J}$ with certainty. Population grows at rate ρ. The population share of age j individuals is denoted by μ_j and determined from $\mu_{j+1} = \psi_{j+1}\mu_j/(1+\rho)$ where $\sum_{j=1}^{\bar{J}} \mu_j = 1$ for $j = 1, 2, ..\bar{J}-1$ and $0 < \mu_j$.

3.1.2 Labor Supply

All surviving individuals work until their retirement age (j^*). They supply labor inelastically in return for wage income (w_j). This wage income is determined by the economy-wide wage rate (w) and age-dependent labor efficiencies (ξ_j) of individuals in the form of $w_j = w\xi_j$. Workers pay a constant fraction (τ_{sh}) of their wage earnings as social security taxes. The remaining amount is also subject to labor income tax (τ_l). Throughout their retirement, individuals receive social security benefits denoted by q, which amounts to a certain fraction of their average wage earnings during their work time. These income flows are formally summarized as

$$y_j = \begin{cases} (1-\tau_{sh})(1-\tau_l)w_j & \text{if } j < j^* \\ q_j & \text{if } j \geq j^*. \end{cases} \tag{1}$$

3.1.3 Individual Retirement Accounts

Individuals open individual retirement accounts by simply depositing a positive initial amount at a financial firm. These accounts are operated by the financial firms. Individuals are required to pay two types of fees to these firms. The first one is an operation fee (ϕ) that accrues on the total balance of an individual in IRA. The financial firms also deduct a certain fraction (ω) from the periodic contributions of individuals. The periodic contribution of an age-j individual is denoted by x_j.[5] The beginning of period balance in these accounts is denoted by b_j. The funds in IRAs are channeled to the production sector and earn risk-free interest rate (r). The government puts aside a fraction (λ) of the amount invested in IRA in a separate account. There is a cap on these contributions which is expressed as $\lambda\bar{x}$ where $\bar{x}$ is the before tax minimum wage. The balance in the government account is denoted by b_j^g. Assets in the government accounts also earn the risk-free interest rate (r).

At the very beginning of a period an individual who is already in the individual retirement system decides whether or not to withdraw from the system before making any other choice. When an individual decides to withdraw, capital taxes are applied to the total return which encompasses both past and current interest income from both individual and government accounts. The capital tax rate is denoted by $\tau_b(t_j, j)$. This tax rate depends on the age of the individual and the number of years he stayed in the

[5]Following the initial positive contribution, these contributions are allowed to be as low as zero.

system and can be less than the tax rate applied on regular assets. This tax advantage creates another incentive for individuals to open an IRA. If the contributor decides to withdraw, he collects all the net balance in his individual retirement account and a certain fraction of the balance accumulated in the government account.[6] Similar to the tax rate applied on individual retirement assets, this fraction is a function of the age of the individual (j) and the number of years of contribution (t_j) and denoted by $\kappa(t_j, j)$.

The number of years of contribution has the following law of motion for an individual who remains in the system

$$t_{j+1} = t_j + 1. \tag{2}$$

If the individual withdraws from the system it evolves according to

$$t_{j+1} = \begin{cases} 1 \;\; if \;\; x_j > 0 \\ 0 \;\; if \;\; x_j = 0. \end{cases} \tag{3}$$

The first case tells us that the individuals are given the option to reopen an individual retirement account immediately after terminating their existing accounts. There is no age restriction for being in the individual retirement system therefore we allow for the possibility that an individual can be a contributor to an IRA at all ages except $\bar{J}$.

3.1.4 Budget Equations

An individual can accumulate his assets either in an ordinary account that earns the risk-free interest rate or in an IRA as mentioned above. The balance in the ordinary

[6]We assume that individuals receive the net balance accumulated in the IRAs and government accounts as a lump-sum payment. The current application in Turkey allows for once-and-for-all lump sum payment as well as payment in multiple installments. For simplicity we assume that the individuals prefer the former option upon exiting the system.

account is denoted by a_j. Individuals face a liquidity constraint therefore $a_j \geq 0$ and they are also not allowed to borrow against their IRA balances i.e. $b_j > 0$. At the beginning of each period an individual decides whether or not to withdraw the balance at his IRA. If the individual decides to terminate his IRA, he gets all the balance and the current interest earnings in his individual retirement account, as well as a certain fraction of the balance accumulated in the government account, less of taxes.

The budget equation of an individual who decides to stay in the system is given by

$$c_j(1+\tau_c) + a_{j+1} + x_j = R_k(a_j + \gamma) + y_j + \pi \tag{4}$$

$$b_{j+1} = x_j(1-\omega) + R(1-\phi)b_j \tag{5}$$

$$b^g_{j+1} = Rb^g_j + \lambda \, min\{x_j, \bar{x}\} \tag{6}$$

$$x_j \geq 0 \;\; ; a_{j+1} \geq 0 \tag{7}$$

where $R_k = (1 + (1-\tau_k)r)$ and $R = 1 + r$. r is the marginal return on capital less of depreciation and τ_k is the tax rate on capital income. γ denotes the accidental bequest transfers by the government and π is the profit income coming from financial firms.[7] For an individual who is withdrawing from the system, the budget equation is

$$\begin{aligned} c_j(1+\tau_c) + a_{j+1} + x_j &= R_k(a_j + \gamma) + R(1-\phi)b_j - t_b \\ &\quad + Rb^g_j \kappa(t_j, j) - t_g + y_j + \pi \end{aligned} \tag{8}$$

$$b_{j+1} = x_j(1-\omega) \tag{9}$$

$$b^g_{j+1} = \lambda \, min\{x_j, \bar{x}\} \tag{10}$$

$$x_j \geq 0 \;\; ; a_{j+1} \geq 0 \tag{11}$$

[7]We simply assume that positive profits of financial firms are equally distributed among individuals.

where t_b and t_g are capital taxes levied on total returns from private and government IRA assets, respectively. More specifically, t_b and t_g are given by

$$t_b = \tau_b(t_j, j)\left(R(1-\phi)b_j - \sum_{i=1}^{t_j} x_{j-i}\right) \quad (12)$$

$$t_g = \tau_b(t_j, j)\kappa(t_j, j)\left(Rb_j^g - \sum_{i=1}^{t_j} \lambda\, min\{x_{j-i}, \bar{x}\}\right). \quad (13)$$

Those taxes are collected in the period in which an individual decides to close her individual retirement account.

3.2 Technology

Firms combine labor and capital using a Cobb-Douglas technology to produce output. The production function is given by

$$Y = f(K, N) = AK^{\alpha}N^{1-\alpha} \quad (14)$$

where A>0, $\alpha \in (0, 1)$ is the capital's share of output and K and N are aggregate capital and labor inputs, respectively. Firms share a certain portion of the social security tax deductions from the wage payments denoted by τ_{sf}. Net real return to capital (r) and real wage rates (w) are determined in a perfectly competitive environment. Accordingly first order conditions of the firms profit maximizing problem yield

$$r = \alpha A(K/N)^{\alpha-1} - \delta \quad (15)$$

$$w(1 + \tau_{sf}) = (1 - \alpha)A(K/N)^{\alpha} \quad (16)$$

where δ is the depreciation rate of the physical capital.

3.3 Financial Firms

The financial firms operate the individual retirement accounts. They collect management fees (ω) on the periodic contributions and operation fees (ϕ) on the total assets accumulated in the IRAs. We assume that they bear no transactional costs therefore their revenue, denoted by Y_I, is as follows

$$Y_I = \omega\tilde{X} + R\phi\tilde{B} \tag{17}$$

where $\tilde{X}$ denotes the total periodic contributions made in that period and $\tilde{B}$ denotes the total IRA assets accumulated. The government levies capital income tax on the revenue of these insurance firms and their profits net of these taxes are redistributed to the households. The net profits are

$$\Pi = (\omega\tilde{X} + R\phi\tilde{B})(1 - \tau_k).$$

3.4 Government

Government is assumed to run a balanced budget at every period. The expenditures of the government consist of government purchases of goods (G) and sum of the matched contributions deposited in the government accounts (X_{IRA}). On the revenue side we have capital, labor and consumption tax revenues, as well as the unclaimed part of the government's contribution due to early exit (G_{IRA}) and death (G^D_{IRA}). In addition to these, the government finances some part of its expenses through bond sales. The stock of bonds (D) that the government issues is a fixed portion (d) of output (Y). Accordingly the government budget equation and the law of motion for the bond stock are given by

$$G + X_{IRA} + (r - \rho)D = R\,(G_{IRA} + G^D_{IRA}) + T_b + T_g + \tau_c C \quad (18)$$
$$+\tau_l(1 - \tau_{sh})wN + \tau_k(rK + Y_I)$$
$$D = dY \quad (19)$$

where T_b and T_g are the total taxes collected from the returns on individual retirement accounts and government accounts, respectively. We assume that the consumption tax rate τ_c adjusts to maintain a balanced budget.

Another responsibility of the government is to administer the public pension system. This system is self-financing and therefore the government does not bear any costs associated with it. It simply sets the tax rates that balance the social security budget. These taxes are collected both from the firm (τ_{sf}) and the worker (τ_{sh}). Retiree benefits are a certain fraction of their average wage earnings through their work life and they are stated as follows

$$q_j = \theta \frac{\sum_{j=1}^{j^*-1} w_j}{j^* - 1} \quad (20)$$

where θ is the replacement rate. The government also makes transfer payments (γ) to individuals at the beginning of each period. These transfers are accidental bequests and they arise because the time of death is stochastic and the deceased individuals may leave behind positive asset balances. They are distributed equally in lump-sum fashion to all surviving individuals by the government.

3.5 Stationary Equilibrium

Each period the individual compares the value of having an IRA to staying out of the individual retirement system. The corresponding decision problem can be stated as follows

$$V_j^*(a_j, b_j, g_j, t_j) = \max_{\{I,N\}} \left\{ V_j^I(a_j, b_j, g_j, t_j), V_j^N(a_j, b_j, g_j, t_j) \right\} \tag{21}$$

where V^I and V^N are the value functions of an individual who has an IRA and who does not, respectively. For an individual who stays in the system, the value function is

$$V_j^I(a_j, b_j, g_j, t_j) = \max_{a_{j+1}, x_j, c_j} U(c_j) + \beta\psi_{j+1} V_{j+1}^*(a_{j+1}, b_{j+1}, g_{j+1}, t_{j+1}) \tag{22}$$

s.t. equations (4), (5), (6), and (7). For an individual who decides to exit the system the value function is

$$V_j^N(a_j, b_j, g_j, t_j) = \max_{a_{j+1}, x_j, c_j} U(c_j) + \beta\psi_{j+1} V_{j+1}^*(a_{j+1}, b_{j+1}, g_{j+1}, t_{j+1}) \tag{23}$$

s.t. equations (8), (9), (10), and (11).

Let $\mathbf{x} = (a, b, g, t) \in X = AxBxGxT$ denote the state vector where $A \subset R_+, B \subset R_+, G \subset R_+$, and $T = \{0, 1, 2, ..10\}$.

Definition of Equilibrium: Given a set of time-invariant fiscal policy arrangements $(\tau_{sf}, \tau_{sh}, \tau_l, \tau_c, \tau_k, \tau_b, \theta, \lambda, \bar{x}, g, \kappa, d)$, a stationary equilibrium is a collection of value functions $V_j(x)$, individual policy rules $C_j : R_+ \times R_+ \times R_+ \times T \to R_+, A_j : R_+ \times R_+ \times R_+ \times T \to R_+, B_j : R_+ \times R_+ \times R_+ \times T \to R_+$, of each age j=1,2..$\bar{J}$ and relative prices of capital and labor (w, r), lump-sum transfers (γ) and profits of financial firms (π) such that individuals maximize utility subject to their budget constraints, the government budget constraint is satisfied and the goods market clears. We can state these conditions more formally as follows:

- Aggregate capital is the sum of individual assets and aggregate labor supply is the sum of labor supply by individuals:

$$K = \sum_{j=1}^{\bar{J}} \mu_j [a_j + b_j + g_j + \gamma] + G^D_{IRA} - D \tag{24}$$
$$N = \sum_{j=1}^{j^*} \mu_j \xi_j. \tag{25}$$

  The physical capital stock includes the sum of all assets both in regular, individual retirement, and government accounts as well as the accidental bequest transfers. From this sum we subtract the stock of public debt D to get the net physical capital stock.

- The social security system is self financing:

$$(\tau_{sh} + \tau_{sf}) \sum_{j=1}^{j^*} \mu_j w \xi_j = \sum_{j=j^*+1}^{\bar{J}} \mu_j q. \tag{26}$$

- The relative prices solve the firm's maximization problem stated in equations (15) and (16).

- Government budget is balanced as stated in equation (18).

- Aggregate resource constraint holds:

$$f(K, N) = \sum_{j=1}^{\bar{J}} \mu_j c_j + (\rho + \delta) K + G + Y_I. \tag{27}$$

4 Quantitative Analysis

The objective of our quantitative analysis is to examine the impact of the subsidized individual retirement accounts on the saving rate and other key macro variables. To accomplish this, we build two model economies. The benchmark economy has no individual retirement system and is calibrated to match Turkish data. Then, we introduce the individual retirement system into the benchmark model which gives us the second economy, also called the IRA economy. We compare the quantitative findings from these two economies.

4.1 Calibration

The first step in our quantitative analysis is the calibration of model parameters. We use a $\bar{J}$-period OLG model where one period corresponds to a year. Individuals enter the economy at the real-time age of 21, retire at age j^* =31 and can live up to $\bar{J}$ =70 which correspond to ages 51 and 90, respectively.[8] Individuals survive from age j to $j+1$ with a positive probability of ψ_{j+1}. Survival probabilities for Turkey are calculated using the population data from Turkish Statistical Institute (TurkStat). The share of age groups in the population are obtained from the equations $\mu_{j+1} = \psi_{j+1}\mu_j/(1+\rho)$ and $\sum_{j=1}^{\bar{J}} \mu_j = 1$ where ρ is the growth rate of population. We set ρ to the average annual growth rate of population between 2007 and 2013 in Turkey, which is 1.4 percent. We compute the age efficiency index ξ_j by employing seven waves of Income and Living Conditions Survey of TurkStat between 2006 and 2013. This index mimics the life-cycle profile of hourly wage earnings of workers in Turkey. We assume that $\xi_j = 0$ for $j \geq j^*$ and use these values to capture the age-income profiles. The period utility of an

[8] j^* is taken to be the average age of the new retirees which has been around 51 recently according to the data from the Social Security Agency (http://www.sgk.gov.tr).

individual is represented by a CRRA function as follows

$$U(c_j) = \frac{c_j^{1-\sigma}}{1-\sigma}.$$

The CRRA parameter σ is set to 1.5, which is a common value used in the literature.

There are several government related parameters that we need to pin down. These are consumption (τ_c), capital income (τ_k) and social security taxes paid by households (τ_{sh}), and firms (τ_{sf}). Consumption tax rate is allowed to adjust so that the government budget is always balanced at steady state. The rate that achieves a balanced government budget is 11.9 percent for the benchmark economy. This rate is close to the average effective tax rate on consumption calculated in Üngör (2014).[9]

Tax rates on capital income in Turkey vary according to the type of the investment. Capital income taxes applied to regular checking or savings accounts with less than 6 months maturity is 15 percent, for accounts with 6 months to 1 year maturity the rate is 12 percent and it drops to 10 percent for accounts with more than 1 year maturity. While the return on government T-bills or bonds are also taxed at 10 percent rate, rent income is taxed at 20 percent. In the model we have one type of asset therefore we get the average of the different capital income taxes and set τ_k to 15 percent.[10]

The labor tax rate is calibrated to match the average of the average annual labor income tax rates between 2006 and 2012 in Turkey. The average annual tax rate is calculated by applying the labor income tax formula to the average earnings. Our calculation yields a rate of 17 percent for the aforementioned period. Furthermore, the total social security tax rate, $\tau_s = \tau_{sh} + \tau_{sf}$, is determined endogenously such that the social security system is self-financing as stated in equation (26). The portions

[9]Using two different methods Üngör (2014) computes the average consumption tax rate rate between 1998 and 2012 as 14.3% and 14.8%.

[10]Source: http://www.kpmgvergi.com/PratikBilgiler/VergiMevzuatiBilgileri/Oranlar.

of the social security tax paid by households (τ_{sh}) and firms (τ_{sf}) are determined in accordance with the current application which states that employees pay 45 percent of the premiums and employers pay the remaining 55 percent.[11]

Another parameter describing the social security system is the replacement rate θ, i.e. the fraction of a worker's pre-retirement income paid out by a pension program upon retirement. According to the current regulations, this rate is determined as 2 percent multiplied by an individual's number of years of contribution.[12] Using this formula and the number of years of contribution which is 30 in the model we get a replacement rate of $\theta = 0.6$.

The remaining government sector parameters include the government purchases to output ratio (g) and public debt stock to output ratio (d). g is set to 15 percent which is the average value between 1998 and 2013. To calibrate d, we use data on the ratio of the public debt stock to output between 2006 and 2012. The mean value of this ratio is 40 percent between these years therefore we set d=0.4.

We calibrate discount factor (β) to match a capital output ratio of 2.61 in our benchmark economy. There is no official data published on the capital stock of Turkey. A limited number of works have attempted to calculate the value of capital stock. Saygılı and Cihan (2008) estimates the real capital stock of Turkey and reports that the average ratio of capital to output is roughly 2.5 between 1987 and 2007. We calculate the same ratio as 2.61 by using the annual capital stock data provided by Saygılı and Cihan (2008) and the output data from TurkStat between 1998 and 2010. Using a different method Demiroğlu (2015) obtains a ratio of around 2.1 for Turkey.

The parameter α that reflects the average income share of capital is set to 0.5. This is

[11] Source: http://www.sgk.gov.tr/wps/portal/tr/sigortalilik/isveren/isveren_prim_oranlari.

[12] Social Security Law number 5510 which was passed in 2006 describes the calculation of the replacement rates. Details of the law can be found at http://www.resmigazete.gov.tr/eskiler/2006/06/20060616-1.htm provided by the Official Gazette of the Republic of Turkey.

a widely used number for emerging and developing economies and implies a higher rate of return on capital than the one in the developed economies.[13] The depreciation rate for physical capital (δ) is computed using the law of motion for capital stock at steady state which says that the ratio of the depreciated part of physical capital to output is equal to the investment output ratio. Using this relation and the average private investment to output ratio between 1998Q1 and 2013Q2, which is nearly 18 percent for Turkey, we get $\delta = 0.055$.

There are several key parameters that describe the current application of the individual retirement system in Turkey. Capital taxes are levied on the total return from assets accumulated in an individual's retirement account upon exit. These rates are a function of the model age of the individual (j) and tenure in the system (t_j). We denote these rates as $\tau_b(t_j, j)$ which can be summarized as

$$\tau_b(t_j, j) = \begin{cases} 5\% \;\; if \;\; t_j \geq 10 \;\; and \;\; j \geq 36 \\ 10\% \;\; if \;\; t_j \geq 10 \;\; and \;\; j < 36 \\ 15\% \;\; if \;\; t_j < 10. \end{cases}$$

As mentioned above, the government makes direct contributions to the individual retirement accounts which amount to 25 percent of the individual contributions. This implies a value of 0.25 for λ. The fraction that the individual is eligible to withdraw from the assets accumulated in the government accounts also depends on the age of the individual (j) and the number of years he spent in the system (t_j). This fraction, $\kappa(t_j, j)$,

[13] See Üngör and Kalafatcılar (2014) for a discussion about the value of α in case of Turkey.

is given by

$$\kappa(t_j, j) = \begin{cases} 0\% \;\; if \;\; t_j < 3 \\ 15\% \;\; if \;\; 3 \leq t_j < 6 \\ 35\% \;\; if \;\; 6 \leq t_j < 10 \\ 60\% \;\; if \;\; t_j \geq 10 \;\; and \;\; j < 36 \\ 100\% \;\; if \;\; t_j \geq 10 \;\; and \;\; j \geq 36. \end{cases} \tag{28}$$

In addition to these, there are parameters related to the fees that are charged by financial firms. These are the operation fees (ϕ), and management fees (ω). The operation fees vary according to the type of funds the assets are invested in. In our calibration we set ϕ to 1.83 percent which is the average operation fee applied to the funds consisting of government bonds per annum.[14] Besides operation fees, the insurance firms deduct management fees from the periodic contributions to the individual retirement accounts. The regulations dictate that these management fees should not exceed 2 percent of the periodic contributions made. In accordance with this regulation we set ω to 2 percent.[15]

Another important parameter related to the individual retirement system is the contribution limit of the government. Current regulations state that the government contributes up to 25 percent of the annual minimum wage before taxes. This is denoted as $\lambda \min\{x_j, \bar{x}\}$ in the model where $\bar{x}$ corresponds to the gross minimum wage. We do not have a minimum wage requirement in the model. In order to calibrate the ceiling on government contributions, we target the ratio of the minimum wage earnings to the mean wage in the data.[16] This ratio is around 0.5 for years 2006 and 2010. Using this

[14]The annual operation fee for such funds is capped at 1.91 percent.

[15]More details regarding the fees associated with the system can be found in the Pension Monitoring Center's website at http://www.egm.org.tr.

[16]The data on before and after tax minimum wages are provided by the Ministry of Labour and Social Protection. We get the average wage earnings data from the Labour and Earnings Statistics for all workers published by Turkish Statistical Agency.

ratio and the average wage earnings computed from the model we define $\bar{x}$ as follows

$$\bar{x} = 0.5 \frac{\sum_{j=1}^{j^*} w\varepsilon_j \mu_j}{\sum_{j=1}^{j^*} \mu_j}.$$

Table (1) presents a summary of all the parameters of the model.

4.2 Findings

4.2.1 Main Scenario with Consumption Tax Finance

In this section we report our steady state results for the benchmark economy and the final economy with individual retirement accounts which mimics closely the current application in Turkey. We compare some key macro variables in these two economies. In order to isolate the sole effect of the individual retirement accounts, we keep all other aspects of the benchmark economy unchanged.

The introduction of individual retirement accounts with tax benefits and direct government contribution provides individuals with an alternative saving mechanism. It offers a higher net rate of return on individual savings than the ordinary accounts if the individual agrees to keep his savings for a certain period of time. This creates a wedge between the two accounts in favor of individual retirement accounts regardless of the equilibrium risk-free rate. Initially individuals exploit this new opportunity by raising their savings. This leads to a higher aggregate physical capital stock thereby resulting in a lower equilibrium interest rate and a higher wage rate.

While higher wages reassure the increase in savings, lower return on capital negates some part of the initial rise. Additionally government finances the additional cost of this subsidized system by adjusting consumption tax rate. A higher (lower) consumption tax rate is another factor making savings more (less) attractive for individuals. Clearly there are opposing forces affecting the equilibrium risk-free rate and other macroeconomic variables. In order to measure the net impact of the individual retirement accounts on the economy, the steady states of the two model economies are carefully computed.

The results from our simulation exercise are summarized in Table (2). According to our findings the net saving rate in IRA economy is nearly 0.27 percentage points higher than the one in the benchmark economy as the private pension system attracts individuals by offering both a higher return on savings and a reduction in capital tax rate. Introducing the individual retirement accounts results in a 15.62 percent rise in the physical capital stock. The larger physical capital stock yields 1.34 percentage points reduction in interest rates. The productivity of labor also benefits from a higher physical capital stock therefore the gross wages are 7.52 percent higher compared to the benchmark case.[17]

The government budget is kept at balance by adjusting the consumption tax rate in the steady state of the IRA economy. The consumption tax rate increases by 6.97 percentage points to compensate the additional cost burden due to the policy change. Nevertheless, we observe a 5.35 percent rise in total consumption. This is mainly because the higher labor earnings more than makes up for the negative impact of the lower capital income and higher consumption tax rate in the IRA economy.

Unlike the benchmark case, total assets are accumulated in three different accounts in the IRA economy. These are ordinary saving accounts, individual retirement and government contribution accounts. Table (5) presents the distribution of total assets

[17]We computed the rate of return on assets in individual retirement accounts. The net rate of return on the total amount of contributions depends on the age at the time of withdrawal, the number of years of contribution, management and operation fees, accompanying tax reductions, and the timing of periodic contributions if they are unequal. The rate of return on the total contributions made to the IRA is calculated and reported in Table (3). For comparison purposes, the table also includes the rate of return that would arise if all of the contributions were deposited in a regular account. According to our calculations, the IRAs have a much higher rate of return than the ordinary accounts after tax deductions. The difference is almost tripled after the model age of 36.

among these accounts. In the baseline IRA economy, assets in individual retirement accounts account for 41.69 percent of the total assets whereas the regular assets constitute 46.85 percent. The remaining 11.45 percent correspond to the balance accumulated in government contribution accounts. Since the individuals in the private pension economy have two alternative assets to invest in, they channel some part of their savings from regular accounts into their individual retirement accounts. We compute the share of individual retirement assets that constitute incremental saving and find that it corresponds 23.9 percent. The remaining 76.1 percent of the individual retirement assets are shifted away from the regular assets.[18]

Besides its impacts on the net saving rate, physical capital stock and output, the welfare implications of the government subsidized pension system are also worth exploring. We assess the overall welfare impact of the new scheme by looking at the two steady states from the eyes of an unborn individual and compute the compensating differential (Δ) in consumption. This differential is the permanent percentage change in the consumption of an individual in the IRA economy at all ages that is required to make him indifferent between the two economies. The formal expression for the consumption compensations is

$$\sum_{j=1}^{\bar{J}} \{\Pi_{z=1}^{j} \psi_z\} \beta^{j-1} u(c_{o,j}) = \sum_{j=1}^{\bar{J}} \{\Pi_{z=1}^{j} \psi_z\} \beta^{j-1} u((1+\Delta) c_{IRA,j}).$$

In this formulation $c_{o,j}$ denotes the consumption of an age j individual in the benchmark economy and $c_{IRA,j}$ corresponds to the consumption where there is a government subsidized individual retirement system. Our calculations yield $\Delta = -6.9$ which implies that moving from the benchmark economy to the one with the private pension scheme,

[18]The incremental saving is computed as the ratio of the change in the steady-state aggregate assets to the assets accumulated in private pension accounts and government contribution accounts.

an unborn individual is ready to give up 6.9 percent of his consumption at each age.[19] In other words, the IRA economy is more preferrable for an unborn individual than the benchmark economy.

The results from our baseline simulation can be compared to the findings in İmrohoroğlu et al. (1998). They build a life cycle general equilibrium model that represents the key features of the IRAs in the US.[20] They find that the IRA system raises the net national saving rate by 0.28 percentage points. This is very close in magnitude to the 0.27 percentage points increase we get in our baseline simulation. They also get a 6.18 percent increase in capital stock. In our model economy the introduction of the individual retirement accounts generates a 15.6 percent increase in the capital stock. This is a larger increase than the one obtained in the baseline IRA economy in İmrohoroğlu et al. (1998). The reason we obtain a similar rise in net saving rate despite the fact that capital stock increases by more is that we have a higher increase in output compared to their model.[21] They also report that 9 percent of IRA savings are incremental whereas the remaining is a shift from non-IRA saving. Our calculations yield a higher fraction (23.9 percent) of incremental savings due to individual retirement accounts.

4.2.2 Alternative Financing Tools

In order to assess the importance of how the IRA system is financed, we repeat the same exercise by allowing either labor or capital income tax rate to adjust when

[19]In order to check the robustness of our main findings, the same experiment is conducted after the retirement age in the public pension system is changed from 51 to 57. In this counterfactual experiment, the introduction of IRAs increases net saving rate, capital stock, and consumption tax rate by 0.26 percentage points, 14.9 percent, and 6.91 percentage points, respectively. In this case, incremental saving turns out to be 23.1 percent and compensating differential in consumption units becomes -6.1 percent. In the light of those findings, it seems that our main findings are robust to the choice of retirement age.

[20]The key institutional features of individual retirement accounts are i) deductibility from taxable income in the year of contribution ii) Tax exemption of funds until withdrawal iii) Cap on the amount of contribution iv) Additional tax penalty on early withdrawals.

[21]The difference between the income share of capital in two economies generates this difference.

balancing the government budget. In those experiments we fix the consumption tax rate at its value in the steady state of the benchmark economy.[22]

The results for labor-tax financing are presented in columns 5 and 6 of Table (2). These results reveal that the net saving rate is 0.14 percentage points higher than the benchmark economy. Accordingly the capital stock rises by 8.19 percent moving from the benchmark to the IRA economy provided that both economies are in steady state. These increases are lower compared to our baseline scenario in which the extra cost of the private pension system to the government budget is financed by changing the consumption tax rate. How factor returns and tax rate respond to the policy change explains the relatively weaker impact of the labor tax-financed IRA system on savings and capital accumulation. We observe that wage rates rise by 4.04 percent along with a 12.54 percentage points increase in labor income tax rates. This generates an after tax wage rate that is around 12 percent smaller compared to the economy with no individual retirement system.

IRA system looks less favorable in this case because the rise in labor income taxes offsets the positive impacts of the mechanism on savings and physical capital stock by significantly reducing the disposable income of individuals. The consumption compensations being 2.05 percent also show that a new-born individual needs a permanent increase in his consumption to prefer living in labor-tax financed IRA economy rather than the benchmark. Hence we can say that if the current practice of the individual retirement system is financed by using labor income taxes, the benefits from the system in terms of the increase in net saving rate, capital stock and consumption of individuals are apparently lower than those in the baseline scenario.

We also examined the impacts of the individual retirement system when the financing of the government budget is done by changing capital tax rate. Raising capital

[22]Recall that benchmark consumption tax rate that clears the government budget is 11.85 percent.

income taxes to finance the government budget in the IRA economy creates an additional incentive for individuals to shift their savings from highly taxed regular accounts to individual retirement accounts. However higher capital income taxes discourage individuals from saving. The increase in individual retirement assets that is due to additional savings is 4.37 percent in this case. The remaining 95.63 percent constitute a shift from assets in regular accounts. The distortionary effect of capital taxation is observable in the relatively smaller increase in capital stock when compared to the former tools of financing. The capital stock increases by 3.16 percent and capital output ratio rises by only 1.57 percent. Therefore the increase in net saving rate is 0.06 percentage points which is a much smaller change compared to consumption and labor tax financed IRA economies.

4.2.3 Fees and Capital Tax Benefits

There are two types of fees collected by the financial firms from individuals who have individual retirement accounts. The management fee is applied to the periodic contributions while the operation fee is calculated over the total balance in the individual retirement accounts including the returns. One question of interest is how much these fees affect the possible positive impacts of the private pension scheme on the variables of interest. To address this question we run the same model shutting down all the fees charged by financial firms. The results of this experiment are presented in columns 3 and 4 of Table (4).

The change in capital stock and net saving rate compared to the benchmark economy reveal that these fees have non-negligible impacts. With no operation or management fees, the capital stock increases by nearly 29 percent and the net saving rate by 0.49 percentage points. These are nearly twice the increases that were observed in the individual retirement economy with fees. Due to the higher increase in capital stock, the magnitude of the rise in wage rates and the decline in interest rates are bigger compared to the baseline IRA economy. Despite the fact that we observe a higher increase in labor income, the reduction in interest rates undoes some part of this by affecting capital income negatively. In this case, consumption compensating differential turns out to be 7.25 percent.

The distribution of assets in different types of accounts, as presented in Table (5), shows that eliminating these fees generates a 4 percentage points higher share of IRA assets than the baseline scenario. Also in this case 37 percent of assets in both private pension and government contribution accounts is incremental saving and the remaining 63 percent is a shift from regular assets. Thus compared to the IRA economy with fees, a larger portion of the assets in individual retirement accounts is due to additional savings of individuals.

The current application of the individual retirement system consists of two incentive channels for individuals. The first one is the direct government contributions that are equivalent to a particular fraction of periodic installments by individuals. The other one is the tax reductions from which individuals can benefit depending on their age and how long they contribute to these accounts.

To see how much the impact of the tax benefits provided to individual retirement assets, we simulated an IRA economy with only direct government contributions. Columns (5) and (6) of Table (4) present these results. The introduction of the individual retirement accounts without the tax advantage results in a 12.95 percent increase in capital stock and a 6.28 percentage points increase in capital-output ratio. The net saving rate increases by 0.23 percentage points. These are moderately smaller increases compared to the economy with individual retirement accounts providing both a direct government subsidy and a tax advantage. The financing of the system is achieved with a 4.9 percentage points rise in consumption tax rate. Increase in total consumption from the benchmark economy amounts to 4.5 percent.

The compensating differentials show that a new born individual will be indifferent between the benchmark and the IRA economy without capital tax benefits as long as his consumption in the latter is permanently reduced by 7 percent. This amount is almost equal to the consumption compensation we get in the baseline IRA economy despite the fact that total consumption increases by less. The life cycle consumption profiles in both economies are presented in the left panel of Figure (1). Individuals in the baseline IRA economy seem to have higher levels of consumption in their later ages. In the calculation of lifetime expected utility, the later ages have relatively smaller weights given that the subjective discount factor is less than one and adjusted by survival probabilities which diminish by age. After age 33, the individual starts consuming slightly more in the baseline IRA economy. In the absence of tax benefits, the distribution of consumption more towards younger ages is one factor that leads to a compensating differential that is similar in magnitude to the baseline IRA economy.

4.2.4 Reducing Capital Tax Rate as an Alternative to IRA System

As mentioned previously one of the reasons for devising the current individual retirement system is to increase private savings in the economy. An alternative policy to achieve this goal could be to provide a subsidy to net earnings on capital by reducing capital tax rate. The last two columns of Table (4) present the results of this alternative policy experiment. According to our results, an increase in capital stock that is equal in percentages to the one in the baseline IRA economy can be achieved by lowering capital tax rates by 10.8 percentage points. This requires a 6.28 percentage points increase in consumption tax rate that is enough to fund such a policy change.

Although the impacts of this system on physical capital and net saving rate are similar to the baseline IRA economy, the increase in the expected lifetime utility is equivalent to a 3 percent permanent increase in the consumption from an unborn individual's point of view. This is almost half of the consumption compensating differential for the baseline IRA economy. Consumption profiles presented in the right panel of Figure (1) show that even though the increase in total consumption is the same in these economies, consumption at earlier ages is higher in the baseline IRA economy. In other words, this policy shifted the increase in consumption towards later years in life. Since consumption at earlier ages is discounted at a lower rate, this generates a higher expected lifetime utility for a new-born individual in the baseline IRA economy compared to the one with a subsidized capital tax rate.

4.2.5 Life Cycle Profiles of Consumption and Assets

The life-cycle behavior of an individual's assets and consumption displays interesting features as well. Figure (2) illustrates total assets and the stock of assets in individual retirement accounts. In the baseline IRA economy, individuals find it optimal to enter the system at the age of 22. They tend to increase their periodic contributions as much as possible towards the end of the 10-year term in order to benefit more from the government contribution. Recall that after 10 years there is no increase in the fraction an individual can claim from the assets in the government account unless the individual is close to age 56. Hence the individuals terminate their IRAs at the end of each 10 years and they immediately reopen new IRAs. They repeat this behavior until almost the end of their lifetimes. As a result the assets in IRAs exhibit the spiky behavior as displayed in the right panel of Figure (2). Total assets of an individual is almost the same under two economies until age 56. However beginning from age 57, their asset holdings under the IRA system exceed the ones in the standard model as the individuals gain access to the whole amount accumulated in the retirement account. The less smooth behavior of total assets is due to the repeated entry and exits from the IRA system as mentioned above.

In Figure (3), we observe the life-time consumption profiles of individuals for the benchmark and the private pension economy. Until age 56, an individual consumes slightly more in the IRA economy. After this age we observe a more noticeable difference between the consumption levels of individuals of the same age in these economies. The higher consumption levels observed in the private pension economy arises because individuals earn a higher wage income during their work years and receive higher benefits during their retirement in the IRA economy. In addition to this, individuals are eligible to get all the assets accumulated in the government contribution account after age 56, implying a higher return on assets deposited to individual retirement accounts. Higher return on savings channeled to individual retirement accounts generates two opposing effects on the consumption behavior of individuals. The first one is the positive income effect that increases an individual's consumption. The second one is the negative substitution effect that results in a shift from consumption to savings. Figure (2) shows that the first time that an individual actually collects all the assets accumulated in this government account corresponds to age 57. As the individual reaches this age, the balance in his ordinary account reaches a high level. We also observe that consumption of an individual in these two economies start diverging after age 57 that can be linked to a more dominant positive income effect.

5 Conclusion

A new private pension scheme has been effective in Turkey since the beginning of 2013. The incentive mechanism in this scheme is the 25 percent direct contributions made by the government for each unit deposited in the individual retirement accounts. This system has been viewed as an important policy tool to boost household savings in the long-run. In this paper we evaluate quantitatively the new private pension scheme in a computable general equilibrium OLG setting. In particular we address how much the net saving rate, total assets and physical capital stock change moving from a benchmark economy to one where the contributions of individuals to the IRAs are matched by the government. A rigorous evaluation of this policy is important since this kind of an incentive mechanism has not been used in any other country before.

Our baseline quantitative analysis compares a benchmark economy with no individual retirement accounts to an economy with an individual retirement system mimicking the current application in Turkey. We first calibrate our benchmark model using Turkish data and simulate the three alternative economies. The results from our baseline simulation yield that the physical capital stock is 15 percent higher in the economy with a government subsidized private pension scheme. The impact of the system on net saving rate is a 0.27 percentage points increase. We also evaluate the long-run welfare impacts of the new scheme. Our analysis shows that an unborn individual prefers the IRA economy and become indifferent between the two if his consumption in the IRA economy is cut down by 6.97 percent. This benefit emerges as an outcome of higher wage rates due to the higher physical capital stock accumulation in the economy. In an alternative scenario we examined the case where the financing of the system is done by increasing labor income taxes. The results from this experiment suggest that, using labor income taxes to balance the government budget, the benefits of introducing IRAs in terms of increasing savings, capital and welfare get reduced.

The fees charged by financial firms stand as a significant factor with a potential to discourage individuals from investing in individual retirement accounts. We run a counterfactual experiment where both the management and operation fees are set to zero in order to evaluate this impact. According to this experiment, the rise in saving rate and physical capital stock in the no-fee economy is nearly twice the changes that emerge under the IRA economy with fees.

One important goal of implementing a savings matched individual retirement system is stated as increasing savings hence capital stock in the economy. As an additional exercise we designed an alternative policy where the government provides a subsidy to the tax rate applied on assets in ordinary accounts. A comparison of the results from this policy with our baseline IRA economy shows that having a private pension scheme financed with consumption taxes is more beneficial for individuals because they can enjoy higher consumption levels at younger ages in the IRA economy.

Table 1: Calibration of Benchmark Model

ρ	α	β	δ	σ	g	d	τ_l
0.0139	0.50	0.937	0.055	1.5	0.15	0.40	0.17
τ_{sf}	τ_{sh}	τ_k	θ	λ	ϕ	ω	τ_c
0.21	0.17	0.15	0.60	0.25	0.018	0.02	0.119

Table 2: Simulation Results

		IRA funded with alternative taxes					
	No IRA	Consumption Tax		Labor Tax		Capital Tax	
	Level	Level	Change	Level	Change	Level	Change
Capital Stock	6.73	7.78	15.62%	7.28	8.19%	6.94	3.16%
Consumption	1.72	1.82	5.35%	1.77	2.90%	1.74	1.15%
Capital-Output Ratio	2.61	2.81	7.52%	2.72	4.02%	2.65	1.57%
Net Saving Rate (%)	3.63	3.90	0.27 (ppt)	3.77	0.14 (ppt)	3.68	0.06 (ppt)
Interest Rate	13.62	12.28	-1.34 (ppt)	12.88	-0.74 (ppt)	13.32	-0.30 (ppt)
Wage Rate	1.08	1.16	7.52%	1.12	4.04%	1.10	1.64%
Compensating Differential	-	-	-6.90%	-	2.05%	-	-6.24%
Consumption Tax (%)	11.85	18.82	6.97 (ppt)	11.85	0.00 (ppt)	11.85	0.00 (ppt)
Labor Tax (%)	17.00	17.00	0.00 (ppt)	29.54	12.54 (ppt)	17.00	0.00 (ppt)
Capital Tax (%)	15.00	15.00	0.00 (ppt)	15.00	0.00 (ppt)	41.93	26.93 (ppt)

Table 3: Rates of Return From Assets in Different Accounts

Age at the Time of Exit	Return from IRA	Return from Regular Account	Wedge
14	83.3%	68.3%	15.0 (ppt)
24	109.8%	94.0%	15.7 (ppt)
37	181.1%	130.9%	50.2 (ppt)
47	118.8%	79.7%	39.0 (ppt)
57	126.1%	85.6%	40.5 (ppt)
67	154.5%	109.0%	45.5 (ppt)

Table 4: Alternative Policies

	No IRA	Consumption Tax (No fees)		IRA No Tax Benefit		Equivalent Capital Tax Reduction	
	Level	Level	Change	Level	Change	Level	Change
Capital Stock	6.73	8.66	29.00%	7.60	12.95%	7.81	16.06%
Consumption	1.72	1.89	9.00%	1.80	4.48%	1.82	5.49%
Capital-Output Ratio	2.61	2.97	13.00%	2.78	6.28%	2.82	7.73%
Net Saving Rate(%)	3.63	4.11	0.49 (ppt)	3.85	0.23 (ppt)	3.91	0.28 (ppt)
Interest Rate	13.62	11.35	-2.27 (ppt)	12.49	-1.13 (ppt)	12.25	-1.37 (ppt)
Wage Rate	1.08	1.22	13.00%	1.15	6.28%	1.16	7.73%
Compensating Differential	-	-	-7.25%	-	-7.12%	-	-3.01%
Consumption Tax(%)	11.85	19.00	7.62 (ppt)	16.73	4.89 (ppt)	18.13	6.28 (ppt)
Labor Tax(%)	17.00	17.00	0.00	17.00	0.00	17.00	0.00
Capital Tax (%)	15.00	15.00	0.00	15.00	0.00	4.20	-10.80

Table 5: Share of Assets in Different Accounts in IRA economies with Alternative Funding

Share in total assets (%)	Consumption Tax	Labor Tax	Capital Tax	Consumption Tax (No fees)
Ordinary accounts	46.85	43.61	36.9	43.11
Individual retirement accounts	41.69	44.28	49.4	45.61
Government contribution accounts	11.45	12.11	13.6	11.28

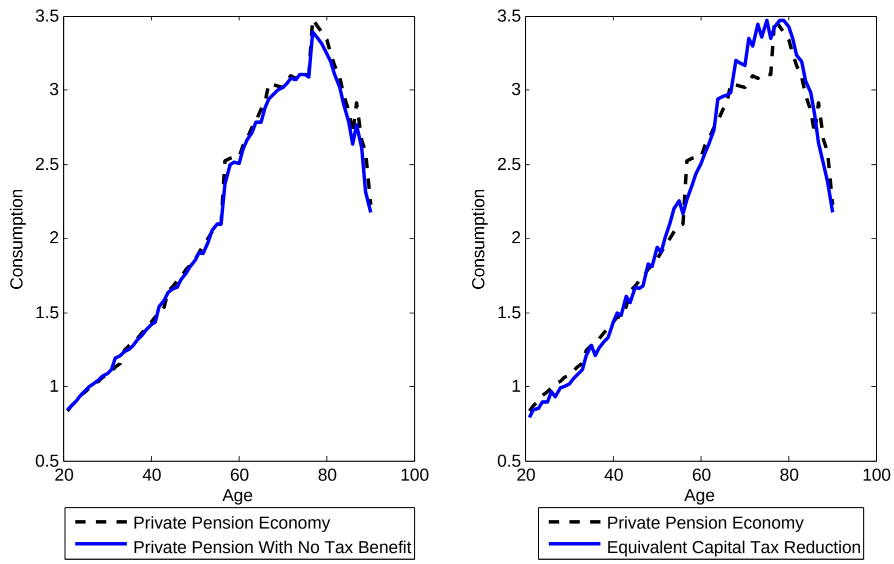

Figure 1: Consumption Profiles Under Different Scenarios

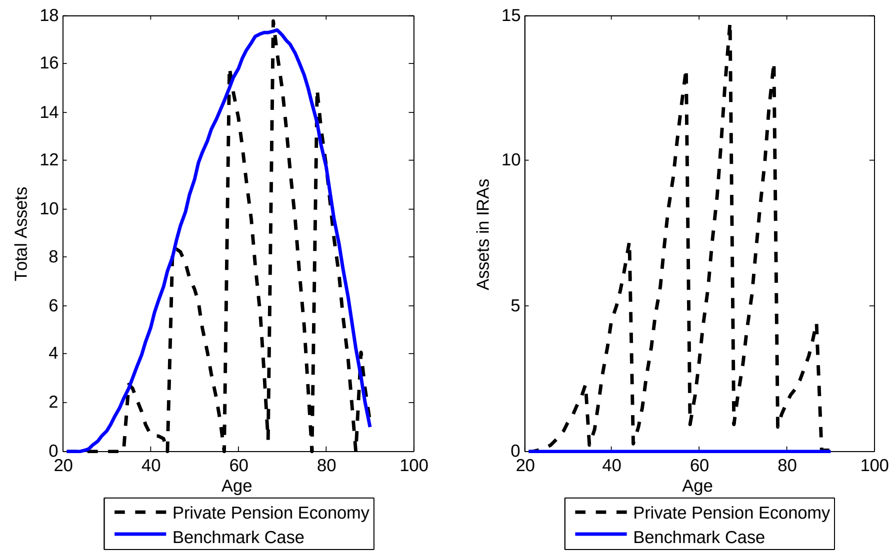

Figure 2: Life Cycle Asset Profiles

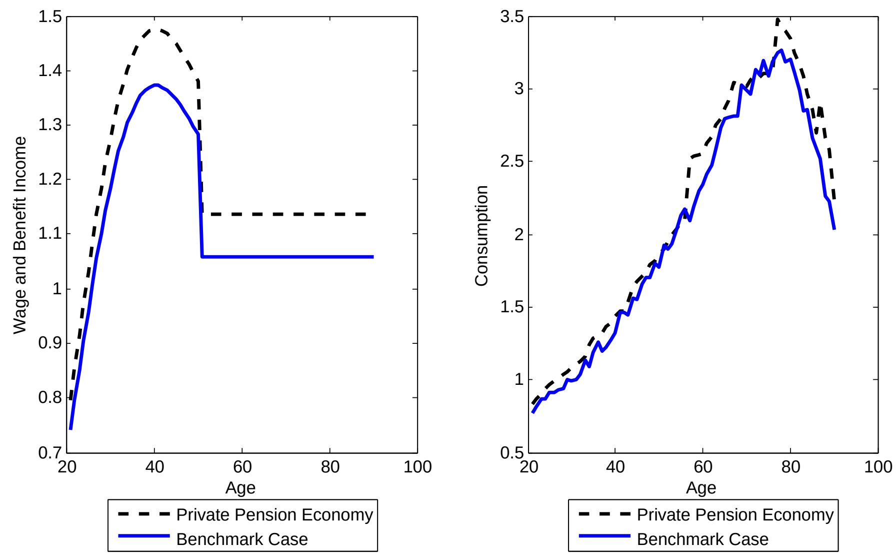

Figure 3: Income and Consumption Profiles

Appendix

To solve the dynamic programming problem of the agents we go through the following steps:

1. Build a grid for the vector of state variables $\mathbf{X}$, and the decision variables a', and b'.

2. We start with an initial guess for the interest rate R^0, accidental bequests γ^0, social security tax τ_s^0, labor income tax τ_l^0 and the profit shares households get from the insurance firms π^0.

3. Given these guesses we find the decision rules for each cohort by computing a backward recursion starting from the last period of life at $j = J$ until the first age $j = 1$ using the dynamic program in equations (21), (22), and (23).

4. Based on these decision rules new values of R^1, γ^1, τ_s^1, τ_l^1, π^1 are computed and if these new values are close enough to the initial guesses we stop, otherwise we update our initial guesses with R^2, γ^2, τ_s^2, τ_l^2, π^2 where $R^2 = \zeta R^0 + (1 - \zeta)R^1$, $\gamma^2 = \zeta\gamma^0 + (1-\zeta)\gamma^1$,$\tau_s^2 = \zeta\tau_s^0 + (1-\zeta)\tau_s^1$, $\tau_l^2 = \zeta\tau_l^0 + (1-\zeta)\tau_l^1$, $\pi^2 = \zeta\pi^0 + (1-\zeta)\pi^1$.

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