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Abstract

The returns from individual accounts in pension schemes are subject to fluctuations in capital markets. This increases income uncertainty for the beneficiary and exposes individuals to the risk of fluctuations in the economy in general, and of the stock market in particular. This fact has recently gotten considerable attention from policymakers. A minimum pension guarantee is a way to avoid this pitfall by providing a minimum annuity regardless of the actual investment performance of individual accounts. In this study, we present a cost analysis of a minimum benefit guarantee mechanism for the Individual Pension System in Turkey, a privately managed defined contribution scheme which was introduced in 2003 as a complement to the traditional pay-as-you-go system. We examine the cost estimates and the probability of guaranteed payoffs under various economic and demographic assumptions.

Keywords: Defined Contribution, Individual Pension System, Pension Guarantees, Turkey.

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1. Introduction

The way that aging populations, an expanding informal economy, low pension coverage, and inefficiency in the administrative and political management of funds have all increased the fiscal cost of traditional pay-as-you-go (PAYG) systems has led many governments to change the basis of retirement income from defined benefit to defined contribution schemes.

While PAYG largely depends on demographic trends and labor market productivity (i.e. the active-passive ratio), defined contribution schemes depend primarily on the performance of the stock market (i.e. the rate of return on invested assets). Indeed, more importantly, the sustainability of both systems ultimately depends on the future productive capacity of the economy (Bell and Wray 2000 and Brown 2008). However, the crucial issue we are concerned with in this study is that while in PAYG the risk is assigned to the government, in private schemes it is individuals who bear the risk resulting from capital market investment. Since the returns of individual accounts are subject to fluctuations in capital markets, this increases income uncertainty for beneficiaries during retirement and exposes individuals to the risk of fluctuations in the economy in general and in the stock market in particular. For this reason, policymakers have recently devoted considerable attention to pension guarantees as a way to avoid this pitfall. Several countries have already implemented various sorts of guarantees for pension accumulation in defined contribution schemes.

In 2003, Turkey introduced the Individual Pension System (IPS), a privately managed defined contribution scheme, as a complement to the traditional PAYG system, which started to have severe imbalances in the early 1990s. Since then the new system

has grown substantially, from about 315,000 to about 1.8 million participants over five years. Since the IPS has a great potential to maintain this growth trend and make up a substantial part of the overall pension system in the near future, it is important to provide a framework for studying minimum pension guarantees. Therefore, in this study we attempt to analyze the cost of a minimum pension guarantee for the IPS in Turkey. Following LaChance and Mitchell (2003), we discuss various scenarios calculated using stochastic models for the Turkish data. This work is meant to stimulate discussion of a minimum pension guarantee for Turkey's IPS, following in the footsteps of Teksoz and Sayan (2002), which is the only study on this topic to the best of our knowledge. The differences of this work from that of Teksoz and Sayan are twofold. First, we used different stochastic processes to model bond and equity returns with updated data up to 2008. Second, our assumptions are compatible with the regularities of the IPS, which was introduced after Teksoz and Sayan's study. Therefore, our model and simulations present a current picture of the minimum guarantee issue in Turkey's private pension system.

The paper is organized as follows. Following this introduction, Section 2 provides a survey of the literature on minimum pension guarantees. In Section 3, we briefly discuss Turkey's social security reforms and introduce its IPS. Section 4 details the assumptions, stochastic processes used, and estimated parameters for the Turkish data, and presents the simulation results. Finally, Section 5 concludes.

2. Literature on Minimum Pension Guarantees

Around the world, there has been a substantial increase in the share of privately managed defined contribution schemes among overall pension systems.

In addition to the early example of full privatization in Chile, several countries have also privatized their social security systems. Argentina, Australia, Bolivia, Columbia, Costa Rica, Croatia, Dominican Republic, El Salvador, Hungary, Kazakhstan, Lithuania, Macedonia, Malaysia, Mexico, Nicaragua, Peru, Romania, the Seychelles, Singapore, the Slovak Republic, Ukraine, and Uruguay reformed their systems through a multi-pillar system to various extents. Poland, Latvia, Russia, Sweden, Kyrgyzstan, Mongolia, and Italy, on the other hand, adopted "notional defined contribution," a mixed system – between defined contribution and defined benefit – in which individual accounts are based on payroll taxes by employees and employers and run by the state.

The main shortcoming of defined contribution schemes is that they assign capital market risk to individuals, in contrast to the traditional PAYG systems, where the risk is assumed by the government (i.e. the entire society). Participants have control over their pension funds and may get the benefit of high stock market returns. But this picture has a downside as well. Dramatic fluctuations in the stock market and the timing of retirement impose a huge risk on individuals. That is, in the case of private pensions, the "simple" "risk-return tradeoff" may be "critical" for the mass of people if investment returns are not high enough, thereby leaving them with insufficient capital accumulation during their retirement years. This is the reason behind regulations requiring minimum pension guarantees[1]. Introduction of a guarantee plan may improve risk-sharing[2]. Put simply, the minimum guarantee is a promise by the government or pension fund management that

[1] Of course, as Nelson and Chan (2007) show, what is truly more crucial in pensions is the state of interest rates and the economy, rather than the issue of government guarantees.
[2] LaChance and Mitchell (2002) analyze the option to buy back a defined benefit promise as another way of dealing with the downside risk of defined contribution schemes.

during retirement, the annuitized benefit will be above a pre-specified minimum level[3]. Minimum pension guarantees may also make defined contribution (DC) plans more attractive for more traditionally risk-averse groups, such as women and low-income workers. However, although stipulating a minimum guarantee is an important tool for dealing with the pension system's shortcomings for low-income groups, the disadvantages for women of pension systems – whether public or private – need to be considered in a wider perspective (Stahlberg et al 2004).

There are two main ways to implement pension guarantees: a minimum rate of return, and minimum benefit guarantees. While a minimum rate of return plan entitles participants to receive payments at least equal to their lifetime contributions to the system plus some rate of return, minimum benefit guarantee plans provide a minimum annuity regardless of the actual investment performance of individual accounts (LaChance and Mitchell 2003, p.2). The former has two variations. In nominal principal guarantees, the plan guarantees a nominal rate of return of zero percent. In a real principal guarantee, on the other hand, the minimum rate of return is indexed to the inflation rate (ibid). The role of the minimum rate of return can be thought of as reducing inequality in capital market outcomes, much like social insurance does in labor market outcomes (Turner and Rajnes 2001).

Regardless of the provider, the cost of these guarantee plans is undoubtedly the most important issue[4]. It primarily depends on the type and generosity of the plan as well as the moral hazard issue. With the existence of pension guarantees, moral hazard may

[3] See Sin (2002) for a comprehensive discussion of minimum pension guarantees.
[4] In the context of the comparative advantages of pension fund guarantees, Cooper and Ross (2003) assert the superiority of public funds over private ones. Also see Ter-Minassian (2005) for a broader discussion of the problems and fiscal cost of guarantees.

occur since individuals (or firms) may have a tendency to choose riskier portfolios to invest in, and this will thereby raise the overall cost of the plans (Merton and Bodie 1992, Smetters 2002, Cooper and Ross 2003). Niehaus (1990) states that high-risk firms have the incentive to increase benefit levels. The author indicates that therefore, so long as the guarantee exceeds the benefit level, the value of the put option increases with the level of promised benefits. Also, in this case, moral hazard increases with the level of underfunding of the plan (taken from Jametti 2007).

Merton and Bodie (1992) discuss three ways to deal with the moral hazard issue: monitoring risks, pricing guarantees, and imposing restrictions on assets. Monitoring portfolios in order to prevent guarantees from being activated requires substantial power and may be highly costly. Pricing guarantees also have difficulties, as individuals' choice of portfolios and risk may be too diverse to cope with. In the case of restricting portfolios, there may be two variations. One is to provide guarantees only to a predetermined "standard investment portfolio." In the second, although individuals are free to invest in any portfolio, the guarantee is calculated according to a standard portfolio as a benchmark (LaChance and Mitchell 2002, p.4).

What follows just below is substantially based on Turner and Rajnes (2001) and Walliser (2002). The case of Chile is important, as it has been a model for several other countries. Chile provides a real principal guarantee based on a 36-month rolling average real rate of return for all pension funds. The guarantee level changes each month due to the rolling average. If the real return of a pension fund turns out to be lower than the minimum rate, the participant's pension account is credited with the minimum rate. This guarantee level is either 50 percent of the entire pension funds average or 2 percentage

points less than that average, whichever is lower. On the other hand, if the actual real return exceeds these ratios, that extra amount is collected in a reserve fund.

Also, with Chile's 1999 reforms, fund managers are obligated to have two distinct portfolios: a diversified one, and one with price-indexed fixed income securities. Both portfolios have their own minimum rate of return, as described above. This increases workers' portfolio choices. Workers are also given the option to switch to lower-risk portfolios when retirement gets nearer. Participants thereby do not have to hold higher-risk portfolios in order to be covered by guarantees. The Chilean government also restricts the level of equities and investments abroad in portfolios in order to reduce the moral hazard risk. However, this limited portfolio diversification has caused the government to simultaneously face poor economic performance and financial pressures generated by the guarantees (Walliser 2002, p. 10).

Chile has multi-pillar financial backing to maintain a minimum rate of guarantee. In the first stage, the fund manager is obligated to have a reserve fund. If there is a shortage in this reserve, a second separate reserve fund of fund management is used to back it up. If this fund is insufficient as well, then the fund manager uses fund assets to pay. Finally, if there is still a need, the government pays the minimum guarantee.

In Argentina the guarantee system is similar to the one in Chile in terms of the portfolio constraints. The crucial difference is that the guarantee is nominal and asymmetric in Argentina. The guarantee is activated "if a fund outperforms the average by 30 percent or falls short of the average by 70 percent." This asymmetry causes higher government participation in upside risks and lower exposure to downside risks compared to the Chilean model (ibid, p. 10).

In Colombia the minimum rate of guarantee is determined in a complex way, as follows: One-half of the guaranteed rate of return is set as 90 percent of the weighted average performance of pension industry performance, with the restriction that no fund can exceed 20% in weight. The other half of the rate is determined as the weighted average of 90% of the performance of the country's three stock exchanges and 95% of the returns for a reference portfolio based on the average portfolio of the pension industry. Also, financial backing for the guarantee system is the same as in Chile.

El Salvador has almost the same guarantee system as Chile.

Mexico's minimum rate of return varies with the amount paid into the system by the participants. Since Mexico is in the midst of a transition period from a defined benefit system to a defined contribution scheme, workers may be involved in two systems. In particular to this transition period, when individuals retire (at a minimum age of 65 or after 25 years of contributions), they may choose the higher return of the accumulations in either the defined benefit or defined contribution scheme. There are portfolio restrictions to reduce investment risks, much like in Chile and Argentina (Sinha and Renteria 2005).

Peru's guarantee system was very similar to the Chilean model until the 1996 pension law abolishing the minimum guarantee. The law requires the supervisory agency to provide a pension guarantee. However, what this means in practice is a mandatory investment reserve maintained by pension companies in order to protect against fraud and mismanagement.

In Uruguay, public management of pension funds guarantees a 2% annual real rate of return. Private pension companies, on the other hand, provide a guarantee of a 2%

real rate or average return of all pension portfolios minus 2 percentage points, whichever is lower. Here, private pension companies undertake the cost of maintaining the minimum guarantee.

Malaysia and Singapore guarantee a minimum rate of return of 2.5% a year, with the governments as guarantor.

In Hungary, the Private Fund Supervisory Board decides the minimum and maximum rates of return that may be credited to workers' accounts. That is, it is discretionary. Also, workers are provided with a minimum benefit from their pension account upon retirement. The minimum benefit guarantee in the mandatory DC scheme is equivalent to 25% of the defined benefit (DB) fund. There is a reserve fund for both the minimum rate of return and minimum benefit. There is some regulation of portfolio composition.

In Poland, the government guarantees a minimum benefit of about 30% of the average wage for both DB and DC funds. Additionally, for the DC scheme if the rate of return is below 50% of the past 24-month weighted average of all returns fund or 4 percentage points below the average return for all pension funds, any pension company must make extra payment into the workers' account to meet the minimum rate of return.

In Croatia, a minimum guaranteed rate of return is one-third of a reference amount determined by the supervisory agency, but has to be lower than the discount rate of the Croatian National Bank, if the return has been positive for the previous 12-month period.

Tables 1 and 2 summarize the plan designs and types of the guarantees provided by various countries.

Table 1: Guarantees in Voluntary Defined Contribution Schemes

Country	Plan Design	Noteworthy Features
Brazil	Open pension funds	Required real rate of return 6% per annum; portion of excess return paid into workers' account based on tenure; unavailable on new accounts
Denmark	Occupational plans	Insurance contracts provide guaranteed rate with maximum set by government and further restricted by EU; participants may receive excess yields above all allocation to reserve funds; maximum guaranteed rate declining with fall in market interest rates
Germany	Supplementary scheme	New system (2001) must guarantee nominal value of total principal contributed by retirement to receive favorable tax treatment
	Existing occupational plan	Guaranteed minimum rate of return available in some plans
Japan	New supplementary plans	New system (2001) mandates have three investment options, including guarantee of total principal contributed
New Zealand	National Provident Fund	Primarily for employees of local governments, now closed to entrants; fund credits member accounts with nominal return equal to 4% per annum financed through conservative asset allocation and use of reserve fund; government backs shortfall
Sweden	Supplementary plans	Specific to blue-collar workers as negotiated by their trade union and employers; minimum guarantee is one

		option with the return set historically in a range of 3-4% by the Financial Supervisory Board
United Kingdom	Investment options for DC plans	Investment banks and mutual funds (unit trusts) may offer funds that purchase put options to guarantee a certain return
United States	Church and nonprofit plans Public-sector retirement systems Some nonqualified private sector plans	Providing different sort of guarantees by linking returns from DB plans and DC plans, and backed by some reserve funds

Source: Adapted from Turner and Rajnes (2002) and Rajnes (2003)

Table 2: Guarantees in Mandatory Defined Contribution Systems

Country and type of guarantee	**Guaranteed level of investment**	**Guarantors[a]**
Countries with an absolute level of guarantee		
Australia	Means-tested flat benefit	G
Malaysia	2.5% nominal	G
Singapore	2.5% nominal	G
Switzerland	4.0% nominal	E, CG
Uruguay (state-owned)	2% real	G
Countries with a relative guarantee		
Argentina (private)	70% of the average nominal rate of return for all plans, or 2 percentage points below the average, whichever is lower	PF, OPF, G
Argentina (public)	In addition to the guarantee for private pension companies, a cumulative guarantee at retirement of a rate equal to the rate on savings accounts on government-owned bank	
Chile	50% of the average real rate of return for all plans, or 2 percentage points below, whichever is lower	PF, OPF, G
Colombia	Minimum based on a composite of the average performance of all pension funds and the performance of the country's three stock exchanges	PF, OPF, G

Croatia	Up to discount rate of the Central Bank	PF, OPF, G
El Salvador	Chilean-style framework begun in 1998 – regulatory details not available	PF, OPF, G
Hungary (abolished in 2009)	Minimum rate set each year, depending in part on expected market rates	PF, OPF, CG, G
Kazakhstan	Topping-up of low account balances	G
Peru	Until November 1996, 50% of the average nominal rate of return for all plans, or 2 percentage points below, whichever is lower; thereafter, no guarantee but statutory option exists for supervisory agency to establish one	NA
Poland	50% of the average nominal rate of return for all plans, or 4 percentage points below the average, whichever is lower	PF, OPF, CG, G
Uruguay (private)	The lower of 2% real and the average return of the system minus 200 basis points	PF, OPF, G
Countries with no guarantee[b]		
Bolivia, Latvia, Mexico[c], Peru, Sweden		

Source: Turner and Rajnes (2001) and Walliser (2002) with additions

a The guarantors are the institutions backing the guarantee. For each country, they are listed in the sequence that they are called upon to meet the guarantee. These may include one or more of the following: PF = pension fund; OPF = pension fund owners; CG = central guarantee fund; E = employer; G = government.

b Hong Kong, which is a province of China, operates a mandatory defined contribution system that does not provide a guarantee. That system took effect in 2000.

c Mexico does not have a guarantee as a permanent feature of its system. It does have a guarantee during the transition phase to the new system. The federal government promises the equivalent of one minimum wage to any worker who has contributed to the new system for 1,250 weeks for 24 years, even if not continuously.

NA = not applicable

3. Private Pensions in Turkey: The Individual Pension System

3.1 Social Security Reform in Turkey

The unsustainable deficit in social security since the early 1990s due to the low retirement age, expanding informal economy, low pension coverage, increasing

longevity, and inefficiency in the fund's administrative and political management served to spur comprehensive social security reforms (Sahin 2006, Elveren 2008a and Kar and Elveren 2008).

Turkey launched these reforms in 1999. The government implemented a two-pillar system in which current social security institutions (the first pillar) were kept with overhauls to their structures, along with private pension schemes which provide the support (the second pillar). The main goals of the 1999 reforms were to extend the average contribution period and shorten the benefit collection period by increasing the minimum entitlement age. The reforms were twofold. The first proposal was to set out the legal framework for voluntary private pension funds in the Individual Pension System, which aims to complement the public pension system that officially began in 2003. The second proposal in the reform package was to set up a series of administrative reforms to rein in the deficit of Turkey's three state social security funds: the Social Insurance Institution (SSK), the Retirement Fund (ES), and the Social Security Institution of Craftsmen, Tradesmen and other Self-Employed (Bag-Kur). With the 2006 reforms, these institutions were unified under the new umbrella Social Security Institution (see Table 5 in Appendix A). In addition to these institutions, there is the Green Card Program, which is financed by the Fund for the Encouragement of Social Cooperation and Solidarity, covers 13.5 million individuals, and was introduced in 1992. The objective of the program is to provide healthcare services to poor people who lack social security.

Under the new Social Security Law as introduced under the 2006 Social Security Reform, in order to ensure actuarial equilibrium in pension schemes, certain measures

were proposed to unite the three distinct social security institutions; to set the retirement age as 58 for women and 60 for men and increase it gradually to 65 for both after 2036; to gradually increase the contributory period from 7,000 to 9,000 days (100 days increase every year after the law came into force for SSK members) for full retirement, from 4,500 to 5,400 days for partial retirement, and from 1,800 to 3,600 days for disability benefits; to decrease the replacement rates to 2% in SSK and Bag-Kur, 2% for civil servants who start working after the law came into force; to take the average salary of employment duration instead of the average of the last few years' salary used for calculating pensions; and to increase the premium rates for civil servants about 5% by collecting health premiums (Sahin, 2008). Some important changes in favor of participants took place with the new regulations of August 2008. For instance, the entrance fee required of participants was reduced. Previously, its maximum amount was equal to the gross minimum wage, but was reduced to not exceed half of the minimum gross wage at the time of the proposal signed. Participants were provided a right to merge their individual accounts regardless of the pension company or the number of contracts. The monthly minimum contribution was made no lower then 5% of the gross minimum wage. (A summary comparison of the old and new systems is presented in Table 6 in Appendix A.)

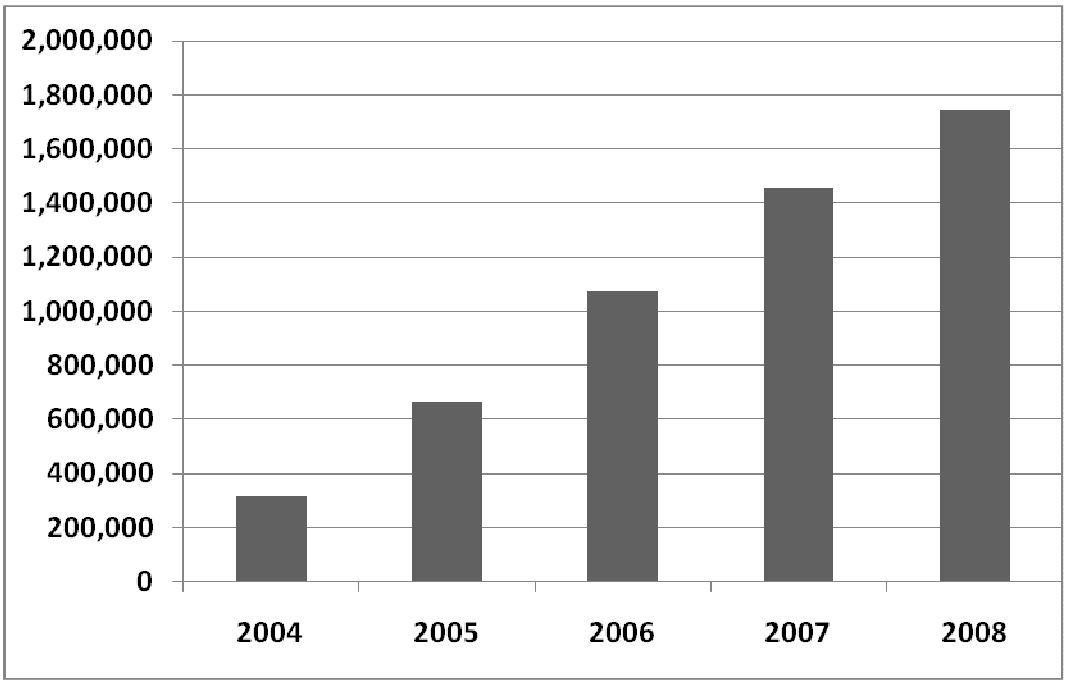
3.2. The Individual Pension System

The Individual Pension System (IPS), established in 2003, was a major component of the 1999 social security reforms.

The IPS was introduced as a complement to the public pension system on the basis of voluntary participation and the defined contribution principle to provide a supplementary income during retirement (Elveren 2003b, 2005). These individual savings to investment also aimed to contribute to economic development by creating long-term resources for the economy and thereby increase employment (Elveren 2003a). After passage of the law and other legislation to strengthen the base of the system, the Turkish Individual Pension System began on October 27, 2003 with the contribution of six pension companies. As of this writing, there are twelve pension companies operating in the system.

Since the IPS was introduced, there has been a steep increase in the number of participants in the system. Figure 1 shows the number of participants in the system for each year. We used the year-end data to illustrate the increase in the participation rate. While there were about 315,000 people in the system at the end of 2004, this number doubled by the end of 2005 to reach 666,000. The participation rate continued to rise, adding around 400,000 more people to the system every year since then.

Figure 1: Number of Participants in the IPS by Year



Source: The Pension Monitoring Center, www.egm.org.tr

3.2.1. Features of the IPS

The basic character of the IPS is that individuals can participate in the system on a voluntary basis and have an additional income over the pension provided by the social security system.

The main features of the IPS are as follows (Individual Pension System 2004 Progress Report 2005):

- Pension rights are specified based on the defined contribution system, i.e. on the total amount of the contributions and their returns.
- The savings are tracked in individual accounts and are safekept by a custodian (ISE Custodian and Settlement Bank of Turkey, or Takasbank) and approved by the Capital Markets Board (CMB).

- Pension mutual funds are managed by specialists from portfolio management companies established within the Capital Markets Law.
- Efficient monitoring and supervision infrastructure was established with the contribution of the Treasury Undersecretariat, the CMB, the PMC, Takasbank, independent audit firms, and internal audit departments.
- Participants have the chance at every stage of the system to make choices about their investments.
- Participants are provided with tax incentives at the stages of saving, investment and retirement.
- Participants are entitled to retire after reaching age 56 and making 10 years of contributions, and are subject to tax penalties if either requirement is not fulfilled.

Other requirements related to the system and pension companies can be summarized as follows: Pension companies may deduct up to 8% from the premiums as administrative costs. Additionally, the companies charge an entrance fee which cannot be more than half of the gross minimum wage. They can also charge a daily fund management fee, which cannot exceed 0.01% of the portfolio. A rule that the share of foreign stock cannot exceed 15% of the portfolio and that at least 30% of the portfolio must consist of public domestic debt bonds, i.e. Treasury bonds, was abolished in 2008 because it was de facto invalid. A typical participant chooses a portfolio where over 80% is invested in Treasury bonds. Participants cannot invest more than 15% of the funds in a portfolio that has more than 80% foreign assets. Similarly, participants are required to invest at least 30% of their

funds in a portfolio in which 80% consist of government bonds. The goal of these requirements is to prevent high fluctuations in returns and high amounts of investment in foreign assets (htpp://www.egm.org.tr, 2008).

3.2.2. Tax incentives

No tax incentives are granted to the pension schemes other than personal private pension arrangements.

The Individual Pension System provides participants with tax advantages in three different ways: Advantages that are secured when contributions are paid, advantages that are secured during the investment period, and advantages that are secured when a participant leaves the system (Individual Pension System Progress Report 2005, 2006).

Tax advantages when contributions are paid:

The contributions of the plan participants are deductible from the income tax base up to a limit of 10% of the gross monthly income. Moreover, the total deduction per year is not allowed to exceed the threshold of the annual minimum wage level. For group personal pension plans, the total of employee and employer contributions is subject to the same limits. Contributions made by employers on behalf of their employees are deductible from the corporate tax base as business expenses.

Tax advantages during the investment period:

Appreciations in the value of pension funds are non-taxable. However, the investment returns from single investment instruments in the pension fund are subject to withdrawal taxes.

Tax advantages when a participant leaves the system:

If a participant has been contributing to the system for less than 10 years at the time of withdrawal, the distributions are taxed at an income tax rate of 15 percent. If the participant has been contributing to the system for more than 10 years but is below age 56 at the time of withdrawal, 25% of the lump sum is tax free and the remaining will be subject to 5% withholding tax (Icoz, 2005).

4. Modeling Minimum Pension Guarantee

As discussed in previous sections, there has been a rapid transition from defined benefit PAYG plans to defined contribution plans all over the world. A similar conversion has been discussed for the Turkish public pension system (Ergokmen, 2006; Sahin, 2006). This study adds another dimension to previous discussions by introducing the minimum guarantee measure for the IPS in Turkey in addition to the early work of Teksoz and Sayan (2002)[5].

Teksoz and Sayan (2002) use an autoregressive stochastic model per A. D. Wilkie (1995) that incorporates data on the correlation of real returns as well as some randomization in order to show the cost of providing a minimum pension guarantee. They assume guaranteeing a minimum pension of 20% of the final salary of each worker in the system based on the assumption that the government would participate in the system as a contributor, paying a predetermined proportion of the employee's salary for each participant in the system. That is, the government adds to the contributions paid by members in order to provide a minimum replacement rate of 20% in case the scheme fails to generate. The authors state that this requires that the government set up a fund to

[5] This work only considers the minimum pension guarantee, not the rate of return guarantee which has been introduced by some insurance companies for their life insurance products.

accumulate the amounts used to top off the pension income of participants if their income is below 20% of the last salary prior to retirement (Teksoz and Sayan 2002, p 36). The authors find that investing in equities yields the lowest probability of receiving less than the guaranteed level of income (i.e. 24%), as well as 75% investing in bonds and 30% in a half equities/half bond strategy. Simulations show that the expected pension for those granted minimum pensions is equal to 11% of their final salary. And the cost of the government guaranteeing a minimum replacement rate of 20% will then be 1% of the salary of each member investing in equities as well as for 50/50 equity/bond mix strategies, and 3% for strategies of investing in bonds (ibid 38).

The minimum guarantee measure carries a substantial cost for sponsors (government or pension companies), and this cost varies, depending on the design of the system. This section aims to discuss the cost and probability of guaranteed payoffs under Turkey's IPS. Before discussing the simulation results below, it will be useful to introduce the assumptions (both economic and demographic), stochastic processes used, and the parameters obtained by using Turkish data.

4.1. Assumptions

We summarize guarantee costs for four representative workers each for men and women who participate in the IPS for respectively, T=10, 20, 30 years and whose regular contributions are C=50, 100, 150, 250 Turkish lira (TL). It is assumed that the individual accounts in the IPS start in 2009, and economic variables are projected accordingly.

All projections are expressed in real values. The fixed contribution amounts are taken from the Individual Pension System 2008 Progress Report (The Pension

Monitoring Center) as four main categories. We use the minimums of the contribution amounts presented as 50, 100, 150 and 250 Turkish lira in our analysis[6]. The annual increases in the contribution amounts are modeled in line with annual increases in average wages by assuming 1% promotional salary increases with real Gross National Product (GNP) growth. The guarantee amount (minimum wage) has been increased by a 6% constant inflation rate for the simulations. Moreover, as stated in the same progress report, 4% of the premiums have been deducted as administrative costs.

The mortality follows the 1980 US CSO gender-specific mortality table, a tool commonly used by Turkish insurance companies. Each participant is assumed to contribute to the system for at least 10 years and to retire at the early retirement age of 56. At this age, the value of a $1 annuity is denoted by the annuity factor $\ddot{a}_{56}$ and equals 13.76 and 15.46 for men and women, respectively, according to the mortality table[7].

4.2. Stochastic Processes

The risk-free rate and bond returns are modeled using the normal representation of the Vasicek model following LaChance and Mitchell (2003), the stock returns are modeled using the risk-free rate plus a mean value, and GNP is modeled as a stochastic process following Teksoz and Sayan (2002). We use real rates to estimate the parameters.

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[6] The IPS 2008 Progress Report presents the contribution amounts as five main intervals: 0-50, 50-100, 100-150, 150-250 and 250+ in Turkish lira. Since many insurance companies set TL 50 as a minimum for monthly regular contribution, we used the minimums of the last four categories in our calculations. Also, since the group of 250+ consists of just less then 5% of the whole, it is acceptable to ignore a few very high levels of payment.

[7] $\ddot{a}_X$ is the actuarial present value of a whole life annuity due $1 payable at the beginning of each year as long as the insured, who is currently age x, survives and is given by $\ddot{a}_x = \sum_{k=0}^{\infty} \frac{{}_k p_x}{(1+d)^k}$, where ${}_k p_x$ is the probability of an individual aged x surviving for k years, and d is the discount rate. The present value of the yearly retirement income is calculated using a constant discount rate of 4% per annum.

The data are collected from the Web sites of the Capital Markets Board of Turkey (SPK), the Istanbul Stock Exchange (IMKB), the State Planning Organization (DPT), and the Turkish Statistical Institute (TUIK). It should be emphasized that since Turkey went through periods of very high inflation after 1978, interest rates were affected by the economic instability in those periods and reached very high levels. Due to a lack of historical data, we had to use all the available data in our analysis without any adjustments, and this explains the high mean values or volatilities obtained from the stochastic models[8].

4.2.1. Risk-Free Rate

We modeled the risk-free rate by using a discrete time model, which is the normal representation of the Vasicek model. In Vasicek's model, the continuous risk-free rate, r_t at time t is defined as a mean reverting process:

$$dr_t = a(b - r_t)dt + \sigma dW_t^r \quad (1)$$

Where dW_t^r is a standardized Wenier process, a, b, σ are constants and the initial risk-free rate is given by $r_0 = r$ (Hull, 2006). The Vasicek model leads to the following normal representation of the risk-free rate

$$r_{t+1} = b + e^{-a}(r_t - b)\sigma e^{-a}\sqrt{\frac{1-e^{-2a}}{2a}}Z_t \quad (2)$$

where $Z_t \sim N(0,1)$. This equation can also be represented as a simple $AR(1)$ model:

[8] Since Turkey has had a relatively stable economy for the last 5 years, inflation and interest rates have fallen significantly. Considering the low, stable rates of the last few years, the mean and volatility estimates can be criticized as not representing Turkey's current economic situation. Although we use the parameter values obtained from the models, it is possible to use a different mean value (a lower mean value to better represent the current economic situation) and keep the volatility parameter as in the original model to take the high uncertainty in the market into account, as A. D. Wilkie (personal communication, April 2008) suggested.

$$r_t = \mu + \theta(r_{t-1} - \mu) + \rho Z_t \quad (3)$$

where

$\mu = b$

$\theta = e^{-a}$

$a = -ln\theta$

and

$$\rho^2 = \sigma^2 \frac{1 - e^{-2a}}{2a}$$

$$\sigma^2 = \rho^2 \frac{-2 \ln a}{1 - a^2}$$

Thus, we use the $AR(1)$ model and convert the estimated parameters to obtain a, b and σ.

For these estimates, we used nominal interest rates obtained from 3-month Turkish government bonds annual time series for the period 1986-2008. Since the Vasicek model uses the continues risk-free rate, we use the continuously compounded nominal rates (i.e. $\ln(1 + r_t)$) to estimate the parameters. Using continuously compounded rates is important because the Turkish data include very high interest rates for specific years, and this adjustment produces significantly different values.

The least square parameter estimates obtained are $a = 2.17, b = 0.14$ and $\sigma = 0.38$. The annual continuously compounded risk-free rates can then be simulated by generating a series of error terms Z_t and substituting them into equation (2).

4.2.2. Bond Returns

Ones modeling the risk-free rates using the Vasicek model, the entire term structure can be determined as a function of r_t. Thus, bond portfolio returns can be calculated by using the direct relation between the movements of the risk-free rate and bond returns. As in LaChance and Mitchell (2003), the bond portfolio is invested in 10-year Treasury zero coupon bonds, assumed to be rebalanced annually. Vasicek shows that equation (1) can be used to obtain the following expression for the price at time t of a zero-coupon bond that pays $1 at time T:

$$P(t,T) = A(t,T)e^{B(t,T)r_t} \tag{4}$$

In this equation,

$$B(t,T) = \frac{1-e^{-a(T-t)}}{a} \tag{5}$$

and

$$A(t,T) = exp\left[\frac{(B(t,T)-T+t)(a^2b-b^2/2)}{a^2} - \frac{\sigma^2 B(t,T)^2}{4a}\right] \tag{6}$$

Since it is assumed that the 10-year bond fund is rebalanced annually, its annual return B_t is given by the percentage increase in price after one year:

$$B_t = \frac{P(9,r_{t+1})}{P(10,r_t)} - 1 \tag{7}$$

where r_t and r_{t+1} are generated by equation (2).

4.2.3. Stock Returns

Letting S_t^I represents the stock index level at time t, continuous stock returns are modeled by the following geometric Brownian motion:

$$\frac{dS_t^I}{S_t^I} = r_t dt + \sigma dW_t^S \tag{8}$$

where dW_t^S is a standardized Weiner process which is assumed to be uncorrelated with the one in equation (1). Following the risk-neutral valuation technique, the drift of the return process in equation (8) is set equal to the risk-free rate. In addition, let S_t denotes the annual stock return in year t. Then S_t is distributed according to a lognormal distribution and can be represented by:

$$ln\ [\![(1 + S\_t\ ) = r\_t + \mu_S + \sigma_S Z\_t\ ]\!] \tag{9}$$

where $Z_t \sim N(0,1)$.

Equation (9) states that stock returns are determined by the risk-free nominal interest rate r_t and a risk premium or a mean rate μ_S. The real stock returns on Turkish equities have been calculated using the composite equity index of the Istanbul Stock Exchange National-100 over the 1986-2008 period. The least square estimators for the mean rate and volatility are respectively $\mu_S = -0.086$ and $\sigma_S = 0.58$. Using these parameter estimates, annual stock returns are simulated by generating a series of error terms Z_t and substituting them into equation (9).

4.2.4. Investment Returns

For the accumulation of contributions up to retirement, two types of assets were used in the simulations: equities and government bonds. We considered different investment portfolios for the individual account (IA) investments made between two

funds: a stock fund and a bond fund (of 10-year Treasuries). Following LaChance and Mitchell's (2003) notations, we denote by α the proportion invested by the participant in the stock fund. Further, S_t and B_t represent the total return at time t for stock and bond funds respectively. It follows that the portfolio investment rate of return in year t is given by:

$$R_t = \alpha S_t + (1 - \alpha) B_t \tag{10}$$

In the illustrative examples, the results are generated for three alternative portfolios with $\alpha = 0\%, \alpha = 50\% \; and \; \alpha = 100\%$.

4.2.5. Wages

Although we use regular monthly contributions presented by the Individual Pension Plan 2008 Progress Report for the calculations, we assume that increases in the contribution amounts are directly related to increases in the wages of the participants. Thus, we first model the wage increase and reflect it in the regular contributions.

Annual changes in the wage of an employee are assumed to be made through adjustments for price inflation and promotional raises and to account for productivity gains, as in Teksoz and Sayan (2002). Promotional wage increases during the working life of an individual are assumed to be 1% a year. The increases to account for productivity gains are captured through the growth in national productivity – assumed to be represented by the growth in GNP per employee, allowing a one-year time lag. This lag is introduced to mimic the role of the previous year's productivity increases on the wage bargaining process between employees and employers.

Based on these assumptions, real wage growth is projected through

$$w_t = g_{t-1} + p \tag{11}$$

where

g_{t-1}: the rate of change in real GNP in year t – 1

p: promotional salary increase (1%)

To randomize projected wages, stochastic changes in real GNP are modeled by letting $Z_t \sim N(0,1)$, and expressing g_t as

$$\ln(g_t + 1) = \mu_g + \sigma_g Z_t \tag{12}$$

where σ_g and μ_g represent the standard deviation and mean of this distribution, respectively.

Using historical data for the growth in GNP per head over the period 1951-2008, the estimators for the mean and standard deviation were obtained as μ_g = 0.047 and $\sigma_g = 0.043$.

4.2.6. Minimum Guarantee Amount

The minimum guarantee amount at time t, G_t, has been determined as the real minimum wage in Turkey, which for the first half of 2009 is equal to TL 527. The minimum wage has been increased by 6% per year in the projections[9].

[9] This rate has been chosen as an example taking into account real increases in the minimum wage. It is possible to use other rates, such as 8% and 10%, in the simulations.

4.2.7. Individual Account Payouts

Letting C represent the fixed contribution amount, then the TL contribution in year t, C_t is given by

$$C_t = C(1 + w_t)(1 - E) \tag{13}$$

where

C: the contribution amount, 50, 100, 150, 250 in TL

w_t: the rate of change in real wages in year t

E: administrative expenses (4%)

The value of the Individual Account at retirement, IA_T , is computed as:

$$IA_T = \sum_{t=0}^{T-1} C_t \prod_{j=t}^{T-1}(1 + R_j) \tag{14}$$

where $R_j$was defined above.

4.2.8. Guarantee Formulas

The guarantee payments can be specified based on the account's investment result. No guarantee is paid at retirement if

$$IA_T \geq G_T \tag{15}$$

If the value of the Individual Account is below the guaranteed minimum, then the guarantee payment must cover the difference

$$G_T - IA_T \tag{16}$$

$$f_T = max[0, G_T - IA_T] \tag{17}$$

where

f_T: the guarantee payoffs

4.2.9. Simulations

The results below are obtained by simulating the value of equation (17). Cost estimates and the probability of guarantee payoffs are obtained by using 10,000 Monte Carlo simulations. Tables 3 and 4 present the results.

Table 3: Cost Estimates: as a % of IA Amounts

		Investment Strategy								
		100 % Bond			50 % Bond 50 % Equity			100 % Equity		
	Contribution Period	10 years	20 years	30 years	10 years	20 years	30 years	10 years	20 years	30 years
Sex	Contribution Amount									
Male	50 TL	881.41	215.33	29.55	356.46	0	0	118.36	0	0
	100 TL	390.71	57.66	0	128.23	0	0	9.18	0	0
	150 TL	227.14	5.11	0	52.15	0	0	0	0	0
	250 TL	96.28	0	0	0	0	0	0	0	0
Female	50 TL	1002.66	254.28	45.56	412.85	0	0	145.34	0	0
	100 TL	451.33	77.14	0	156.42	0	0	22.67	0	0
	150 TL	267.55	18.09	0	70.95	0	0	0	0	0
	250 TL	120.53	0	0	2.57	0	0	0	0	0

Source: Authors' Calculation

We calculated the costs of the guarantees as the differences between the defined guarantee amount and the accumulations of the individual accounts as a percentage of the accumulations in the individual accounts. According to the simulations, the contribution period and the amount of the regular contribution have crucial effects on the cost of the guarantee. Table 3 shows that as the contribution period grows longer, the guarantee cost decreases. Investment strategy plays an important role in the cost of the guarantee as well. Since the returns for equities are higher than bonds, as the percentage of the assets invested in equities increases, the cost of the guarantees decreases. Furthermore, there is a significant difference between the costs of guarantees for men's and women's retirement incomes. Since the simulation results are the annual retirement incomes, due to women's longer life expectancy, the total amount is divided by a larger number for women and produces lower annual amounts in the individual accounts. This leads to higher costs for the proposed guarantee for women. We ignore the difference between the average earnings of men and women in this study and only consider the different life expectancies to compare the costs of the guarantees among them. However, if we took the difference between the average earnings of men and women indicated by the 2004 Household Budget Survey into account, we would see that there was even bigger gap between the costs of the guarantees due to different contribution rates[10].

[10] For detailed discussion of this issue for Turkey, see Sahin 2008, Elveren 2008b, and Kar and Elveren 2008.

Table 4: Probability of Guarantee Payoffs

		Investment Strategy								
		100 % Bond			50 % Bond 50 % Equity			100 % Equity		
	Contribution Period	10 years	20 years	30 years	10 years	20 years	30 years	10 years	20 years	30 years
Sex	Contribution Amount									
Male	50 TL	1	0.9978	0.7816	0.9722	0.7113	0.4519	0.9165	0.7357	0.6195
	100 TL	1	0.9047	0.2928	0.9117	0.5376	0.3026	0.8494	0.6321	0.5240
	150 TL	1	0.6376	0.0907	0.5215	0.4216	0.2146	0.7921	0.5643	0.4603
	250 TL	0.9920	0.1761	0.0064	0.7089	0.2755	0.1282	0.7025	0.4699	0.3799
Female	50 TL	1	0.9990	0.8413	0.9773	0.7367	0.4774	0.9244	0.7516	0.6340
	100 TL	1	0.9416	0.3732	0.9258	0.5687	0.3268	0.8620	0.6533	0.5414
	150 TL	1	0.7351	0.1343	0.8685	0.4561	0.2380	0.8108	0.5846	0.4795
	250 TL	0.9971	0.2665	0.0128	0.7451	0.3054	0.1459	0.7225	0.4931	0.4004

Source: Authors' Calculation

Table 4 presents the probability of guarantee payoffs for females and males and for different investment strategies, contribution periods and contribution amounts. Regardless of any other factors in the table, the probabilities of guarantee payoffs for females are higher than for males. This is again because of the differences in life expectancies. On the other hand, 10-year contributions invested in bonds is not enough to have a retirement income higher than the proposed guarantee amounts, except for the

highest contribution amount (TL 250). Therefore, for both sexes almost everyone will need some guarantee payoffs for 10-year contributions.

For short contribution periods, such as 10 years, as the percentage of assets invested in equities increases, the probability of guarantee payoffs decreases. For 20- and 30-year contributions, for both females and males, contributions invested in bonds produce higher probabilities, while probabilities decrease when contributions are invested in both bonds and equities. Higher equity returns may have an effect on decreasing probabilities in this mixed portfolio. However, probabilities increase when the contributions are invested only in equities. Therefore, the higher volatility in equity returns increases the probability of having retirement accumulations below the guarantee threshold. As the contribution period increases, the probabilities decrease.

It is possible to generate new scenarios by changing the assumptions for the contribution amounts, administrative expenses, or minimum guarantee amount. Although the numbers presented in Table 3 and Table 4 would change under different assumptions, we can still conclude that the guarantee cost would decrease as the contribution period lengthens, and there will be a gap between the retirement incomes of males and females due to differing life expectancies, unless we use a gender-neutral mortality table.

5. Conclusion

We examined the minimum pension guarantee for the Individual Pension System, a private pension scheme, in Turkey. Guaranteeing a minimum pension for participants in private pension schemes has emerged as a major tool to avoid the downside risk of fluctuations in the stock market. Several countries have adopted minimum pension

guarantees with varying implementations. Although a rate of return guarantee has been introduced by some insurance companies for their life insurance products, a minimum pension guarantee has not been considered by officials of Turkey's Individual Pension System. However, it is crucial to provide this guarantee, particularly in countries like Turkey which have fairly volatile stock markets and where such guarantees have a substantial potential to grow into a major component of the social security system. Therefore, we developed a model to analyze the cost of a possible minimum guarantee pension policy. To do so, we simulated scenarios using basic assumptions on starting wage increases to determine increases in the contribution amounts, the contribution period, administrative expenses, mortality, investment strategies, and the minimum guarantee amount. Our findings show that as the contribution period grows longer, the cost of the minimum guarantee and the probability of payoffs decrease. The higher return of equities reduces the cost of guarantees, as the percentage of assets invested in equities increases. However, the higher volatility of equity returns increases the probability of payoffs. Furthermore, there is a significant difference between the cost of such guarantees for men's and women's retirement incomes due to their differing life expectancies. These results provide more information on the issue of a minimum pension guarantee in Turkey in addition to the early findings of Teksoz and Sayan (2002).

As mentioned above, this study has some shortcomings caused by a lack of robust data, which prevented us from using more appropriate methods to yield more accurate results. Also, clearly the results of this kind of study depend greatly on the assumptions made. We also acknowledge that gender is an important dimension of social policy in general and private pension schemes in particular. We merely note this fact here, leaving

further discussion of the gender gap in pension benefits and minimum pension guarantees to future studies, as a tool to lessen it. Future research might consider hedging strategies of such a minimum pension guarantee for insurance companies or the government as the sponsor.

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Appendix

Table 5: The Structure of the Social Security System in Turkey before the reform

Social Insurance	Social Assistance
SSK , 1946 ES, 1950 Bag-Kur, 1971	The Social Assistance Supplement, 1977 The Old Age and Disability Assistance Scheme, 1977 The Social Services and Child Protection Agency, 1983 The Social Assistance and Solidarity Encouragement Fund, 1986 The Green Card Program, 1992

Table 6: Social Security Reform: Comparison of the Old and New Systems

Parameters	Old		New
	Before 1999	After 1999	After 2006
Minimum retirement age	38 (for women) 43 (for men)	58 (for women) 60 (for men)	Staged increase up to 65 after 2036 both for women and men
Institutions	3 main institutions (SSK, ES, Bag-Kur) based on occupation	No change	Unification of three main institutions
Contribution period (for full retirement)	5000 days for all three institutions	7000 days for SSK 9000 days for ES and Bag-Kur	Staged increase in SSK up to 9000 days by 2028
Replacement rates	different implementations of different institutions and years of services	2.6 % for SSK and Bag-Kur and 3.0 % for ES (on average)	2 %
Salary considered for the calculation of the retirement income	Last 5 years' average	No change	overall average

Source: taken from Sahin 2008