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Simulation of Benefits and Risks After the Planned Privatization of the Pension System in Turkey

Is the Expected Boost to Financial Markets Feasible?

Abstract: *The recently started process of social security reform in Turkey is widely argued to have a significant potential to affect the direction of further development of financial markets in the country in the years ahead, particularly through the planned introduction of privately managed defined-contribution (or money purchase) retirement plans. This paper aims to evaluate the prospects for the emergence and growth of a demand for these plans by analyzing investment risks and associated benefits facing employees purchasing them and to assess the effectiveness of various risk-reduction strategies that might be pursued by individuals as well as the government. Within this framework, a money purchase pension plan, supplementary to the basic state scheme, is considered. Possible variations in a member's pension income, arising due to stochastic increases in salary earnings and investment returns under alternative portfolios, are captured using an actuarial simulation model designed for this purpose. The cost to the government of providing guarantees on minimum pension incomes and the effects of changes in individuals' investment strategies, retirement ages, and career patterns on the retirement benefits obtained are investigated, and the results are related to various aspects of social security reform–financial market interaction in Turkey.*

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Key words: *actuarial simulation models, defined-contribution (money purchase) pension schemes, financial markets, social security reform, Turkey.*

Many observers argue that the direction of further development of Turkish financial markets in the years ahead depends largely on the outcome of the recently started reform process for rehabilitating the financially troubled social security system in the country. At the center of attention are two major channels through which the reform will affect financial markets. The first is the expected reduction in deficits of social security institutions that, by the end of the last decade, had become the major contributor to the borrowing requirements of the government, diverting savings away from financial markets. The second channel is the currently planned introduction of privately managed defined-contribution (also called "money purchase") retirement plans—which are often argued to have the potential to boost the long-term savings and the volume of financial transactions in Turkey. Despite widespread talk about potential contributions of the reform process for the further development and deepening of financial markets, and to the liberalization process of the Turkish economy in general, a comprehensive and rigorous analysis on the feasibility or the likely magnitude of the expected boost is yet to appear in the literature.[1] This paper aims to contribute to the process of informed discussion on various aspects of social security reform–financial market interaction in light of the planned introduction of money purchase schemes in Turkey.

Turkey's publicly managed, pay-as-you-go (PAYG) system began to generate large deficits after 1990. The rapidly growing contribution of the social security system to public sector imbalances made the need for reform increasingly visible, eventually proving to be unsustainable by the end of the 1990s (Sayan and Kiraci 2001a, 2001b; Topal 1999). Since the primary reasons underlying the deficits were the generosity of benefits relative to contributions and unreasonably early retirement ages, the government responded by introducing a bill for parametric reform involving changes in the values of critical policy parameters such as the statutory entitlement (minimum retirement) ages and contribution/replacement rates. Other important changes brought about by the bill included a switch from nominal to real wages in the calculation of pension benefits, and the introduction of unemployment insurance (Akmaz 2000; Sayan 2001). Although the bill legislated in September 1999 could be viewed as an imperative step to curb the growth in social security deficits in the short run and is likely to reduce the deficit in the medium run, its long-run impact has yet to be seen (IMF 2000).[2] Since complete elimination of social security deficits was expected to require additional measures,[3] however, the legislation of 1999 was intended to be just the first stage of a larger reform to overhaul the system. A particularly important step toward the completion of the reform process is the planned introduction of money purchase pension schemes to be managed by the private sector (IMF 2000). The legal and regulatory

framework has already been drawn up through a bill currently awaiting ratification of the Turkish parliament. As stated in the Letter of Intent of December 1999 submitted to the IMF by the Turkish government,[4] the bill aims to intensify social security reform and diversify the sources of long-term savings by creating the legal infrastructure for the establishment and development of privately managed pension funds.

Pension companies to be established within this framework will offer pension income to active workers who contribute a predetermined portion of their earned salaries. Under these plans, the contribution receipts will be accumulated and invested in each member's account and the retirement income will depend on the level of contributions and investment returns. Operation of such a defined-contribution–based pension scheme requires involvement of such financial institutions as insurance companies, unit trusts, and banks. Since the contributions collected need to be invested in various financial assets, the system has the potential to significantly boost the volume of financial transactions in Turkey, facilitate deepening of financial markets in the country, and contribute to the privatization process.

As suggested in the social security reform literature, these are in fact the potential benefits of introducing money purchase pension schemes offered by the private sector for liberalization and development of financial markets. Such schemes are also likely to have a positive impact on macroeconomic balances since they facilitate the management of public deficits by reducing the publicly managed social security systems' risks of default and help increase long-term savings—making them even more desirable (World Bank 1994). Yet, even if the bill awaiting ratification is enacted, creation of the legal framework to allow working individuals to purchase such retirement plans is only a first step toward collecting these benefits since the existence of such a framework does not by itself guarantee that the anticipated outcomes will follow. For the system to actually take off and start operating in the direction foreseen by the bill, investors should be convinced that the demand for retirement plans to be offered would be large enough to make private pension business profitable. Even though the high population share of people of working age at this stage of demographic transition in Turkey provides reason for optimism,[5] the emergence and actual growth of this demand will essentially depend on the working individuals' evaluation of (1) the affordability of contributions required to generate the desired flow of pension payments, and (2) the likelihood of obtaining comparable real returns to other financial instruments with matching risk structures.

If the contributions that the employers are currently required to make toward accumulation of severance payment funds for each employee are directed to money purchase schemes, every employee presently covered by a pension scheme will be able to purchase the retirement plans we consider without any additional cost. The introduction of a comprehensive unemployment insurance scheme through the pension reform act of 1999 already reduced the role of the severance payment program to provide a lump-sum retirement compensation. So, the funds needed

for money purchase schemes could be released by the dissolution of the severance payments program, which has long been the subject of controversy and abuse. Under the circumstances, affordability of the plans to be offered would not be an issue, even in the highly unlikely case of unwillingness by the employees to make additional contributions.

The likelihood of obtaining comparable real returns to other financial instruments with matching risk structures, on the other hand, requires further investigation. In fact, one of the important characteristics of money purchase pension plans is the lack of risk-sharing mechanisms, implying that members have to face all risks arising from the uncertainty about real income levels after retirement (Knox 1993). Furthermore, the bill to be legislated in Turkey allows contributing individuals to have greater flexibility in choosing the asset composition of portfolios to be formed than in many other countries with similar schemes—see OECD (2000) for a comparison of regulations governing pension fund investments. So, in the absence of government subsidies to the scheme or other guarantees on minimum pension levels or minimum rates of return on the fund, unfavorable investment returns or low salary levels might lead to insufficient levels of income after retirement. Then, what seems to be a good solution from the government's point of view may be disastrous for individuals who bear all the risks. This implies that evaluating the feasibility of a transition to these schemes, whether complete or complementary, requires a detailed analysis of the risks involved.

The purpose of this paper is to analyze these risks and associated benefits under defined-contribution retirement plans (money purchase pension schemes) to be introduced in Turkey, and to assess the effectiveness of various risk-reduction strategies that might be pursued by individuals as well as the government. For this purpose, we consider a money purchase pension scheme supplementary to the basic state scheme and investigate the potential level of benefits from alternative portfolios that might be selected under a contribution rate of 8 percent using an actuarial simulation model allowing for stochastic investment returns and salary increases. After justifying our choice of 8 percent as the contribution rate in reference to the dissolution of the severance payments program that we propose in the paper, we investigate and discuss the cost to the government of providing guarantees on minimum pension incomes. We also consider effects of changes in individuals' investment strategies, retirement ages, and career patterns on the retirement benefits obtained.

Pension Provisions and Money Purchase Plans

Other than the assets owned by the individual, there are basically two sources of income available to cover working individuals against the loss of wage/salary income after retirement. The first is often compulsory and universal coverage of social security typically designed to provide basic retirement income on a PAYG basis. PAYG schemes finance pension benefits of current retirees out of contributions that

currently active workers are required to make out of their salaries and are considered unfunded schemes. The second is complementary (compulsory or voluntary) pension plans that are designed to generate additional retirement income and are generally financed on a funded basis. Under these plans, contributions from members and their employers are invested and accumulated in a fund and the stream of returns accruing to this fund is used to finance pensions paid to those members.

There are two types of funded pension schemes distinguished by the distribution of risk and return between the members and the sponsor (generally the employer) (Davis 1995).[6] Under a defined-contribution (or money purchase) plan, the fund is usually based on regular contributions fixed as a proportion of salary, accumulated and invested in each member's account. Since the retirement income is generally provided by purchasing an annuity with the accumulated assets in the individual's account, the amount to be collected depends solely on the level of contributions and investment returns. The investment of the fund could be carried out by various financial institutions, such as insurance companies, unit trusts, and banks. The retirement income can normally be obtained from whole-life annuities offered by life insurance companies. A defined-benefit plan, on the other hand, provides a retirement income calculated according to a predetermined formula, typically taking into account the duration of service and the individual's average salary over a certain period of time. The employer (or sponsor) guarantees the promised pension by pledging to supplement the fund whenever necessary. Unlike such defined-benefit plans in which the employer assumes the investment risk, there is no risk sharing under defined-contribution schemes that put the employer under any obligation other than a fixed contribution. Depending upon the market returns, the pension income actually received by the employee might be higher or lower than what they would have received under a defined-benefit plan. So, all investment risk stemming from the variability of investment return on accumulated contributions is borne by the member/employee. Even though they do not allow for risk sharing, money purchase schemes offer maximum flexibility and facilitate mobility of the employee across jobs. When the employee switches to another job, the accumulated amount can be moved from one scheme to another, or left as is.

Furthermore, since there is a direct relationship between investment returns and retirement benefits in money purchase schemes, there is no additional cost to the provider of deficit financing. This increases their popularity in pension reform proposals, which are usually introduced to avoid deficit-financing needs created by existing social security operations. In fact, the global experience of a slowdown in economic growth in the last decade made these deficits generated by PAYG-based systems even more visible. With additional consideration given to the prospects, in light of aging populations, that these deficits will further grow in the years ahead, the pressure to switch away from existing social security systems has increased. The favorable rates of return on assets relative to the growth rates of wages during the 1990s have also added to the popularity of funded schemes against

PAYG schemes, and many countries have moved toward funded schemes (Schwarz and Demirguc-Kunt 1999).[7] Others, like Turkey, are in the process of setting up the legal and institutional framework to allow workers to have access to defined-contribution pension plans. However, the transition from a PAYG to a funded scheme can be difficult, as the current generation is forced to pay twice to settle the existing debt of the old system. Besides this intergenerational fairness aspect and differing economic implications of each system, the transition requires external finance, generally from the government budget, and that is difficult to provide in a country already suffering from deficits created by the PAYG system.[8]

Since money purchase schemes involve an investment risk for employees due to the uncertainty about the level of retirement income, there may be a demand for guarantees to cover employees against this uncertainty. These guarantees might be in the form of guaranteed minimum pensions or guaranteed rates of return on the fund. In any case, provision of such guarantees is costly and generally requires government backing (Daykin 1995). Despite their costs, these guarantees serve as safeguards to protect the employees against significant losses of income upon retirement and need to be provided before any complete or partial transition to a funded system operating on a defined-contribution basis. This issue is particularly important in countries whose emerging markets are characterized by high average returns and volatility and low correlations with other markets as in Turkey (Akdeniz et al. 2000). In such countries, the level of investment risk might exceed acceptable limits, depending upon the development level of financial markets and the human capital stock of the country. By comparison, an unfunded PAYG scheme, in which a pensioner's income mainly depends on the level of current contributions, is considered to be less risky in this respect and less costly to administer.

Institutionally, money purchase pension schemes can be offered by two different types of financial institutions. The first is a mutual fund, in which contributions are accumulated and invested on behalf of members, such as AFP (Administradoas de Fondos de Pensiones) in Chile. Maximizing the return on the fund, subject to an acceptable level of risk and expenses, is the main concern of such funds. Since the pension payable to the employee depends entirely upon the market value of the member's fund at retirement, a suitable investment policy may involve gradually decreasing the allocation to risky assets (such as equities) as retirement approaches. The second is life insurance companies that provide a monthly pension to the employee in return for their accumulated capital at retirement. These pensions are often in the form of annuities indexed to inflation. Therefore, assets that offer guaranteed real returns with minimum risk are required for those institutions to meet their liabilities.

Modeling of the Proposed Money Purchase Plan

In light of uncertainty concerning the level of retirement income, evaluating the feasibility of a transition to these schemes first requires a detailed analysis of the

risks involved from the member's point of view. The actuarial model introduced in this section is designed to investigate the possible variation in the retirement income of a member of the proposed money purchase plan and to evaluate the cost of government subsidies toward guaranteed minimum pensions. Four different investment strategies were considered to be available to the workers purchasing the plan described below, and 1,000 simulations were run under each strategy by allowing for stochastic changes in relevant returns to contributions collected and in the salary levels of members. The robustness of results to changes in scheme assumptions were tested through sensitivity exercises. Simulation results reported in the next section point to the directions to reform the Turkish social security system.

The money purchase pension scheme we consider is designed to supplement the basic old-age security scheme provided by the state, which is assumed to cover benefits on death, early retirement, sickness, and so on. The state is further assumed to be capable of guaranteeing a minimum pension of 20 percent of final salary for workers who join the scheme by contributing a fixed proportion of their total annual salary. The amount of accumulated contributions up to retirement is used to purchase a whole-life indexed annuity (pension) at retirement. The contributions and the investment income of the proposed plan are assumed to be tax-free. Throughout this section we use real currency units adjusted for price inflation. Under these assumptions, the accumulation of contributions can be represented as

$$A_W = CR \cdot (1-E) \cdot \left\{ SAL_W + \sum_{t=1}^{W-1} \left[\prod_{u=t+1}^{W} (1+R_t) \right] SAL_t \right\}, \tag{1}$$

where A_W is the total accumulated fund after W years of plan coverage before retirement, CR is the contribution rate as a percentage of yearly salary, E is administrative expenses as a fraction of the contributions paid in year t, SAL_t is the real annual salary paid at the of year t, and R_t is the real rate of investment return earned in year t.

When the accumulated capital at the end of the contribution period, A_W, is invested in a whole-life index-linked annuity, the present value of the yearly retirement income that the member will collect by the end of his life is calculated using a constant discount rate of 3 percent per annum. Mathematically, the annual amount of indexed pension, P, at retirement is defined as

$$P = A_W / \ddot{a}_x, \tag{2}$$

where $\ddot{a}_x$ is the actuarial present value of a whole-life annuity due of TL 1, payable at the beginning of each year, as long as the insured, who is currently at age x, survives, and is given by

$$\ddot{a}_x = \sum_{k=0}^{\infty} \frac{{}_k p_x}{(1+d)^k}, \tag{3}$$

where ${}_kp_x$ is the probability of an individual aged x to survive for k years, and d is the discount rate (Bowers et al. 1986).

In the simulations, ILO (1995) mortality assumptions for Turkey for the year 2020 were used. In particular, with the retirement age, x, taken to be 55, the corresponding actuarial present value term was found to be $\ddot{a}_{55} = 15.026$ (for male, and at $d = 3$ percent).[9]

The assumed contribution rate for the simulations is taken to be 8 percent of each salary. This choice of the contribution rate is not arbitrary. Instead, it is a rate that can easily be introduced without raising concerns about its affordability through a meager modification of current regulations. Roughly corresponding to one month's salary/wages for each year of service, the assumed rate is equivalent to the severance payment that employers are legally required to make to every employee who retires or gets fired for reasons that they cannot be blamed for. Introduced for the first time in 1936, to act both as a deterrent, holding back employers from arbitrarily firing employees, and as an unemployment compensation or lump-sum retirement benefit, the severance payment has long been subject to controversy and abuse.[10]

Furthermore, given that the pension reform act of 1999 introduced a comprehensive scheme for unemployment insurance, one of the major rationales behind severance payments became obsolete. Then, if severance payments are eliminated and the funds that the employers will save are channeled instead to contributions toward employees' membership in money purchase schemes, the role of severance payments as a lump-sum retirement benefit will also be replaced without additional costs on employers or employees. In fact, this will also give employees a chance to take advantage of higher returns on privately managed pension funds. Such a move is expected to create additional benefits since labor market distortions caused by severance payments will now be avoided and the funds collected by pension funds will contribute to the deepening of financial markets. In other words, modifying the current regulations so as to require that employers pay 8 percent of the salary for each employee as contributions for money purchase retirement plans to complement the basic state scheme rather than toward severance payments will lead to a Pareto improvement. This is why the assumed contribution rate for simulations is taken to be 8 percent.[11]

Other scheme design assumptions used in simulations are as follows:

- Entry age: 20;
- Retirement age: 55;
- Life type: single male;
- Career pattern: fully employed before retirement;
- Probability of preretirement mortality: zero;
- Postretirement mortality: ILO (1995) assumptions for Turkish mortality in the year 2020;
- Administrative expenses: 15 percent of the yearly contributions, zero after retirement.

In adjusting nominal values for consumer price inflation, the *Cost of Living Index for Wage Earners* series, regularly published by the Istanbul Chamber of Commerce (ICC), was used, enabling all model results to represent the purchasing power of an employee in today's money.

Annual changes in the salary of an employee are assumed to be made through adjustments for inflation and promotional raises and to account for productivity gains. The use of real currency units in our simulations eliminates the need to consider adjustments due to price inflation separately. Promotional salary increases during the working life of an individual are assumed to be 1 percent per annum. The increases to account for productivity gains are captured through the growth in national productivity—assumed to be represented by the growth in gross national product (GNP) per employee, allowing a one-year time lag. This one-year lag is introduced to mimic the role of the previous year's productivity increases on the wage bargaining process between employees and employer. As for employment growth, the annual increases in national employment are assumed to be constant, for each year over the projection horizon, at 2 percent, which is the average annual growth rate of employment between 1989 and 1998. Based on these assumptions, real salary growth is projected through

$$S_t = g_{t-1} + p, \tag{4}$$

where S_t is the rate of change in real salary in year t, g_{t-1} is the rate of real change in real GNP per employee in year $t - 1$, and p is the promotional salary increase (assumed to be constant at 1 percent for each year in the projection horizon).

To randomize projected salaries, stochastic changes in real GNP are modeled by letting Z_t represent an independently and identically distributed unit normal random variable and expressing g_t as

$$g_t = \exp\{\sigma Z_t + \mu\} - 1, \tag{5}$$

where σ and μ represent the standard deviation and mean of this distribution, respectively. Using historical data between 1924 and 1998, the estimators for the mean and standard deviation were obtained as $\mu = 0.045$ and $\sigma = 0.075$.

For the accumulation of contributions up to retirement, two types of assets were used in the simulations: equities and government bonds. The real investment return on Turkish equities, r_t, was calculated using the composite equity index and average dividend yield of the Istanbul Stock Exchange (ISE) over the 1986–1998 period. Estimators for the mean and standard deviation of the force of real equity returns, $\ln(1 + r_t)$, were found to be 0.079 for the mean and 0.772 for the standard deviation, reflecting the volatile nature of equity returns in Turkey (see, for example, Akdeniz et al. 2000). As argued by Khorasanee (1995), the estimator for the standard deviation obtained from the historical data is too high for modeling equity returns as a log-normal, identically distributed, independent random variable, as in the case of GNP growth. In search of an alternative, we considered the

Table 1

Correlation of the Forces of Real Equity Returns

k	1	2	3
Correlation	–0.6601	0.0843	–0.0685

correlation coefficients of the force of real equity returns with its lagged values obtained from the same historical series. Table 1 reports the correlation of $\ln(1 + r_t)$ and $\ln(1+ r_{t-k})$ for $k = \{1,2,3\}$.

The negative correlation for $k = 1$ and the alteration of signs for $k = 2$ and $k = 3$ suggest that a stationary first-order autoregressive stochastic model for the force of real equity returns as described by Wilkie (1995) is suitable here. Following Wilkie (1995), therefore, the force of equity returns is modeled as

$$\ln(1+r_t) = \mu + \rho\left[\ln(1+r_{t-1}) - \mu\right] + \sigma\left(1-\rho^2\right)^{1/2} Z_t, \tag{6a}$$

where r_t is the equity return for year t, μ is the mean value of $\ln(1+r_t)$, σ is the standard deviation of $\ln(1+r_t)$, ρ is the correlation coefficient of $\ln(1+r_t)$ and $\ln(1+r_{t-1})$, and the Z_t is normally distributed unit random variable.

Equation (6a) states that the value of force of return for year t depends upon its previous value and a random error term, Z_t, as well as μ, σ, and ρ. Using the values reported above, the equation becomes

$$\ln(1+r_t) = 0.079 - 0.660\left[\ln(1+r_{t-1}) - 0.079\right] + 0.580\ \mathrm{N}(0,1). \tag{6b}$$

As for the real returns on Turkish government bonds, i_t, the relevant rates were obtained from the one-year term domestic borrowing interest rates series. Estimators for the mean, standard deviation, and correlation coefficients of the force of real bond returns, $\ln(1 + i_t)$, with its lagged values were obtained using data for the 1984–1998 period. The mean and standard deviation were found to equal 0.027 and 0.075, respectively; the coefficients of correlation between $\ln(1 + i_t)$ and $\ln(1 + i_{t-k})$ for $k = \{1,2,3\}$ are as reported in Table 2.

The positive correlation for $k = 1$ and the rapid decline of the correlation for $k = 2$ and 3 verify that a stationary, autoregressive stochastic model, as used to model equity returns, is suitable here as well (Wilkie 1995). Given the reported values of estimators of μ, σ, and ρ, the force of real Turkish government bond returns can be expressed as

$$\ln(1+i_t) = 0.027 + 0.465\left[\ln(1+i_{t-1}) - 0.027\right] + 0.067\ \mathrm{N}(0,1). \tag{7}$$

Table 2

Correlation of the Forces of Real Bond Returns

k	1	2	3
Correlation	0.465	0.161	–0.104

Simulation Results

In this section, we present the results from simulation experiments conducted using the stochastic model described above to generate 1,000 salary–return pairs and to calculate resulting pension incomes under each of the four different investment strategies we consider. The discussion is then carried out in reference to the statistical properties (such as the mean, standard deviation, and the values corresponding to fifth to ninety-fifth percentiles) of this large sample of pension incomes obtained by converting accumulated contributions into annuities at the time of retirement.

We start the discussion of simulation results on the level of retirement income (pension benefits) by comparing different investment strategies to assess the magnitude of the risk facing members and the cost of government subsidies to provide guaranteed minimum pensions. The discussion then continues with the results of sensitivity exercises conducted to test the robustness of results to changes in the ages of entry into the system and retirement and the career pattern, as well as with respect to the gender of the member.

Results Under Different Investment Strategies Considered

The possible variation of retirement income as a percentage of final salary is simulated for four different investment strategies, using the main scheme design assumptions described in the third section. The following investment strategies were considered.

Strategy A represents the option of investing the fund in Turkish equities throughout the employee's period of service (thirty-five years).

Strategy B represents the option of investing the fund in Turkish government bonds throughout the employee's thirty-five years of service.

Strategy C represents the option of investing the fund in equities during the first fifteen years and then switching to government bonds for the remaining twenty years.

Strategy D represents a balanced investment strategy with 50 percent of the fund invested in equities and the other 50 percent invested in government bonds for the whole period of service.

Table 3

Pension Income as a Percentage of Final Salary Prior to Retirement

	Strategy A 100% equities	Strategy B 100% bonds	Strategy C 15 years equities then bonds	Strategy D 50% equities 50% bonds
Mean	2.30	0.17	0.27	1.08
Standard deviation	15.60	0.09	0.33	3.23
Fifth percentile	0.06	0.07	0.08	0.10
First quartile	0.21	0.11	0.12	0.18
Second quartile	0.49	0.14	0.19	0.32
Third quartile	1.28	0.20	0.31	0.78
Ninety-fifth percentile	7.65	0.34	0.69	3.67

Possible levels of retirement income were obtained from simulations run under each investment strategy. Table 3 reports retirement incomes expressed as a proportion of final salary (that is, in the form of replacement rates) by strategies and specific percentiles of the resulting distribution of 1,000 observations.

The results in Table 3 indicate that Strategy A, which is presumed to be the riskiest strategy, provides the most generous retirement income relative to other strategies at all percentiles, except for the fifth percentile. The pension income is expected to equal 49 percent of the final salary with a probability of 50 percent (see Table 3, second quartile row). While yielding such high replacement rates—and hence, retirement incomes—Strategy A also generates considerable variation in the retirement income received by individuals, varying between 6 percent and 765 percent (7.65 times) of the final salary at the fifth and ninety-fifth percentiles.

The variability of the retirement income, which is one of the important risks of the money purchase scheme, can be reduced by investing in less volatile assets. Investing in government bonds—as in Strategy B, for example—is observed to clearly reduce the variability of income level. However, the median level of retirement income is also reduced from 49 percent to 14 percent of the last earned salary. It is worth noting that the ninety-fifth percentile of the low risk Strategy B represents a lower income than the fiftieth percentile (second quartile) of the high risk Strategy A.

The balanced investment Strategy D reduces the variability relative to Strategy A, mainly by decreasing the likelihood of receiving a higher income. Yet, this strategy also significantly reduces the possibility of receiving a lower income: Compare 6 percent to 10 percent—minimum replacement rates that might result under Strategies A and D—respectively. Although Strategy D represents a higher retirement income than Strategy A under the worst circumstances (at the fifth

Table 4

Probability That Strategy *Y* Provides Higher Income Than Strategy *Z*

	Z			
Prob(*Y*>*Z*)	Strategy A	Strategy B	Strategy C	Strategy D
Y				
Strategy A	—	0.82	0.74	0.57
Strategy B	0.18	—	0.37	0.20
Strategy C	0.26	0.63	—	0.31
Strategy D	0.43	0.80	0.69	—

percentile), it generates a lower income as compared to Strategy A for all other percentiles.

Investing in equities in the early years of the career, then switching to low-risk assets, as represented by Strategy C, also reduces the variability at the expense of a significantly reduced median retirement income.

The probability that a particular investment strategy provides a higher retirement income than an alternative strategy is given in Table 4 for each strategy.

As observed in Table 4, investing purely in equities, as in Strategy A, provides a higher retirement income than the alternative Strategies B, C, and D, with probabilities of 82 percent, 74 percent, and 57 percent, respectively. However, investing in low-risk assets, as in Strategy B, provides a higher income than Strategies A, C, and D, with probabilities of only 18 percent, 37 percent, and 20 percent, respectively. All mixed investment strategies (C and D) have better probabilities than Strategy B, as investment in equities improves the performance of mixed strategies.

Tactical Switching to Low-Risk Assets Before Retirement

The retirement income risk of an individual increases as the size of the fund grows toward retirement. This is an important risk for the individual since unfavorable investment returns just before retirement may reduce the size of the fund markedly and with no further chance of recovery. The commonly suggested approach to overcome this problem is switching to low-risk assets when retirement approaches (Davis 1995). The timing of such switching varies with the level of the accumulated fund and the state of the financial market at the time of switching.

To analyze the effect of such a tactical switching to low-risk assets here, the investment strategies we consider were modified by allowing the fund to be invested in risk-free index-linked government bonds with a 3 percent real return a year just when the return on high-risk assets hit its peak within the five years preceding retirement.[12] Another round of simulations was carried out to compare

the replacement ratios obtained after switching to index-linked bonds within five years of retirement, without changing any other characteristics of Strategies A through D. The results obtained after 1,000 runs under the tactical switching scenario are shown in Tables 5 and 6.

By comparing replacement ratios in Tables 3 and 5, one can assess the degree of risk protection obtained by switching. For Strategies A and D, the results show that switching to index-linked bonds during the last five years before retirement visibly reduces the risk of lower income and increases the possibility of receiving higher income. On the other hand, for Strategies B and C, the tactical switching does not considerably improve the risk of low income, nor does it affect chances of higher income to a significant extent. These results imply, in general, that switching to low-risk assets to reduce the negative effects of volatility of equity returns seems appropriate for Turkish financial markets. The results in Tables 4 and 6 generally agree with this view as well.

The Cost of Government Subsidies Toward Guaranteed Retirement Incomes

Another alternative to reduce investment risk in money purchase pension schemes was noted to be a provision of a guaranteed level of income for each member of the scheme. For the proposed scheme, it was assumed that the government would guarantee a replacement ratio of 20 percent for each member of the scheme.

The cost of this guarantee was calculated as a proportion of the employee's salary based on the assumption that the government would participate in the scheme as a contributor and pay a predetermined proportion of the employee's salary for each member of the scheme. In other words, the government is now required to add to the contributions paid by members at the rate of 8 percent of their salaries, in case the scheme itself fails to generate a minimum replacement rate of 20 percent. The implementation of this policy requires that the government set up a fund to accumulate the amounts set aside to supplement contributions made by each member of the scheme and the applicable returns on them. The accumulated fund will then be used to top off the pension income of the member if this income turns out to be less than 20 percent of the last salary of the member prior to retirement. To simplify calculations, the real return on the amounts set aside as the government's contribution will be equal to the real growth of salaries for each year spent in the scheme. Then the cost of government subsidy, C_G^Y, for a worker choosing strategy $Y = \{A,B,C,D\}$, can mathematically be expressed as

$$C_G^Y = \left\{ \left[0.20 - E\left(RR^Y \,\middle|\, RR^Y < 0.20 \right) \right] * \text{Prob}\left(RR^Y < 0.20 \right) * \ddot{a}_{55} \right\} / n_S, \qquad (8)$$

where RR^Y is the replacement that can be obtained under strategy Y, Prob($RR^Y <$ 0.20) is the probability that a replacement rate less than 20 percent might result

Table 5

Pension Income as a Percentage of Final Salary Prior to Retirement: Modified Strategies Involving a Switch to Index-Linked Bonds Within the Last Five Years

	Strategy A 100% equities	Strategy B 100% bonds	Strategy C 15 years equities then bonds	Strategy D 50% equities 50% bonds
Mean	2.91	0.17	0.25	1.50
Standard deviation	13.51	0.08	0.23	5.84
Fifth percentile	0.10	0.08	0.08	0.12
First quartile	0.28	0.11	0.13	0.22
Second quartile	0.65	0.15	0.18	0.43
Third quartile	1.72	0.21	0.29	1.03
Ninety-fifth percentile	9.59	0.35	0.67	4.67

Table 6

Probability That Modified Strategy *Y* Provides Higher Income Than Strategy *Z*

	Z			
Prob(*Y*>*Z*)	Strategy A	Strategy B	Strategy C	Strategy D
Y				
Strategy A	—	0.87	0.81	0.58
Strategy B	0.13	—	0.39	0.15
Strategy C	0.19	0.61	—	0.23
Strategy D	0.42	0.85	0.77	—

from investment strategy Y, $E(RR^Y | RR^Y < 0.20)$ is the expected value of RR^Y when $RR^Y < 0.20$, and n_S is the number of years in service.

Table 7 presents the results obtained under the government subsidy scenario for each investment strategy. The probabilities that a smaller than 20 percent replacement rate might result from each investment strategy are shown in the first row of Table 7. It is observed that investing in equities, as in Strategy A, yields the lowest probability of receiving less than the guaranteed level of income—that is, 24 percent. The expected pension of those below 20 percent will be equal to 11 percent of final salary (row 2 in Table 7). The cost to the government of guarantee-

Table 7

The Cost of Government Guarantee as a Percentage Point Addition to the Contribution Rates Paid by Members

	Strategy A 100% equities	Strategy B 100% bonds	Strategy C 15 years equities then bonds	Strategy D 50% equities 50% bonds
Prob($RR^{\gamma} < 0.2$)	0.24	0.75	0.54	0.30
E($RR^{\gamma} \mid RR^{\gamma} < 0.2$)	0.11	0.12	0.12	0.13
Cost of guarantee, C_G	0.01	0.03	0.02	0.01

Note: The numbers in the last row show the rate of government's contribution as a proportion of the employee's salary for each member of the scheme.

minimum replacement rate of 20 percent will then be 1 percent of the salary of each member choosing Strategy A, and the government will have to pay the additional one point needed to increase the contribution rate to 9 percent. Whereas the balanced investment Strategy D requires the same level of cost of guarantee as Strategy A, the required subsidies under Strategies B and C will be equal to 3 percent and 2 percent of the salary of each member, respectively. Given these results, the rate of government contribution multiplied by the service period and final salary will represent the total amount of subsidy for each member of the proposed scheme.

Sensitivity Analysis

Various sensitivity exercises were conducted to test the robustness of results to changes in the ages of entry into the system and retirement and the career pattern, as well as with respect to the gender of the member. Strategy D (50 percent equity–50 percent bond) was taken as the baseline case and for each sensitivity exercise, 1,000 simulation runs were repeated by deviating from the main scheme design assumptions for Strategy D as follows:

Sensitivity Exercise 1: change career pattern to alternating between full-time employment and part-time employment for every two years in a row;

Sensitivity Exercise 2: change the assumed gender to female to have $\ddot{a}_{55} = 16.779$ (for female, and at $d = 3$ percent)—instead of $\ddot{a}_{55} = 15.026$ (for male, and at $d = 3$ percent), as reported in ILO (1995);

Sensitivity Exercise 3: change scheme entry and retirement ages to 25 and 60, respectively ($\ddot{a}_{60} = 12.923$ male, ILO mortality assumption for 2020, at $d = 3$ percent).

The simulated values of possible retirement incomes as a proportion of final salary are shown in Table 8. The results in Table 8 reveal that

Table 8

Pension Income as a Percentage of Final Salary Prior to Retirement

	Baseline male, 55 full-time	Sensitivity 1 male, 55 part-time	Sensitivity 2 female, 55 full-time	Sensitivity 3 male, entry: 25 retirement: 60
Mean	1.08	0.47	1.03	1.17
Standard deviation	3.23	1.29	2.65	2.84
Fifth percentile	0.10	0.04	0.08	0.11
First quartile	0.18	0.09	0.16	0.20
Second quartile	0.32	0.17	0.30	0.38
Third quartile	0.78	0.37	0.73	0.89
Ninety-fifth percentile	3.67	1.63	4.39	4.60

- the retirement income for females provided by the scheme is lower than that provided for males at the same retirement age;
- part-time or seasonal employees receive a lower income than the full-time employees at all percentiles, proportionately with their shorter contribution period; and
- later retirement provides a higher income even when the contribution period stays the same.

It must be noted that although the results are somewhat sensitive to changes in basic scheme design assumptions underlying the baseline simulations with Strategy D, the differences are not sufficiently large enough to raise serious concerns about the usefulness of previous discussion, nor the conclusions presented in the next section.

Conclusions

The currently planned introduction of privately managed defined-contribution (or money purchase) retirement plans within the framework of the recent social security reform process in Turkey has widely been argued to have a significant potential to affect the direction of further development of financial markets in the coming years. Although the likely benefits of the emergence of a market for money purchase pension schemes for the development and deepening of financial markets are generally agreed upon, there has been a severe lack of discussion on the question of whether there really is a potential for such a market to develop in Turkey. This paper aimed to help fill this gap by laying the ground for an evaluation of the prospects for the emergence and growth of demand for money purchase retirement plans. For this purpose, the paper presented results from an actuarial simulation model developed to analyze employees' investment risks and associated

under these retirement plans and assessed the potential of various risk-reduction strategies that might be pursued by individuals as well as the government.

More specifically, we considered a money purchase pension scheme, supplementary to the basic state scheme, and investigated the potential level of pension benefits from alternative portfolios that might be selected under a given contribution rate of 8 percent, by allowing for stochastic investment returns and salary increases. We proposed that the contributions for money purchase schemes could be financed by the dissolution of the severance payments program, whose role had already been reduced to provision of a lump-sum retirement compensation by the unemployment insurance scheme introduced through the pension reform act of 1999. Indeed, if the contributions that the employers are currently required to make toward accumulation of severance payment funds at the rate of 8 percent of the salary of each employee are directed to money purchase schemes, all employees will be able to purchase the retirement plans we consider without incurring additional costs.

Possible variations in the pension income of a member were then captured by simulation results from a model we designed for this purpose and implemented using investment and salary earnings data from Turkey. The growth in salary earnings was assumed to be related to the GNP growth rate per employee, which is modeled as an independently and identically distributed log-normal random variable. The forces of return on Turkish equities and government bonds, on the other hand, were modeled as stationary first-order autoregressive stochastic processes as described by Wilkie (1995). The model was also used to investigate the cost to the government of providing guarantees on minimum pension incomes, and sensitivity exercises were carried out to see effects of changes in individuals' investment strategies, retirement ages, and career patterns on the retirement benefits obtained.

Our results indicated that equities might have significant advantages over government bonds, as investing in equities alone (Strategy A) provides the highest median income with a reasonable downside risk compared to other strategies. In return for an 8 percent contribution rate invested in equities for thirty-five years, the proposed scheme might produce a pension income of about 50 percent of the final preretirement salary of the employee, with a probability of 50 percent. The downside risk, which is likely to occur with a 5 percent probability, is reasonable relative to other strategies, particularly B and C: The "worst case" level of pension income to be obtained corresponds to 6 percent of the final salary, and this is somewhat, but not radically, lower than 7 percent and 8 percent of the final salary to be received under the worst cases of Strategies B and C, respectively. If the individual chooses to switch to low-risk assets during the last five years before retirement, on the other hand, Strategy A remains the strategy that is likely to produce the highest median income, whereas the improvement in downside risk associated with this strategy enables the individual to receive a higher pension income than they would have under Strategies B and C (10 percent versus 8 percent of the final salary). Furthermore, Strategy A (along with Strategy D) proves to

be the strategy with the lowest cost to the government in case it chooses to step in to provide guaranteed minimum replacement rates of 20 percent to all members: Minimum pension guarantees under Strategies A and D require government participation to member contributions at the rate of only one percentage point, whereas member contributions under Strategies B and C, respectively, require three points and two points of supplements by the government for the same minimum level of guaranteed pension incomes. To summarize, the employees who are willing to maintain a significant share of equities in their portfolios may collect windfall profits after the introduction of money purchase schemes, provided that the trends of returns to financial assets and GNP growth over the past decade continue. Given the large variation in asset returns, however, it might be wise for employees to demand government guarantees.

Broadly speaking, these results point to a significant role to be played by equity markets in Turkey in attracting workers to money purchase schemes. So, it appears likely that a sizable number of employees will be willing to contribute either to top the 8 percent in employer contributions, which might be redirected away from severance payments, or just to participate on their own. So, the legislation of the current bill is likely to act as a first step in promoting the emergence and growth of a sizable market for defined-contribution retirement plans to be offered by the private sector.

Such a development, if it actually happens, will have significant consequences for Turkey. First, it will give the government a chance to readjust the contribution and replacement rates for the current state scheme in such a way as to reduce pension deficits beyond what would result from the reform of 1999 without undermining the living standards of workers and retirees. It appears feasible, for example, to reduce replacement rates for the basic scheme and introduce lower cost subsidies toward minimum pension guarantees from money purchase schemes, and yet, not to make the retirees worse off. In fact, it seems possible to achieve considerable savings in pension deficits of publicly managed schemes whereas allowing (even assuring) the combined pensions from state and private schemes to exceed current levels, thereby making retirees better off. Furthermore, the employee and employer shares, as well as the levels of contribution rates for the basic scheme, can be adjusted both to increase current disposable incomes of active workers and to provide employers an incentive for prompt payment of contributions[13] without letting pension deficits soar. Second, although it is difficult to provide an estimate as to its magnitude, the volume of transactions in the financial markets is certain to increase significantly, especially if the severance payment program is dissolved and current contributions are channeled into money purchase schemes instead.

The implications of the new system are likely to go beyond the volume of transactions in the financial markets or macroeconomic balances of the country. Perhaps most important, the pension system to be set up will enable the employees to share in capital income. In the foreseeable future, returns to capital are likely to grow faster than returns to labor in most parts of the world, just as they did in the

recent past, and this is even more likely to happen in a fast-growing country like Turkey. Giving employees a chance to get their share of this growth in capital income will definitely help improve income distribution in Turkey, thereby contributing to increased welfare and stability in the country.

Given these far-reaching consequences, the issues addressed in this paper deserve further investigation and extensive discussion. Although a comprehensive list of future lines of research that are needed the most is beyond the scope of this paper, our suggestions (and plans) for future research include the following. First, the analysis in this paper leaves the question on the magnitude of additional funds flowing into financial markets unanswered. As a result, we were forced to assume implicitly that the past trends of the real returns on equities and bonds would be maintained even after the establishment of the funded pension system. This assumption (that was employed for the lack of a better alternative at the moment) is perhaps the major weakness of the present analysis, as the emergence of money purchase schemes is likely to alter prices of assets and their returns sometime after the initial takeoff. Depending upon their magnitude relative to current levels of investment, the inflow of additional funds may even cause instability in asset prices or stock price inflation. Any study attempting to predict likely changes in returns by, for example, appealing to the experience of other countries with a history of money purchase pension schemes would be a very welcome addition to the literature. Once results from such studies become available, investigations similar to the one in this paper would be enabled to produce more reliable results. Second, testing the robustness of results presented here by repeating the simulations with alternative stochastic returns series generated using different techniques—preferably those with well-documented performance records with Turkish data (see, for example, Metin and Muradoglu 2000) would be a good idea. Likewise, repeating them by incorporating information about the returns on foreign assets, which will presumably be available for inclusion in the retirement plan portfolios, might improve the relevance of results. Last, but not least, relevance of the analysis for policy discussion may be increased by estimating the total cost of subsidies that the government will need to provide under the guaranteed minimum pension income scenario by taking into account the estimated number and distribution across portfolio types of employees who would be willing to become members of retirement plans to be offered. The financing of these government subsidies is another issue that must be considered by policymakers, preferably by taking into account possibilities of adjustments in the pension program parameters of the current PAYG system, which will be easier to make in the presence of money purchase schemes that provide another pillar.

Notes

1. Excluding such limited-distribution papers as Teksoz et al. (1998) and Sayan and Teksoz (2001).

2. See Sayan and Kenc (1999) for an overlapping generations, general equilibrium investigation of the long-run effects of parametric pension reform in Turkey.

3. The results in Sayan and Turhan-Sayan (2000) provide evidence that the parametric reform of 1999 is not likely to eliminate the pension deficit, which makes up the largest part of social security imbalances.

4. The letter describes the policies that the Turkish government plans to implement to secure the Fund's support in the context of the ongoing stabilization (disinflation) and structural adjustment program.

5. See Kenc and Sayan (2001) for past and projected changes in the age composition of the Turkish population and a comparative analysis of demographic transition in Turkey and the European Union.

6. We do not consider individualized pension plans managed by life insurance companies without the involvement of the employer here as the number of people covered by such plans is negligible.

7. The list of countries that have switched from PAYG to funded schemes includes Argentina, Australia, Bolivia, Colombia, Hungary, Kazakhstan, Mexico, Peru, Poland, Sweden, and Uruguay.

8. When contributions to the PAYG system are collected through payroll taxes, they distort labor supply decisions and resource allocation, and might affect the competitiveness of the country in international markets. PAYG schemes may also discourage capital formation by reducing the incentives to save, whereas funded systems tend to increase savings and the demand for long-term assets like equities and bonds, thereby stimulating economic growth. See Kenc and Perraudin (1997) for a dynamic programming simulation of distortionary effects of various pension rules and regulations on labor supply and Huang et al. (1997) for an overlapping generations, general equilibrium analysis of the issues involved in a transition from PAYG to funded schemes. Sayan and Kiraci (2001b) and Sayan (2001) point out that transitional aspects are important, even in the context of parametric reform introduced to rehabilitate a PAYG system and discuss some of the implications of introducing pension reform by gradually changing system parameters over a transitional period, as opposed to changing them once and for all.

9. $\ddot{a}_{55} = 15.026$ implies that an individual who would like to collect TL 1 a year as pension income after the age of 55 until death must have accumulated TL 15.026 in contributions net of administrative costs during his working life.

10. It was claimed, for example, that severance payments put an additional burden on employers who are forced to downsize because of financial difficulties and insufficient demand during times of recession. On the other hand, many employers have chosen to fire employees right before they become eligible for severance payment and, hence, continuously avoided making severance payments by replacing them with newly hired workers.

11. The policy switch proposed here does not rule out the possibility of adding two to three points to the contribution rate for those employees who are willing to make the extra payment, and the simulation framework we develop is flexible enough to easily accommodate such an increase in the contribution rate.

12. In fact, it is very difficult, if not impossible, for an individual to know with certainty that a particular rate of return observed at a point in time within a five-year period is the highest that can occur until their retirement. So, the assumption about the timing of the switch to indexed bonds (implying perfect foresight on the part of the employee/member of the scheme) may seem unrealistic. Yet, this is perhaps the only workable assumption here.

13. It is shown in Sayan (1999) that it will be possible to come up with many alternative configurations of contribution rates, lowering the burden on the employee, the employer, or both, should the compliance issue be resolved and evasion of contribution payments be stopped or reduced.

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