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Analyzing the cost of minimum guarantee in mandatory capitalized pension system: a Nigerian example

Abstract

Countries that adopted the Chilean model in the reform of their pension system also had embedded in their new scheme a minimum pension guarantee to augment the final entitlement of contributors who might not have accumulated enough savings to fund an annuity which meets the minimum pension. However, in some cases, like that of Nigeria, this guarantee is only expressed in paper. The sponsor, usually the government, often does not make any provision for this minimum pension subsidy and is, therefore, generally oblivious of the implied cost. By developing various actuarial models, this study shows that the guarantee cost can be significant and can militate against the attainment of the objective of pension reform. It recommends that the fees charged by the various operators be revisited and that special attention be given to career-long low income earners.

Keywords: pension reform, minimum pension guarantee, cost, government subsidy, actuarial models.

Introduction

Following the example of Chile many countries have moved from the defined benefit pay-as-you-go system into the defined contribution scheme. Nigeria migrated in June 2004. The advantages of the new pension system, especially in a developing country environment, which include job portability and a much more flexible retirement decision-making scenario, are well known (Bodie and Crane, 1999; Altmann, 2001). Along with the advantages, however, come new risk and new responsibility. With respect to risk, Davis (2004) cautioned that there is an ever present risk of a future crisis of low future retirement incomes arising partly from the design features and partly from the average lower contributions for defined contribution funds, both by employer and employee. For a graphic illustration of the risk involved see Cannon and Tonks (2009). The individual responsibility is emphasized by Garcia (2006) and Bodie and Crane (1999). It is argued that a shift to defined contribution not merely imposes a shift in savings responsibility from the employer to the employee but also implies an increase in the expected length of an individual's retirement planning horizon.

Nigeria's Pension Reform Act 2004 acknowledges the future risk by recognizing that the final contribution of a participant may not suffice for a comfortable life in retirement. It, therefore, stipulates that all retirement savings account holders who have contributed for a number of years to a licensed Pension Fund Administrator (PFA) shall be entitled to a guaranteed minimum pension as may be specified from time to time by the National Pension Commission (PenCom). If PenCom had not specified a minimum guarantee, then the group of low income employees and another group consisting of employees who started contribution late in their career would have been exposed to the risk of insufficient income at retirement. A careful look at the instrument establishing the Nigerian scheme, however, reveals that the Act only provides an informal guarantee.

There is the general tendency to assume that somehow this guarantee aspect of the new pension system would not constitute a problem. On the contrary, Walliser (2002) cautioned that although guarantees may rarely require outlays, they neither come free nor cheap and the guarantor faces the costs of the guarantees up front. Ajay (2000) made a similar observation in respect of the India pension system. The experience of Chile portrays a lesson for others who may want to incorporate guarantee in their reform. It is known that in spite of the requirements already built into it, the Chilean system still faces great challenges. For instance, it is feared that the government's guarantee provides a potentially strong disincentive to voluntary saving (Schmidt-Hebbel, 1999). Orifowomo (2006) and Kritzer (2008) also drew attention to the fact that many contributors to the Chilean scheme have not been able to satisfy the requirement to qualify for minimum guarantee. Even more worrisome is a 2006 forecast which suggests that in 20 years the minimum pension benefits will be out of reach for close to half of Chile's retirees (Barrientos, 1996). These concerns are pointers to the enormity of the fiscal implication of the provision of guaranteed minimum pension and its attendant administrative costs.

Without the sponsor specifying explicitly the level of the minimum guarantee it may be difficult to determine the appropriate funding requirement and for all the affected parties to have a clear understanding of these costs (Turner, 2001). Sin (2002) also warned that providing guarantee without proper costing is risky business. Another related problem is that then no provision would be made for financing the minimum pension as the Nigerian case has shown. That may foretell a gloomy picture for participants. Schmidt-Hebbel (1999) suggested better targeting and means testing of the guarantee or gradually reducing the value of the government guaranteed minimum pension. This will be in order where the guarantee is well spelt out. In the fuzzy environment of the Nigerian defined contribution scheme this will not be possible. This study, therefore, attempts, first, to give mathematical expressions to the conditions for a contributor to benefit from the guarantee feature and then based on the stipulated conditions, to determine contributors who would satisfy the conditions. An actuarial framework for determining the expected cost to government of the guarantee feature is also developed. This, hopefully, will enable the government to appreciate its potential liabilities and the need to make prior provisions for the guarantee if the scheme is to succeed.

The remainder of the paper is organized as follows. Section 1 presents an overview of previous works while section 2 develops the models. Expected cost of the minimum guarantee is examined in section 3. Numerical illustration is provided in section 4 while results are discussed in section 5. The final section concludes.

1. Overview of previous work

Imprecise definition of the minimum guarantee is not peculiar to Nigeria and is probably pervasive in developing areas. In India, Gillingham and Kanda (2001) reported that the Old Age Social and Income Security (OASIS) Project proposed that fund managers should guarantee their participants a rate of return on the safe investment option no lower than two percentage points below the average return on the safe portfolios each offers. The authors view this as somewhat evasive since it is not clear what this guarantee adds.

In other places where the guarantee is well specified, the World Bank has shown that the guarantees are mainly of two types: some countries offer absolute guarantees while some others offer relative guarantees (World Bank Primer, 2011). Countries in the first group include Malaysia, Mexico, Singapore and Switzerland while notable members of the second group are Chile, Colombia and Poland. Irrespective of the option adopted, however, the World Bank report expressed concern that there is grave danger in offering guarantees as, besides the tendency for fund managers to be conservative in their investment attitude, the costs of the guarantees are not transparent. Walliser (1992) reviewed the design of guaranteed minimum pension in the UK, Latin America and Transition Economies and concluded that for the guarantees to be effective and credible they must be affordable as too much guarantees expose retirees to political risk.

Cannon and Tonks (2009) used historical data to simulate pension fund and pension replacement ratios by which they illustrated the risk in the pension replacement ratio of an individual in a typical defined contribution scheme. Giacinto, Federico and Gozzi (2009) proposed a stochastic dynamic programming allocation approach to investigate what happens when the fund wealth in a defined contribution pension system reaches the allowed minimum value represented by the solvency level. Wenbin (2007) applied the equivalent utility principle to price the commission related to the guarantees. Other utility theory-based applications include that of Muermann et al. (2005) which assessed how regret can influence a defined contribution (DC) pension plan participants' view of rate-of-return guarantees and Deelstra et al. (2004) who modelled the optimal guarantee that maximizes the expected utility function of the benefit. Grande and Visco (2010) argued that government is best placed to offer guarantees because of the long time horizon of the public sector. Their model for computing the put option of a defined contribution scheme was based on risk-neutral valuation in which they assumed that share prices have jumps superimposed on a geometric Brownian motion. Zarita (1994) and Pennacchi (1999) allowed for a stochastic rate of return on pension fund assets so that an employee's accumulated pension savings at retirement are random. In the latter model, however, the rate of contribution, the rate of return on the assets and the real rate of interest all follow a stochastic process. Many of the models in the literature utilized Monte Carlo simulation with continuously compounded rates for the accumulation phase of the defined contribution scheme (Pennacchi, 1999; Chlon-Dominczak et al., 2010; Sahin and Elveren, 2009). Given the odds of a contributor meeting the targeted maturity values in the harsh economic environment that typifies developing economies, our model differs significantly from these earlier models as it is directed at the decumulation or pay-out phase and attempts to specifically determine the cost to government of augmenting pension contributions in order to assist employees to meet the minimum guarantees.

2. Development of the models

We prescribe that the minimum pension guarantee (MPG) adopts the national minimum wage as a benchmark. Thus, the MPG is defined as a proportion k $(0 \leq k \leq 1)$ of the national minimum wage obtainable at the time of retirement. Also a minimum number of years of contribution is prescribed and denoted by "*a*". We also denote by Q the minimum wage in-force at the entry of the contributor into the scheme and s_1, as the long-term average annual rate of increase in the minimum wage. In countries where national minimum wages are reviewed annually based on inflation and other economic indicators, a long-term future rate could be projected using past rates. However, in many developing countries like Nigeria, where reviews are not done annually, it is possible for the same minimum wage to operate over a period of many years. An average rate based on the computed annual rates between inter-review dates would, in this circumstance, serve as a good basis for forecasting the applicable rate.

2.1. Parameter specification. In a defined contribution pension system, expressions for accumulated fund F_n, the annual pension purchased at retirement age r by the fund, $T(r, n)$ and $M(r, n)$, the annual pension purchased at age 'r' by the accumulated fund F_n expressed as a proportion of final wage at age r are derivable using the following notations: P is the wage of the contributor at entry into the program; r is the retirement age; i is the long term effective rate of return per annum on the invested contributions; s is the rate of wage increase per annum; n is the number of years of contributions to retirement; F_n is the accumulated fund in year n net of all administrative charges; g is the contribution rate into the fund as a proportion of the annual wage $0 \le g \le 1$; $T(r, n)$ is annual pension purchased at retirement age r by the fund F_n; c is the annual flat administration charge per contributor; σ is the annual administration charge per annum as a proportion of contribution $0 \le \sigma \le 1$; m is the administration charge per annum as a proportion of fund; $0 \le m \le 1$; E_r is the single premium rate at age r charged by insurers per N1,000 annuity per annum; $M(r, n)$ is an annual pension purchased at age 'r' by the accumulated fund F_n expressed as a proportion of final wage at age r.

$$i^{(12)} = 12\left[(1+i)^{1/12} - 1\right],$$

$$a\frac{(12)}{1} = \frac{1-\left(1+i^{(12)}\right)^{-1}}{i^{(12)}},$$

$$w = \frac{(1+i)}{(1+s)}(1-m) - 1,$$

$$\lambda = (1-m)(1+i) - 1,$$

$$\ddot{S}\frac{w}{n|} = \left((1+w)^n - 1\right)\left(\frac{1+w}{w}\right),$$

$$\ddot{S}\frac{\lambda}{n|} = \left((1+\lambda)^n - 1\right)\left(\frac{1+\lambda}{\lambda}\right).$$

As enunciated in Ibiwoye and Adesona (2010), the following expressions were then obtained:

$$F_n = (1-\sigma)gPa\frac{(12)}{1|}(1+s)^n \ddot{S}_n^w - C\,a\frac{(12)}{1|}\ddot{S}\frac{\lambda}{n},$$

$$T(r,n) = \frac{1000 F_n}{E_r},$$

$$M(r,n) = \frac{T(r,n)}{P(1+s)^{n-1}}.$$

Based on the foregoing, we have the following:

The projected minimum wage at retirement is

$$Q(1+s_1)^{n-1}.$$

A contributor who retires at age 'r' after having contributed for 'n' years will then qualify for MPG if the following conditions are satisfied:

$$n \ge a, \tag{1}$$

$$T(r,n) = P.M(r,n)(1+s)^{n-1} \le kQ(1+s_1)^{n-1}, \tag{2}$$

$$\text{i.e. } \frac{P}{Q} < Q(r,n), \text{ where } Q(r,n) = \frac{K(1+s_1)^{n-1}}{M(r,n)(1+s)^{n-1}}. \tag{3}$$

Condition (1) requires that the participant must have contributed for a minimum of 'a' years. Condition (3) stipulates that in addition to condition (1) a participant will qualify at retirement age 'r' only if his wage at entry into the scheme is less than $\theta(r, n)$ times the amount of minimum wage in force at that time. In that case, government's pension subsidy at age r (GPS) will be:

$$GPS = kQ(1+s_1)^{n-1} - T(r,n) = kQ(1+s_1)^{n-1} - PM(r,n)(1+s_1)^{n-1} \ge 0 \tag{4}$$

The aggregate cost to government depends on the distribution of the contributions within wage categories and the number of years of contribution, n. The more the number of contributors who earn wages close to the minimum wage, the more the aggregate cost to government. Also the greater the number of participants who contribute for more than the required minimum number of years, the more costly will be the aggregate cost to government and vice versa.

3. Expected cost of minimum pension guarantee (MPG)

To develop an expression for the expected cost of the Guarantee Pension Subsidy (GPS), we introduce the Multiple Decrement Table, otherwise called "Service Table" (ST). This table encompasses deaths and retirements among the population of contributors as decrement factors. Although it normally includes withdrawal from service other than retirement as a third decrement factor, the portability feature of the new scheme makes this unnecessary. Further we define the following notations: x is the age of a contributor at entry into the scheme (therefore, $n = r - x$); l_y is the expected number of contributors aged y on ST; d_y and r_y are the expected numbers of deaths and retirements respectively between ages y and $y + 1$ on ST; $\Omega(y,e)$ is the insurance company's single premium rate for an annuity of 1 increasing at the rate of e per annum. The values are displayed in Appendix B. $\ddot{a}^{\,j}_{x:\overline{z-x}}$ is the present value of an annuity of 1 per annum payable in advance whilst (x) remains in service and where z is the highest age at which retirement occurs. This is computed from the ST Table and at the rate of interest j.

We define the Guarantee Pension Subsidy (GPS)x to a worker aged x at entry as the difference between the Minimum Pension Guarantee (MPG) and that pension which the participant's account can buy. This is simply the expected cost to government of the MPG. In order to simplify the model and also ensure fairness and equity as well as discourage selection against government, we shall assume that the worker remains in the scheme and continues to contribute into the fund up to the age when he starts collecting his pensions. In other words, no minimum pension guarantee is offered to a worker who retires and stops contributing years before attaining the minimum pensionable age stipulated in the Act irrespective of whether or not the individual participant has contributed for the required minimum number of years.

We shall make the critical assumption that both the pensions purchased by the contributor and the subsidy provided by government to maintain the MPG are provided the annuity products marketed by insurance companies. Thus, government subsidy is utilized to pay single premiums to insurance companies. For the determination of the government subsidy we consider three possible scenarios as follows.

Model 1. Both contributors' fund and government's subsidy are used to purchase flat amount annuities. Here the MPG is satisfied only at the point of commencement of pensions as demonstrated in Figure 1. There is then a shortfall over time.

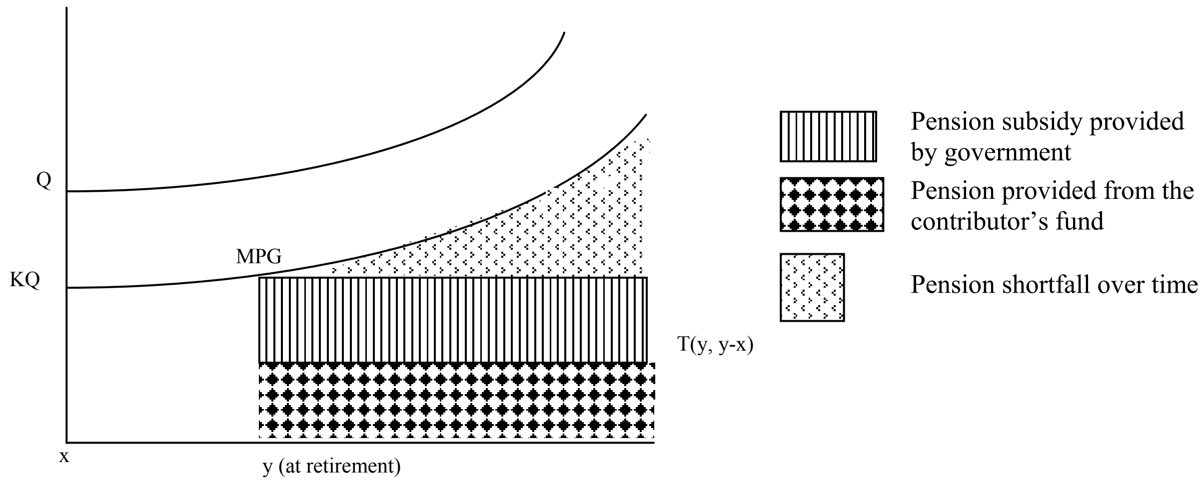

Fig. 1. Participant's fund and government's subsidy used for level annuities

The (GPS)x is given as follows:

$$(GPS)_x = \sum_{y=\alpha}^{z} \varphi(y-x)(1+i)^{-(y-x+\frac{1}{2})} \frac{r_y}{l_x} \text{Max}\left[kQ(1+s_1)^{y\text{-}x\text{-}1} - T(y, y-x), 0\right]\Omega(y,0), \tag{5}$$

where α is the minimum age at which pension payment is allowed and z is the highest age at which retirement occurs.

Also, $\varphi(y-x) = 0$ if $y - x < a$, $\varphi(y-x) = 1$ if $y - x \geq a$, (6) and $T(y, y-x) = \frac{F(y-x)}{\Omega(y,0)}$, (7)

$$\therefore\ (GPS)_x = \sum_{y=\alpha}^{z} \frac{C_y^r}{D_x} \text{Max}\left[kQ(1+s_1)^{y-x-1} - T(y, y-x), 0\right]\varphi(y-x)\Omega(y,0), \quad (8)$$

where $C_y^r = (1+i)^{-(y+1/2)} r_r, y < z$,

$(1+i)^{-y} r_y; y = z$, (9)

and $D_x = (1+i)^{-x} l_x$. (10)

Model 2. Both the contributor's fund and the subsidy from the government are used to purchase annuities that increase at the rate that is at least equal to the rate of increase in minimum wage that is, s_1 per annum. This is demonstrated in Figure 2 that is presented below.

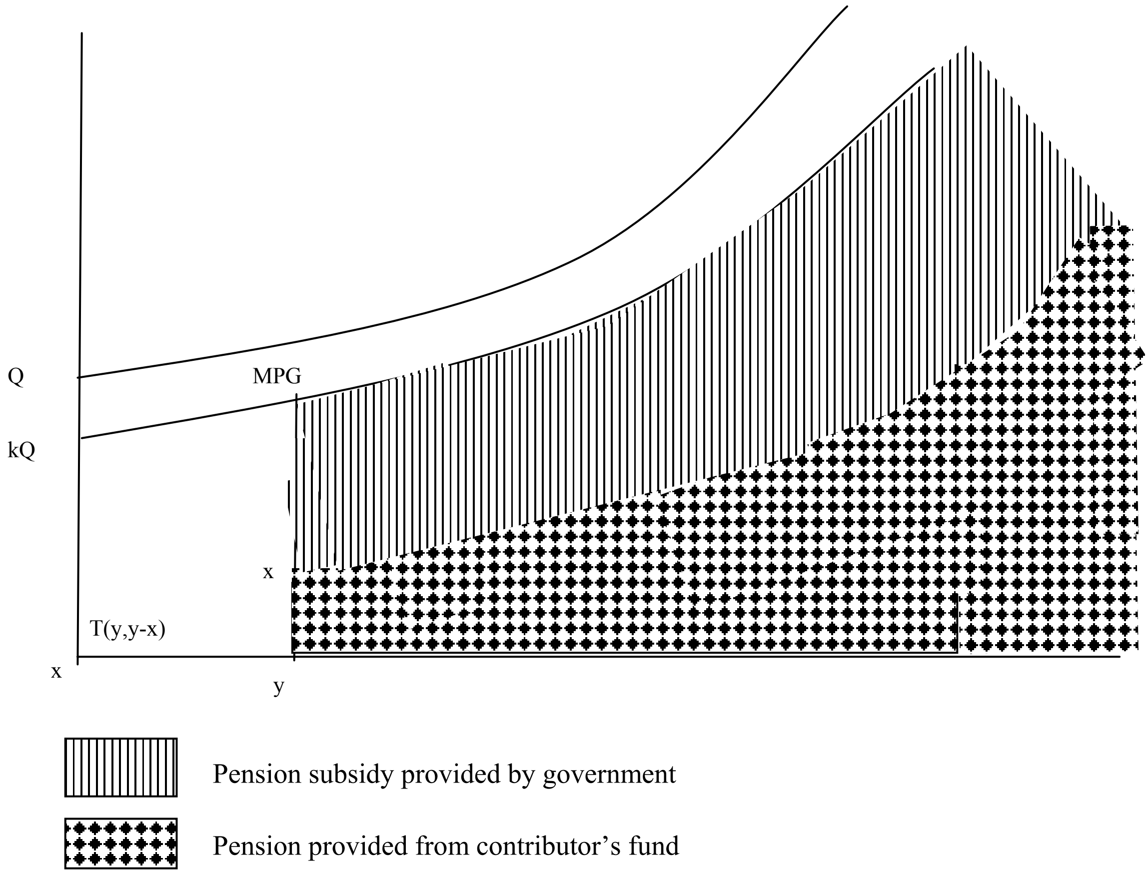

Fig. 2. Participant's fund and government subsidy used for increasing annuities

For this case:

$$(GPS)_x = \sum_{y=\alpha}^{z} \frac{C_y^r}{D_x} \text{Max}\left[kQ(1+s_1)^{y-x-1} - T'(y, y-x), 0\right]\varphi(y-x)\Omega(y, s_1), \quad (11)$$

where $T'(y, y-x) = \frac{F(y-x)}{\Omega(y, s_1)}$. (12)

Model 3. The contributor's fund is used to purchase a flat annuity while the government subsidy is used to purchase an annuity increasing at the rate at least equal to the rate of increase in minimum wage (s1) as demonstrated in Figure 3.

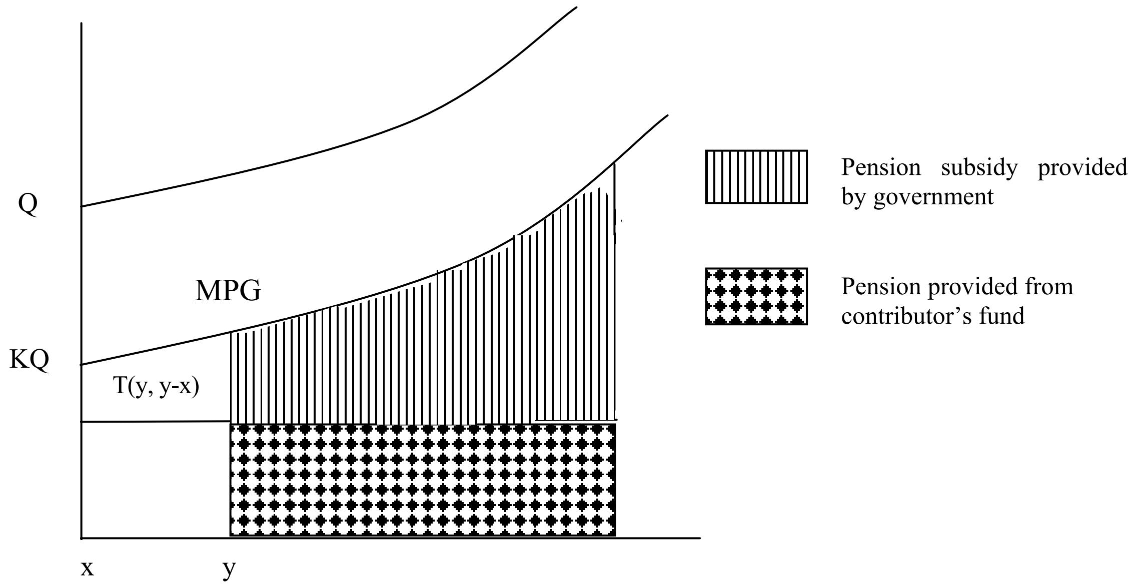

Fig. 3. Participant's fund for level annuity/government subsidy for increasing annuities

Here, $$\left(GPS\right)_x = \sum_{y=\alpha}^{z} \frac{C_y^r}{D_x} \text{Max}\left[kQ(1+s_1)^{y-x-1} - T(y, y-x), 0\right]\varphi(y-x)\Omega\left(y, s_1\right), \tag{13}$$

where $$T(y, y-x) = \frac{F_{(y-x)}}{\Omega\left(y,0\right)}. \tag{14}$$

Expressed either as a proportion of the contributor's wage at entry, P, or as a proportion of minimum wage, Q, we have:

$$\gamma\left(P\right) = \frac{(GPS)_x}{P} \text{ or } \gamma\left(P\right) = \frac{(GPS)_x}{Q}, \tag{15}$$

where $\gamma\left(P\right)$ and $\gamma\left(Q\right)$ are the respective expected cost as proportions of the contributors' initial wage and minimum wage.

If, however, provision is to be made annually while the worker continues in the scheme (that is, participant is neither deadcnor retired), we can express the expected annual provision as a proportion of the annual wage as follows:

$$(GPS)_x = \mu(P)P\sum_{t=0}^{z-1}(1+i)^{-t}(1+s)^t \frac{l_x+t}{lx},$$

where $\mu(P)$ and $\mu(Q)$ are the respective annual contribution rates as proportions of the contributors' annual wage and minimum wage.

Thus $(GPS)_x = \mu(P)Pa_x^j$ since

$l_y = 0$, for all $y > z$,

$$\therefore \mu\left(P\right) = \left(\frac{(GPS)_x}{Pa_x^{j'}}\right), \tag{16}$$

where $\ddot{a}_x^j$ is computed on the "ST Table" using the rate of interest $j = \dfrac{i-s}{1+s}$.

Expressed as a proportion of minimum wage at entry, we can also have

$$\mu\left(Q\right) = \frac{(GPS)_x}{Qa_x^{j'}}, \text{ where } j' = \frac{i-s_1}{1+s}. \tag{17}$$

It is observed that Model 1 is not efficient as it provides a guaranteed pension only in the first year of pension. It produces pension shortfalls after the first year of retirement. It is, however, worth considering because, in Nigeria, no specific rule is yet available for the determination of the minimum pension. Besides, flat amount annuity is the only type of annuity that is presently well known in the market. Indexed annuities are not available because indexed bonds that would have facilitated their development are not yet in place. The type of variable annuity inferred in Models 2 and 3 is also not yet in the market. If this latter type of annuity is eventually developed then government will be in a position to consider these two latter models.

$(GPS)_x$ is the total expected provision to be made and funded by government at entry into the scheme in respect of a worker aged x to cater for his minimum pension guarantee. Earlier models have focused on situations where the full account balance of the worker is utilized for the purchase of life annuity. The Nigerian scheme, however, provides for two major variations.

Option 1: A worker may elect to withdraw a lump sum from his account balance at retirement provided that the balance left after such a withdrawal is able to purchase a life annuity of at least 50% of his terminal wage.

Option 2: A worker may elect a programmed withdrawal administered by the Pension Fund Administrators rather than a life annuity. In this case pensions are drawn for a term certain where the term is determined to be the life expectancy of the retiring worker.

There is the need to implement the MPG feature with respect to those who elect any of these options in a fair and equitable manner. We consider that the most equitable approach to the first situation is to compute and pay government's subsidy as if no lump sum was withdrawn; not withstanding the fact that the ultimate total pension does not measure up to the MPG.

With respect to the second option, generally the regular withdrawals would be greater than the pensions from life annuity, the latter being for the whole of life. Government's subsidy to maintain MPG would therefore be generally lower. There is, however, the risk of the person who elects the option outliving the term certain life expectancy. By that time he would have depleted his entire fund so that further income is terminated. A quick and least demanding resolution would be for government to pay the minimum pension from the point of termination to the person for the rest of his life. In a stricter sense and with due equity in mind, it should be possible to modify the model to analytically determine at the point of termination of income what should be paid by government for the remaining part of his life. We have, however, not addressed this in this study.

4. Numerical illustration

Based on the defined contribution pension system that is the main plank of the study we calculate the $(y, y-x)$, for $y = 50, 51,\dots, 65$; $(GPS)_x$, $\gamma(P)$, $\gamma(Q)$, $\mu(P)$ and $\mu(Q)$ for four hypothetical workers with different personal data.

As Service Tables reflecting the Nigerian experience are at the moment not in existent, we have constructed hypothetical service table (see Appendix A). Similarly, the annuity rates $\Omega(y,0)$ and $\Omega(y, .08)$ in Appendix B are hypothetical. To determine F_n, $M(r,n)$, $T(r,n)$, $(GPS)_x$, $\gamma(\mathrm{P})$, $\gamma(Q)$, $\mu(P)$, and $\mu(Q)$ we also specify the following model parameters:

$$g = .15; m = .03; c = 1200; \sigma = 0, i = 0.12; s = 0.1.$$

Q = 216,000, the new annual minimum wage in Nigeria from 2011.

α = 50 years, the minimum age where pension is allowed by PRA 2004.

z = 65, the highest age of retirement.

s_1 = 0.08 as the projected annual rate of increase in future minimum wage.

k = 0.7 we consider this a reasonable figure of pension as a proportion of minimum wage.

The results on the foregoing bases are displayed in Table 1.

5. Discussion of results

In Model 1, Government Pension Subsidy for Worker A is zero, for Worker B it is 143,800, for Worker C it is 22617 and for Worker D it is 662. As proportions of their initial wages, these constitute 0%, 66.57%, 9.05%, and 0.22%, respectively. As proportions of the minimum wage, these are also 0%, 66.57%, 10.47%, and 0.31%, respectively. If these subsidies were to be met by annual contributions these will be 0%, 3.45%, 0.4% and 0.02% of the respective initial wages. Expressed as proportions of the minimum wage the contributions become 0%, 4.19%, 5%, and 0.2%, respectively. Similar explanations hold for the results of the other models.

Table 1. Pension cost scenarios for various age-wage combinations

	WA (Age 35, wage 400,000)			WB (Age 30, wage 216,000)			WC (Age 25, wage 250,000)			WD (Age 42, wage 300,000)		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
$(GPS)x$	0	11160	0	143800	668181	317895	22617	415177	49557	662	22454	1198
$\gamma(P)$	0	27.5	0	66.57	309.34	147.17	9.05	166	19.82	0.22	7.45	0.4
$\mu(P)$	0	1.69	0	3.45	15.61	7.43	0.4	7.28	0.87	0.02	0.66	0.04
$\gamma(Q)$	0	51.67	0	66.57	309.34	147.17	10.47	192.21	22.94	0.31	10.4	0.55
$\mu(Q)$	0	1.98	0	4.19	18.96	9.02	5	9.14	1.09	0.02	0.73	0.04

Notes: WA = Worker A, WB = Worker B, WC = Worker C, WD = Worker D.

For purposes of comparing individual contributors, $\gamma(Q)$ and $\mu(Q)$ appear to be better measures of cost than $\gamma(P)$ and $\mu(P)$ the former set having been defined on a common base Q for all contributors.

Compared with the other two models, the costs for Model 1 are the cheapest. The model is, however, the most inefficient as the MPG is satisfied only at the commencement of pension. Over time and as the minimum pension increases in tandem with the minimum wage, the pensioner continues to receive flat pensions that progressively fall below the emerging MPGs.

Models 2 and 3 are both efficient as they provide sustained MPGs throughout the life of the pensioner. However, it would only be possible to implement these models if variable annuities are available in the market. Incidentally, in Nigeria, as in the most developing economies, marketing of variable annuities is uncommon. The costs for Model 2 are however much higher. Also because of the lower initial pension that the contributor's fund would buy under Model 2, a greater number of contributors would qualify for MPG thereby increasing the costs further.

A special class of pensioners would emerge under Model 3 that would consist of those who did not initially qualify for MPG but over time would fall below MPG pensions. This situation would not occur under Model 1 because both those who qualified and those who did not would eventually fall below MPG pensions. Under Model 2, any contributor who achieved a pension above the MPG at commencement of pension would continue to be above it in subsequent years. For reasons of equity and fairness it may be necessary for government to provide for the needs of such pensioners in Model 3 as and when the situations arise. This would however add to the cost of implementing Model 3.

Conclusion

Minimum Pension Guarantee is a very important pillar in the design of defined contribution pension schemes. Ensuring that government fulfils its obligation in this respect is, therefore, crucial for the success of the new dispensation. Since MPG has the potential to impose enormous additional cost on government, it is most helpful for the latter to identify and examine those factors that can impact on its liabilities. One major source of escalating liabilities is the PFA's management of the worker's fund particularly in the areas of administration charges, return on investment and security of assets.

As demonstrated by Ibiwoye and Adesona (2010), high administration charges and low return on investments would reduce the contributor's ultimate pension expectation. A reduction in the worker's pension results in an increase in government's subsidy towards MPG. It is, therefore, in the best interest of government to protect the contributors' fund by maintaining some level of control and monitoring at the fund accumulation stage. It is in this regard that we recommend that the Nigerian scheme take a cue from the Chilean model where both minimum and maximum annual returns are prescribed for the AFPs, the Chilean equivalents of the Nigerian PFAs.

Discussions should also be carried out by the government and the PFAs towards maintaining levels of administration charges that are mutually acceptable to both sides whilst further analysis aimed at reducing administration costs should be encouraged. At the decumulation stage, government should take sustained interest in the activities of the PFAs that are the providers of the programmed withdrawals as well as it does in the insurance companies that provide life annuities. In particular the determination of the annuity rates and the rates for the programmed withdrawals should be scrutinized with regard to the interest rates and expense charges applied in the determination of these rates. Special consideration should also be given to the contributors in the low-income bracket who generally have lower than average life expectancy and also on whose pension administration charges have worse impact.

In the short term the appropriateness of the annuitant mortality tables in use by the service providers should be investigated as this has significant impact on the pension rates. In the medium to long term, steps should be taken through the collaborative efforts of government, the service providers, and the actuarial profession to institute continuous annuitant mortality investigations reflecting the Nigerian experience most preferably on cohort bases. Similar investigations should also be instituted towards producing "Service Tables" (ST) that reflect the Nigerian experience.

Since the provisions of the PRA 2004 regarding the MPG and other matters are also applicable to those contributors who transferred from the old scheme to the new scheme, it is important that the values of their pensions are given adequate safeguards. One way of doing this is to recognize the erosive effects of inflation on their transferred benefits, acknowledged through the issuance of recognition bonds, by offering them reasonable annual yields as a protection against inflation. Similar recognition bonds in the Chilean system grant a real rate of return of 4% p.a. (Barrientos, 1996; Mackenzie et al, 1997). As a further protection of the contributors, in the event that an AFP is not able to meet up with minimum return in spite of the transfer from the statutory reserve and the "profitability reserve" account, such an AFP is liquidated and the balances of the individual contributors' accounts transferred to another AFP while the government covers the difference (Barrientos, 1996).

This study has taken the micro approach to determining λ and μ as a necessary platform for further work on determining the respective single average values at the macro level. The latter would involve a due consideration of the distribution of the population of the contributors at the point of entry into the scheme, by age, wage and other relevant factors. Government could then adopt these values as the measures of its expected funding requirements either as a single contribution at entry or as annual contributions per contributor, towards maintaining the MPG feature.

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Appendix A

Table 1. Hypothetical service table (ST)

						$a_x(65\text{-}x)$@	$a_x(65\text{-}x)$@
Age						$j = (i - s)/(1 + s)$	$j = (i - s1)/(1 + s_1)$
x	$q(x,d)$	$q(x,r)$	l_x	d_x	r_x	i.e., j = 0.0182	i.e., j = 0.037
20	0.00111		34089	38	0	25.55496	19.71041
21	0.00111		34051	38	0	25.02931	19.42505
22	0.00111		34013	38	0	24.49354	19.1288
23	0.00112		33975	38	0	23.94745	18.82127
24	0.00112		33937	38	0	23.39084	18.50201
25	0.00112		33899	38	0	22.8235	18.17058
26	0.00113		33861	38	0	22.24523	17.82651
27	0.00113		33823	38	0	21.65581	17.46931
28	0.00114		33785	39	0	21.05502	17.0985
29	0.00115		33746	39	0	20.44326	16.71403
30	0.00116		33707	39	0	19.81968	16.31489
31	0.00118		33668	40	0	19.18405	15.90051
32	0.0012		33628	40	0	18.53669	15.47076
33	0.00123		33588	41	0	17.87681	15.02458
34	0.00127		33547	43	0	17.20466	14.56179
35	0.00132		33504	44	0	16.52046	14.08213
36	0.00139		33460	46	0	15.82344	13.58449
37	0.00147		33414	49	0	15.11373	13.06855
38	0.00158		33365	53	0	14.39145	12.53391
39	0.00171		33312	57	0	13.65662	11.98012
40	0.00188		33255	63	0	12.90883	11.40631
41	0.00208		33192	69	0	12.14837	10.81221
42	0.00231		33123	77	0	11.37471	10.19683
43	0.00259		33046	86	0	10.58796	9.559672
44	0.00292		32960	96	0	9.787756	8.899859
45	0.0033		32864	108	0	8.973671	8.216377
46	0.00372		32756	122	0	8.145415	7.508325
47	0.0042		32634	137	0	7.302529	6.774606
48	0.00474		32497	154	0	6.444174	6.013726
49	0.00534		32343	173	0	5.569553	5.224177
50	0.00599	0.2115	32170	193	6804	4.677656	4.404185
51	0.00671	0.1901	25173	169	4785	4.785337	4.511527
52	0.0075	0.175	20219	152	3538	4.798496	4.533833
53	0.00837	0.155	16529	138	2562	4.730969	4.482842
54	0.009311	0.1	13829	129	1383	4.540491	4.317018
55	0.01035	0.2115	12317	127	2605	4.047386	3.862139
56	0.01148	0.1901	9585	110	1822	4.03134	3.856396
57	0.012743	0.175	7653	98	1339	3.914327	3.756728
58	0.014058	0.155	6216	87	963	3.721591	3.585528
59	0.01557	0.1	5166	80	517	3.481366	3.368567
60	0.0172	0.2	4569	79	914	3.028204	2.944074
61	0.018	0.1902	3576	64	680	3.262909	3.185483
62	0.019	0.185	2832	54	524	2.61279	2.570121
63	0.02	0.168	2254	45	379	1.864043	1.848334
64	0.02	0.15	1830	37	275	1	1
65	0.02	1	1518	0	1518	0	0

Notes: r is age at retirement; x is the age of a contributor at entry into the scheme (therefore, $n = r - x$); l_y is the expected number of contributors aged y; d_y and r_y are the expected numbers of deaths and retirements respectively between ages y and $y + 1$.

Appendix B

Table 2. Single premium rates for immediate annuity of initial amount of 1 p.a.

	Rate of increase in annuity	
Age x	0% p.a.	8% p.a.
50	9.8025	21.6180
51	9.7145	21.0859
52	9.6208	20.5507
53	9.5210	20.0127
54	9.4147	19.4723
55	9.3016	18.9301
56	9.1812	18.3866
57	9.1066	17.9490
58	9.0290	17.5129
59	8.9485	17.0790
60	8.8653	16.6480
61	8.7794	16.2207
62	8.6911	15.7982
63	8.6006	15.3812
64	8.5080	14.9706
65	8.4137	14.5674