Modelling individual benefit in a contributory pension system in a developing economy: Analysis of Nigeria's experience

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Abstract The old pension system in Nigeria was bedevilled by many infrastructural defects and administrative inefficiency. It could no longer be sustained and had to be replaced. With the aid of a dynamic recursive model and data from a parastatal, this study determines how much an individual can expect to get at the time of retirement and compares this with what it would have been under the old system. It concludes that the new contributory scheme, although appearing sound in its design, still has some weaknesses that may make the realisation of the objectives of the pension reform elusive. It appears that the individual employee, in an inflationary economy like that witnessed in Nigeria, may have to make substantial additional contribution if he wants to realise the objective of maintaining a standard of living commensurate to what it was just before retirement. It advises that the regulator should enforce that contributions are remitted promptly in order to reap maximum benefit from the scheme.

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Introduction

There are basically two types of pension plans: defined contribution and defined benefit plans. In the first, regular (usually monthly) contributions are made into a fund, which then accumulates with interest and new contributions. The final benefit is unknown, being dependent on future contributions and investment earnings. In the second approach, the final benefit entitlement is known, but the rate of

contribution is not specified. It is determined by an actuarial valuation. Up to June 2004, both types of pension schemes were available in Nigeria in fragmented forms. In 2004, the government, however, took decision in favour of the defined contribution system as the thrust of its pension reform for both the private and public sectors of the economy.

The new pension system adopted for the country has been generally described as the panacea to the intractable problems of pension delivery in Nigeria. Apart from the problem of poor administration ascribed to the old system and to which, we must quickly add, the new scheme is not immune, no study has shown, in

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specific monetary terms, how the new scheme can be more beneficial to the employee or what loopholes to avoid. It is high time the system was examined more thoroughly in order to synchronise the pension promise with actual pension delivered at retirement. This study attempts to fill that gap.

Since the burden of choosing the investment manager and monitoring investment performance has been shifted to the individual employee in the new dispensation, a good place to start the investigation would be to look at the benefit on offer to the individual at retirement by the new system and to compare it with what was expected from the old system. One of the gains of such an exercise is that the worker now has a basis to plan for his retirement using the benefits scale of the old system as a benchmark. Another is that it will help public education, which in turn will foster the cooperation of all stakeholders; a very important consideration in facilitating the implementation process. As of now, some of the trade unions, such as the Academic Staff Union of Universities, are still in disagreement with the government over the latter's decision to change the terms of the contract with the union mid-stream.

Having set the broad objectives for the study, the rest of this paper is organised as follows: The next section critically examines current literature and issues in the direction of pension reform, with explicit reference to developing countries. The following section defines the concept of pension expectation and develops an actuarial model for determining total pension expectation. Then the further section attempts to give explicit empirical content to the model using a numerical illustration of a defined salary structure within Nigeria, the University Salary Scale structure. Finally the last section concludes the study and gives policy recommendation.

Trend in pension reform

When the committee on the reform of the Pay-as-you-go pension system was set up in Nigeria, stakeholders heatedly debated the merits or demerits of keeping the former system, with slight adjustments in the parameters, for example higher contributions as witnessed in Colombia,

lower subsidies as in Germany and increased retirement age as in Brazil,¹ or changing radically to a contributory system. The experience worldwide, however, is that choosing a system to adopt is rarely a straightforward matter, as either type of pension system has different types of costs and benefits.² Robalino *et al.*³ contend that these economic and social costs and benefits should be outlined and quantified to the extent possible so as to ensure that the end programme, if not optimal, is at least welfare increasing.

In making a final choice, a lot seems to depend on what aspect, cost or benefit, is important to the country making the change. Many of the previous studies on pension reform tend to concentrate on the cost aspect.⁴⁻⁹ They looked at the problem as that of the population living longer than in previous eras, and examined the implicit increase that longevity foists on the cost of providing pension at retirement. While improvement, however, has also been observed in longevity in developing economies, developmental priorities like corruption, mismanagement of pension funds, and waste seem to occupy a prime position in pension reform issues in these areas.

In developing areas, problems are not restricted to funding; they are also experienced in the payout phase. A few examples highlight the types of difficulties witnessed in developing countries. In Mexico, for instance, Grandolini and Cerda¹⁰ found that in spite of a relatively young population, total pension liabilities far outstrip the assets, leading to financial disequilibrium. A similar conclusion was drawn in Kenya, where the cost of unfunded pension liabilities amounted to one-quarter of the wealth created in the economy.¹¹ In Zambia, Queisser *et al.*¹² discovered high inflation rates and politically motivated low-yield investments and loans to be the bane of the pension system. A typical developing environment characteristic was spotted in Costa Rica by Demircuc-Kunt and Schwarz,¹³ whereby individuals found a way to substitute for early retirement that was not explicitly included in the scheme through disability pensions.

Reform did not answer all the questions either. Reyes and Pino¹⁴ showed that the much celebrated

reform in Chile had heightened the income inequality at retirement, as the scheme has demonstrated a good performance for the richest workers but not for the poorest ones. Although this is not unexpected because of scale economics, socially it is not regarded as actuarially fair. Other problems that the new system had faced elsewhere include the vulnerability to political risk witnessed in Argentina, where workers suffered large pension losses when the government defaulted on its debts,¹⁵ and that of Bolivia, which became insolvent and illiquid after a few years.¹⁶ These plans serve as examples of the effects of a hurriedly assembled reform. In El Salvador, another developing country, the takeoff of the new pension system was delayed because of a severe financial crisis ignited by allegations of fraud.¹⁷

Besides these developing area-specific problems, widespread drawbacks that can affect the final payout in the defined contribution pension schemes include associated high management charges and a wide dispersion in investment performance.² These tend to make the employee move frequently from one pension fund administrator to another in search of higher returns, often incurring penalties for breaking the investment. They also place the risk of choosing an investment manager and monitoring their performance squarely on the shoulders of the employee, a task many might not have been trained to do.

Retirement income expectation and model development

The benefit under the defined contribution scheme is not easily derived. It depends on the magnitude of the stream of contributions from the date of joining the scheme to the date of retirement, the timeliness of these contributions, as well as the returns from the investment of the contributions. In order to have a basis for comparing benefit for benefit under the new system with that of the former system, we need a model for estimating the benefit accruable to an employee at retirement under the defined contribution system.

We begin the construct of our model with an assumption of a constant amount of yearly contributions from the date of joining the scheme to the date of retirement. If the rate of return on investment is known and also constant, then such a cash flow can be represented by an annuity. Here, let ' C ' represents the size of the contribution and ' i ' the interest rate. The present value of this stream of payments is then given by

$$C \sum_{t=1}^n (1+i)^t = C[\{(1+i)^n - 1\} / i]$$

Because of notch increments and promotions, the size of the contributions is never constant. We are therefore faced with a dynamic system in which the size of the contributions can vary from year to year and the rate of interest can also change, depending on the return on investment. A simple annuity model would not be appropriate in such an instance; rather, such generalised cases are better handled by a recursive model. Our alternative model follows similar works by Blake *et al.*,¹⁸ Haberman and Vigna¹⁹ and Cairns²⁰ who examined the pension planning problem as it relates to the UK economy. The focus of our model, however, is on developing economies, where the usual demographic and economic assumptions used in more developed economies often fail to hold. We now define the following parameters:

A_0 = the initial capital invested at the time the employee first qualifies to join the scheme;

C_t = the amount invested at the end of year t .

At the end of the first year, the accumulated value will be

$$A_1 = (1+i_1)A_0 + C_1$$

At the end of the second year, the accumulated value will be

$$A_2 = (1+i_2)A_1 + C_2$$

At the end of year 3, it will be

$$A_3 = A_2(1+i) + C_3$$

Generalising, the accumulated value at time $t+1$ is given by

$$A_{t+1} = (1+i_{t+1})A_t + C_{t+1}$$

where i_{t+i} is the rate of interest at time $t+1$. To bring the valuation date to the inception of the contract, we divide through by $(1+i_{t+i})^t$. Thus, the new equation becomes

$$\frac{A_t}{(1+i_t)^t} - \frac{A_{t-1}}{(1+i_t)^{t-1}} = \frac{C_t}{(1+i_t)^t}$$

Summing from $t=1$ to $t=n$, we have

$$\sum_{t=1}^n \frac{A_t}{(1+i)^t} - \sum_{t=1}^n \frac{A_{t-1}}{(1+i)^{t-1}} = \sum_{t=1}^n \frac{C_t}{(1+i)^t}$$

Since intermediate terms cancel out, this gives rise to

$$\frac{A_n}{(1+i)^n} - A_0 = \sum_{t=1}^n \frac{C_t}{(1+i)^t}$$

$$\text{or } A_n = (1+i)^n A_0 + \sum_{t=0}^n (1+i)^{n-t} C_t$$

At retirement date, T , we have

$$A_T = \sum_{t=1}^T (1+i_t)^{n-t} C_t$$

where the initial condition implies $C_0 = A_0$.

In other words, the balance in the Retirement Savings Account at retirement is the initial capital accumulated to retirement year, T , plus cash flow payments that accumulated at interest from the date of contribution to the date of retirement.

Data analysis and discussion of results

We consider a cohort of employees who joined the Nigerian University system in the 1980s. The choice of this group is premised on the fact that the new scheme emphasises individual decision taking. Selecting a representative employee from this group for our analysis therefore ensures that the length of service of this employee is long enough to be vested under the old pension provision, yet not so long that the employee falls into the category of those exempted from contributing under the new dispensation. This avails us the opportunity to compare the benefits that an individual in this group will be entitled to under the new system with what it would have been had the old system been sustained.

Our representative employee joined the services of a university as a Lecturer Grade 2 in 1981, was promoted to Lecturer Grade 1 in 1985, Senior Lecturer in 1989, Associate Professor in 1992 and Professor in 1998, and would not be due to retire in the next ten years, *ceteris paribus*. The data for this study are obtained from the salary data forwarded by the National Universities Commission to the universities in Nigeria. The universities are parastatals under the Federal Ministry of Education, and by virtue of the stipulations of Decree 102 of 1990, they were operating defined benefit pension system before the 2004 reform.

Long-term interest rate is assumed to average 10 per cent. It will be observed that in spite of the very low salaries in the first five years of his career, the total accumulation is greater than that of the next five years. This is because interest compounding took place over a longer time interval.

Even so, the importance of the magnitude of the salary becomes more profound when total contribution and total accumulation in years

Table 1: Contribution and benefit structure under PRA 2004

(1) Year	(2) Annual emolument	(3) Contribution at 15%	(4) Accumulation factor	(5) Maturity value
1981	90,600	13,590.00	11.9181765	161,968
1982	91,584	13,737.60	10.9184159	149,993
1983	94,032	14,104.80	9.9227774	139,959
1984	96,480	14,472.00	9.0179300	130,507
1985	97,776	14,666.40	8.1955948	120,200
Total	470,472	70,570.80		702,627
1986	100,656	15,098.40	7.4482474	112,457
1987	103,536	15,530.40	6.7690498	105,126
1988	106,416	15,962.40	6.1517874	981,97
1989	136,368	20,455.20	5.5908126	114,361
1990	143,280	21,492.00	5.0809925	109,201
Total	590,256	88,538.40		539,342
1991	150,192	22,528.80	4.6176623	104,030
1992	345,552	51,832.80	4.1965826	217,521
1993	370,188	55,528.20	3.8139008	211,779
1994	394,824	59,223.20	3.4661153	205,276
1995	417,660	62,649.00	3.1500440	197,347
Total	1,678,416	251,762.40		935,953
1996	436,548	65,482.20	2.8627949	187,462
1997	467,100	70,065.00	2.6017398	182,291
1998	497,796	74,669.40	2.3644899	176,555
1999	528,492	79,273.80	2.1488746	170,349
2000	559,188	83,878.20	1.9529211	163,808
Total	2,489,124	373,368.60		880,465
2001	762,420	114,363.00	1.7748363	202,976
2002	796,908	119,536.20	1.6129909	192,811
2003	831,408	124,711.20	1.4659040	182,815
2004	865,896	129,884.40	1.3322298	173,036
2005	900,396	135,059.40	1.2107452	163,523
Total	4,157,028	623,554.20		915,159
Grand total	9,385,296	1,407,794.40		3,973,546

Source: Computed from NUC data.

11–15 are compared with those of year 1–5 and then year 6–10. Here, we see that as a result of the improvement in total salary package, the total accumulation has risen substantially. A similar conclusion holds for the two remaining sub-groups. In all likelihood, however, the same rate of interest would not apply over the entire range of an employee's career, and the very low salaries in earlier years would impact much less on total accumulation (Table 1).

Four other cases were examined for interest rates averaging 3, 5, 7.5 and 15 per cent. The 3 per cent rate approximates what insurance companies quote for endowment schemes, the 7.5 per cent rate represents typical quotation for deposit administration schemes, while the

15 per cent rate represents the most optimistic scenario. The results are shown in Table 2.

The Pension Reform Act²¹ provides for lump sum payment, phased withdrawal or annuity for life. It is only the third option that has the attributes of retirement income and we shall therefore look at this in some detail. Although we have considered the most optimistic scenario in our study, even then the stipulations of the Act demand that the maturity value of naira 7,438,775 has to be split into two, with only one portion available to purchase the annuity. Thus, only half the maturity value, in this case, the sum of naira 3,719,387, is available to purchase an annuity. Given this allowable maturity figure, the amounts available for different possible rates of

Table 2: Maturity values at differing rates of interest from 3 to 15 per cent

Year	Total annual emolument	Total contribution @ 15%	M.V.				
			<i>i</i> =3%	<i>i</i> =5%	<i>i</i> =7.5%	<i>i</i> =10%	<i>i</i> =15%
1981–5	470,472	70,570.80	143,408	227,686	401,250	702,627	2,048,133
1986–90	590,256	88,538.40	154,474	222,094	346,670	539,342	1,249,950
1991–95	1,678,416	251,762.40	377,192	491,060	678,718	935,953	1,725,062
1996–2000	2,489,124	373,368.60	485,812	577,111	713,189	880,465	1,316,397
2000–5	4,157,028	623,554.20	700,707	756,667	832,087	915,159	1,099,233
Total	9,385,296	1,407,794.40	1,861,592	2,274,617	2,971,913	3,973,546	7,438,775

Source: Computed from NUC data.

Table 3: Annual income based on life annuity at retirement

(1) Rate of interest (%)	(2) Annuity factor	(3) Annuity for life (part distribution)	(4) Annuity for life (full distribution)
3	12.1	307,387	614,774
4	11.3	329,149	658,298
5	10.37	358,668	717,336
7.5	8.82	421,699	843,398
10	7.68	484,295	968,590
15	6.11	608,737	1,217,474

Source: Computed from NUC data.

Table 4: Income based on life expectancy of 12 years at retirement

Rate of interest (%)	Annuity factor	Annual income (part distribution)	Annual income (full distribution)
3	6.59	564,398	1,128,796
4	6.39	582,063	1,164,126
5	6.21	598,935	1,197,870
7.5	5.78	643,492	1,286,984
10	5.41	687,502	1,375,004
15	4.79	776,489	1,552,978

Source: Computed from NUC data.

interest at the time of retirement are shown in Table 3. The last column of Table 3 shows the income that the employee would earn if the whole accumulated figure of naira 7,38,775 had been used to purchase the annuity.

Since our representative employee has spent 25 years in service, if he were to retire in 2005 his annual pension under the previous defined benefit scheme would be computed as $(10 + 2 \times 25)$ per cent or 60 per cent of final salary. With a final salary of naira 4,157,028, this arithmetic sums up to naira 2,494,216.80. Thus, in the most

Table 5: Accumulated retirement savings amount required to generate an annual income of naira 2,160,000 for life

Rate of interest (%)	Annuity factor	Required accumulated amount
3	12.1	26,136,000
4	11.3	24,408,000
5	10.37	22,399,200
7.5	8.82	19,051,200
10	7.68	16,588,800
15	6.11	13,197,600

Source: Computed from NUC data.

optimistic case, and even assuming the total accumulation is used to purchase an annuity, the income accruable to the employee is less than 50 per cent of what it would have been under the old system. If the annuity to be purchased is based on an expectation of life of say, 12 years, rather than on life annuity, then the expected annual income would be as in Table 4.

We see that either way, the expected income from the defined contribution option is much less than that from the annual income of naira 2,494,216.80 that our representative employee would have earned based on 60 per cent of final salary under the old scheme.

Finally, we now consider the amount that an employee needs to accumulate in his Retirement Savings Account in order to earn the benefit promised under the previous pension system. This is shown in Table 5.

Again, we see that the rate of interest plays a crucial role in how quickly the amount builds up. This is significant for the individual employee, as his choice of pension fund administrator

determines the return on his investment and hence the rate of interest at which his fund will accumulate.

Conclusion and policy recommendation

Curiously, advanced economies are not changing to defined contribution with the flurry that is experienced in developing countries. This is not just because the defined benefit system is well entrenched, but perhaps, as Singh (1996)²² noted, the system has some merits, such as reduction of old age poverty and administrative efficiency. All the same, to the extent that corruption, mismanagement and lack of infrastructures like a well-developed capital market and other financial institutions are prevalent in developing countries, the shift from the defined benefit system to the defined contribution system is inevitable. However, if the new system is to be able to provide a reasonable pension income in retirement, timeliness is a very crucial factor. There is a need to make contributions as and when due, and to invest immediately.

There is also a need for an employee to make additional contributions if the employee calculates that the expected accumulated contributions at retirement will not provide the minimum income required at that time. This is where financial education will be helpful. In a developing economy environment, we can extend the general myopic tendency to individuals not finding the need for acquiring financial education. One way forward is for the newly established National Pension Commission (Pencom), as the regulator and the main agency of government and the prime promoter of the reform, to direct employers to organise personal financial training seminars for their employees. Another option that should be exploited, given the type of inflation experienced in developing areas and the present level of development of the local capital market, is that of seizing the advantages presented by globalisation to invest offshore in foreign capital markets, where the economy is more stable. The notable difference this time around is that the amount invested and the names of the investors are in public knowledge. Chile learnt this almost too late. The fear of capital

flight associated with this option requires rethinking because retaining all the funds within the economy and, most likely, investing in government paper only increases the amount of funds that are exposed to waste and corruption.

There should be full information disclosure and Pencom should ensure compliance. Each pension fund administrator should carry out regular valuation of the portfolio held by it, and periodic benefit statements should be generated and issued to participants. Also, investment in foreign capital markets, local market price movements, administrative costs recoverable, etc all require transparency from the operators. Pencom will have to provide the necessary leadership by being transparent and consistent in its dealings with the operators.

In conclusion, the major problem that the individual faces in the new system is investment risk. Pencom will have to formulate and enforce guidelines that Pension Fund Administrators (PFAs) will follow, whereby their investment strategies are such that a minimum risk-free return on investment is earned. Pencom can learn from the hard-sell approach of marketing life insurance, which affected the growth of this sector in its approach to formulating appropriate policies for operators in the new system. A 'Prudent-Person Rule'²³ would probably not work in developing countries, as this could be very subjective. In its place, the 'Value at Risk' model, which seemed to have worked for Banking and Insurance regulation, would be more appropriate.

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