MODELS AND COMPUTATIONS OF ACCUMULATED FUNDS OF DEFINED CONTRIBUTION

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Abstract

Before June 2004, employees could rely on their employers to provide them with an adequate, secure and lasting retirement income. Following the adoption of Defined Contribution (DC), the "traditional" Defined Benefit (DB) plan which generally provides employees with a guaranteed retirement income benefit based on salary and years of service was replaced with DC. With DC in place, employees become directly responsible for making sure that they contribute sufficient funds to maintain the lifestyles they are currently enjoying. Hence, the study covers the university employees in southwest Nigeria. A purposive random sampling was used to select 784 university employees in Private, State and Federal Universities. To determine employees' accumulated funds, employees were requested to give estimates of their monthly contributions and numbers of years have been remitted to Retirement Saving Accounts (RSAs). Where no estimate is given, Consolidated University Academic Salary Structure (CONUASS) was used in proxy for employees' and employers' monthly contributions to RSAs. The monthly contributions were accumulated for individual employees by developing models based on the conditions stipulated in Pension Reform Act 2004 (amended 2014) on how pension contributions are to be made. The result shows total contributions an employee needs to make during active years of service. Because there is possibility for monthly income to reduce at payout phase of retirement, the attention of employees who wish to use their accumulated funds to purchase phased withdrawal are drawn to what they need to know before handing over their pension funds to their respective Pension Fund Administrators.

Keywords: Accumulated Funds, Defined Contribution, Defined Benefit, Annuity models, Lifecycle model

Introduction

In June 2004, changes in employer-sponsored pension plan occurred. Before this time, employees could rely on their employers to provide them with an adequate, secure and lasting retirement income. Following the changes in employer-sponsored pension, Richardson and Spence (2010) noted that the "traditional" defined benefit retirement plan which generally provides employees with a guaranteed retirement income benefit based on salary and

years of service has been replaced with Defined Contribution (DC) scheme. With DC in place, employees become directly responsible for making sure that they contribute sufficient funds to maintain the lifestyles they are currently enjoying. As employers focus on DC, the scheme funding is shared between them and employees. The Pension Reform Act 2004 provides that employee and employer are to contribute 7.5% and 7.5% of employee's monthly basic salary respectively. The contribution rate was revised to 8% and 10% under the Pension Reform Act 2014.

However, employers often neglect assisting participants of DC with transitioning their retirement savings into retirement income. Bateman and Piggott (2010) worried that the rewards for careful planning on the part of individuals, or of careful management by financial institutions in charge of pension funds will be compromised by short term policy reaction to circumstances which, can be anticipated, but for which current structures do not encourage. This speculation has recently been confirmed by Adeyele and Maiturare (2012). Therefore, employees have role to play by making sure that other stakeholders (such as employers and PenCom) of the present scheme play their roles.

Defined contribution retirement benefits sometimes allow retirees to choose from two or more benefit structures. For example, in Nigeria and Chile, retiring employees can choose between a programmed withdrawal and a life annuity. Only retirees who have accumulated significant assets— with a total that provides a replacement rate of 70 percent and worth at least 120 percent of the minimum pension guarantee—can withdraw the remainder as a lump sum in Chile (Pettinato & Masci, 2005). In Nigeria, the condition is that the amount left after the lump sum withdrawal must not be less than 50% of employee's annual remuneration as at the date of his/her retirement. Furthermore, retirees must opt for the programmed withdrawal if the annuity does not provide an income larger than the minimum pension. The present study projects into the future the total contributions individual employees can accumulated based on the present contribution rates. The projected funds will assist the employees to decide between choice of retirement income and on the timing of retirement.

Literature Review

In the past century, government have shouldered a growing share of financial position for the elderly. This trend was sustainable as long as populations were kept young by above – replacement fertility rates, so that growing labour forces provided a ready source for financing the retirees (Mitchell & Piggott, 2011). However, as the twentieth century ended and twenty-first century began, the reality of population ageing has clearly showed that such promises are exerting a burdensome fiscal strain. Subhedar (2005) noted that the increasing burden of the government employees' underfunded pension liability is the major driving force behind the government initiatives in reforming pension system.

While government payouts will likely continue to increase for many decades, it is now evident that future retirees will not be as well off as they had thought (Mitchell & Piggott, 2011) because expenditure on pensions has been identified as the highest item in public sectors (Palacios, 2005). At the same time, demographic trends in almost every country have shown that populations are ageing rapidly, but to lower fertility rates and improvements in life expectancy (Brunton & Masci, 2005). This global age wave has heightened awareness of the financial and mortality risk that confront retirees, risk that sometimes take people by surprise (Bodie, 2000), leading to a situation described as pension 'time-bomb' by Blommestein (2000), and many countries responded to this by reforming their pension systems.

From the perspective of an individual employee in Nigeria, the important questions that this move to DC raises are: how well is such a scheme likely to perform in Nigeria environment and how much risk is there in such a scheme? Some of the risks inherent in DC are investment, longevity and inflation risks. Throughout much of developed world, programmes have been developed to provide a degree of social insurance against such risks. Thus, the systematic scheme has becomes a powerful engine for channelling employees' contributions to retirement saving purposes. These kinds of plans have also become important sources of retirement finance in the world over (Palacios & Pallares-Miralles, 2000). As Nigeria adopts systematic model from other countries, one wonders whether the shift from DB to DC solve pension crisis in Nigeria even though it has been acknowledged by many analysts that the shift from the DB to the DC is an essential response to looming pension crisis

(Blommestein, 2000). These issues are given a considerable attention in this study.
This study extends the work on immediate and differed annuities developed by Kellison (1970) for the accumulation phase of retirement.

Annuity-Immediate: if annuity payments of 1 are made at the end of each year for n years, such an annuity is called an annuity-immediate and its present value in the nth year is denoted by a_n. The accumulated value at the end of n –year is denoted by s_n. An expression can be derived for a_n as an equation of value of a payment of 1 at the end of first year is v. The present value of payment of 1 at the end of the second year is v^2. This process is continued until the present value of a payment of 1 at the end of nth year is v^n. The total present value a_n must equal the sum of the present values of each payment. i.e

$$a_{\overline{n|}} = v^1 + v^2 + v^3 + ... + v^{n-1} + v^n \quad \text{.. (2.1)}$$

Formula (2.1) follows a geometric progression:

$$a_{\overline{n|}} = v^1 + v^2 + v^3 + ... + v^{n-1} + v^n$$

$$a_{\overline{n|}} = v\frac{(1-v^n)}{iv}$$

$$a_{\overline{n|}} = \frac{(1-v^n)}{i} \quad \text{.. (2.2)}$$

Also, an expression for s_n can be derived in like manner as an equation of value at the end of the nth year. The accumulated value of a payment of 1 at the end of the first year is $(1+i)^{n-1}$. The accumulated value of a payment of 1 at the end of the nth years is just 1. The total accumulated value, s_n, must equal the sum of the accumulated value of each payment i.e

$$s_{\overline{n|}} = 1 + (1+i)^1 + (1+i)^2 + (1+i)^3 + ... + (1+i)^{n-1} \quad \text{.. (2.3)}$$

$$s_{\overline{n|}} = \frac{(1+i)^n - 1}{(1+i) - 1}$$

$$s_{\overline{n|}} = \frac{(1+i)^n - 1}{i} \quad \text{.. (2.4)}$$

At times, the interest rate is written to the lower right of the symbol, e.g. s_{ni}

***Deferred life annuity**:* if an imaginary payments of 1 are made at the end of 1st, 2nd, 3rd, and 4th – year. Then the present value of all nine payments is a_9. However, the present value of the imaginary payments which is a_4 must be removed. Thus an expression for the present value is:

$$a_9 - a_4 .$$

The symbol for an mth year deferred annuity-immediate with a term of n years after the deferred period is m/a_n. It should be noted that since payments are under m/a_n is m+1 years after the valuation date, instead of m years.

In general, using the reasoning in this illustration, we have

$$m/a_n = a_{m+n} - a_m = v_m a_n \quad \text{..... (2.5)}$$

Also, assume that imaginary payments of 1 are made at the end of the of 7th, 8th, and 9th years. Then the accumulated value of all 7 payments is s_7. However, there is need to remove the accumulated value of the imaginary payments which is s_3. Thus, an alternate expression for the accumulated value is: $s_7 - s_3$.

In general, the accumulated value of an n-years annuity m years after the last payment date is

$$m/s_n = s_m(1+i)^m = s_{m+n} - s_m \quad \text{..... (2.6)}$$

With respect to defined contribution plan just considered, this first phase deals with accumulation of fund which is subject to interest or investment risk. Therefore the series of payments using model (2.4) is:

$$As_{\overline{n}|r} = A\frac{(1+r)^n - 1}{r}$$

Where A is the periodic or annual contribution

n = number of years (or period) of contribution

s_n= the accumulation value for nth year contribution

Figure 2.1 demonstrates the duration when employee is expected to accumulate saving. For instance, if an employee entered into the present employment at age x = 25 and retired at age 65 for example, this means that such employee will spend 40 years to contribute towards his/her retirement funds.

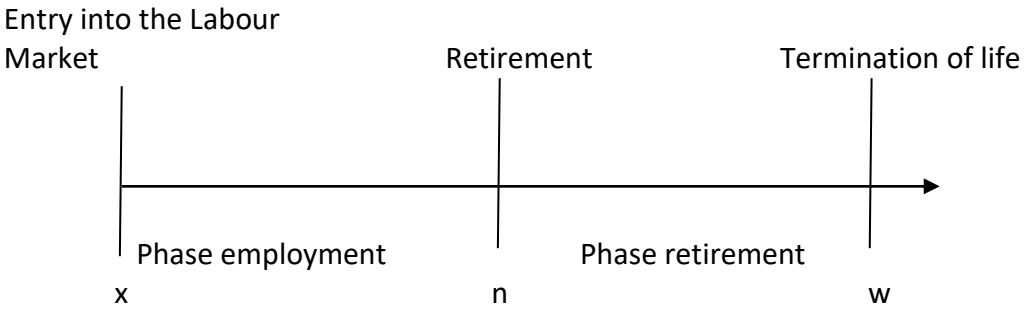

Figure 2.1: Life Cycle model of Retirement

The n year represents the retirement date and it is assumed that employee will not be actively employed and that no other source of income is available to him/her. Pension Reform Act 2004 states that no employee will have access to contributed funds if such fellow is actively engaged in employment after attaining retirement age. In practice, we know that some employee engaged in fulltime work after retirement, so the accumulated funds for the stochastic monthly salaries are:

$$\begin{aligned}\text{pension funds} &= \left[{}^{R}\mathrm{S}\times \mathrm{M}_1^{s}-\alpha\right]+\left[{}^{R}\mathrm{S}\times \mathrm{M}_2^{s}-\alpha\right](1+r_1)+\left[{}^{R}\mathrm{S}\times \mathrm{M}_3^{s}-\alpha\right](1+r_1)(1+r_2)+.....\\ &+\left[{}^{R}\mathrm{S}\times \mathrm{M}_n^{s}-\alpha\right](1+r_1)(1+r_2)(1+r_3).....(1+r_{n-1})\\ &=\sum_{j=1}^{n}{}^{R}\mathrm{S}\times(\mathrm{M}_j^{s}-\alpha)\prod_{j=1}^{n}(1+r_{j-1}) \qquad \ldots \quad (2.7)\end{aligned}$$

where ${}^{R}\mathrm{S}=\text{rate of saving},\ \mathrm{M}_i^{s}=\text{monthly savings for i years}$

and $\alpha=\text{fixed monthly charges made by PFAs}$

Thus, his/her total savings during employment phase represent fixed stock of wealth as discussed by Yaari (1965). Between the n and w, there is uncertainty of death which in turn possess risk factor – longevity risk – individual face at retirement.

Methodology

Data Source

The study covers the university employees in southwest Nigeria. A purposive random sampling was used to select 784 university employees in Private, State and Federal Universities located in southwest Nigeria. The choice of a purposive random sampling is due to the fact that participants are willing and able to provide sufficiently rich data in term of relevant and depth. In order to determine employees' contributions, they were requested to give estimates of their monthly contributions as reflected in their pay slips as well as number of years they have contributed funds to their RSAs. Where an employee was unable to give an estimate of monthly contribution, Federal University Salary Scale (FUSS) was used as a basis for determination of employees' and employers' monthly contributions to Retirement Saving Accounts (RSA). Since the employee and the employer are to contribute 7.5 percent of employees' annual emoluments each, 15% were charged against the Consolidated University Academic Salary Structure (CONUASS) on a monthly basis between July 2004 and August 2014. In order to account for increase in contribution adjustments in line with Pension Reform Act 2014, Models (3.3a) and (3.3b) were developed to capture the 3% increment. By this exercise, total contributions at retirement were arrived at. The rate of return was based on a fair rate reported by the PFAs.

Development of Models

Following the life cycle model examined in figure 2.1; it was noted that during the phase of employment, the employee earns a stochastic labour income. However, this study made used of average salaries in the models developed, which are represented by each month contributions. The reason for this is that, it will be difficult to use each employee's contribution to arrive at expected gross/net contributions. Therefore, the nominal funds as at age 65 based on the adoption are obtained as follows:

$$\text{Pension funds} = \left[{}^{R}S \times {}^{a}M_s - \alpha\right] + \left[{}^{R}S \times {}^{a}M_s - \alpha\right](1+r)^1 + \left[{}^{R}S \times {}^{a}M_s - \alpha\right](1+r)^2 + \left[{}^{R}S \times {}^{a}M_s - \alpha\right](1+r)^3 + \ldots\ldots + \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3.1a)$$

In general,

$$\text{pension funds} = \left[{}^{R}S \times {}^{a}M_s - \alpha\right]\left\{1 + (1+r) + (1+r)^2 + (1+r)^3 + \ldots\ldots + (1+r)^{n-1}\right\} \quad . \ldots\ldots\ldots\ldots \quad (3.1b)$$

where ${}^{a}M_s = \text{average monthly contribution}$

$$\left\{\begin{array}{lllll} \text{Year} & \text{Quarter 1} & \text{Quarter 2} & \text{Quarter 3} & \text{Quarter 4} \quad . \\ 1 & {}^{n}_{c}q^{1}_{1} & {}^{n}_{c}q^{1}_{1} & {}^{n}_{c}q^{1}_{1} & {}^{n}_{c}q^{1}_{1} \\ 2 & {}^{n}_{c}q^{1}_{2} & {}^{n}_{c}q^{2}_{2} & {}^{n}_{c}q^{3}_{2} & {}^{n}_{c}q^{4}_{2} \\ & & & & \\ . & . & . & . & . \quad . \\ . & & . & . & . \quad . \\ . & . & . & . & . \quad . \\ m & {}^{n}_{c}q^{1}_{m} & {}^{n}_{c}q^{2}_{m} & {}^{n}_{c}q^{3}_{m} & {}^{n}_{c}q^{4}_{m} \end{array}\right\} \ldots\ldots \quad (3.2a)$$

The above Models (3.1a and 3.1b) followed an algorithm procedure that enables the determination of employee's net contributions and the details are hereby developed for the first n year as follows:

where ${}^{n}_{c}q^{1}_{1} = ({}^{a}M_c - \alpha - v_t) = \text{net contribution for the 1st quarter of year 1}$

${}^{n}_{c}q^{2}_{1} = \left({}^{n}_{c}q^{1}_{1}\right) + 3 \times ({}^{a}M_c - \alpha - v_t) = \text{net contribution for the 2nd quarter of year 1}$

${}^{n}_{c}q^{3}_{1} = \left({}^{n}_{c}q^{2}_{1}\right) + 3 \times ({}^{a}M_c - \alpha - v_t) = \text{net contribution for the 3rd quarter of year 1}$

${}^{n}_{c}q^{4}_{1} = \left({}^{n}_{c}q^{3}_{1}\right) + 3 \times ({}^{a}M_c - \alpha - v_t) = \text{net contribution for the 4th quarter of year 1}$

${}^{n}_{c}q^{3}_{n-1} = \left({}^{n}_{c}q^{2}_{m\text{-}2}\right) + 3 \times ({}^{a}M_c - \alpha - v_t) = \text{net contribution for the 3rd quarter of year m - 1}$

${}^{n}_{c}q^{4}_{m} = \left({}^{n}_{c}q^{3}_{n-1}\right) + 3 \times ({}^{a}M_c - \alpha - v_t) = \text{net contribution for the 4th quarter of year m}$

.... … ...

v_t = represents value after taxed which some PFAs also charge on a monthly basis

The above algorithm was simulated into an excel spreadsheet with a fixed monthly contribution.

It should be noted that Model (3.2a) does not incorporate capital appreciation as included in Model (3.1b). As a result, another model was developed to account for contribution increment. Model (3.2b) below accounts for this:

$$\left\{\begin{array}{lllll} \text{Year} & \text{Quarter 1} & \text{Quarter 2} & \text{Quarter 3} & \text{Quarter 4} \\ 1 & af(1,1) & af(1,2) & af(1,3) & af(1,4) \\ 2 & af(2,1) & af(2,2) & af(2,3) & af(2,4) \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ m & af(m,1) & af(m,2) & af(m,3) & af(m,4) \end{array}\right\} \quad \text{(3.2b)}$$

Where $af(1,1) = ({}^{a}\mathrm{M}_{c} - \alpha - v_t)s_3 =$ Accumulated contribution for the 1st quarter of year 1

$af(1,2) = ({}^{a}\mathrm{M}_{c} - \alpha - v_t)s_6 =$ accumulated contribution for the 2nd quarter of year 1

…… …… ……

…… …… ……

$af(m,4) = ({}^{a}\mathrm{M}_{c} - \alpha - v_t)s_m$ = accumulated contribution for the 4th quarter of year m.

In respect of the above models, there is a need to make allowances for the adjustment in future contributions which can be upwards or downwards review. For this purpose the model, will be based on percentage of any future adjustments as given below:

$$\textit{Pension funds} = \left[{}^{R}\mathrm{S}\times{}^{a}\mathrm{M}_{s} - \alpha - v_t\right]s_n \pm \left\{{}^{R}\mathrm{S}\times{}^{a}\mathrm{M}_{s}\right\}s_{\frac{1}{m}} \pm \left\{{}^{R}\mathrm{S}\times{}^{a}\mathrm{M}_{s}\right\}s_{\frac{2}{m}} \pm \ldots\ldots \pm \left\{{}^{R}\mathrm{S}\times{}^{a}\mathrm{M}_{s}\right\}s_{\frac{n}{m}} \quad \text{(3.3}a\text{)}$$

$s_{\frac{1}{m}}, s_{\frac{2}{m}}, s_{\frac{3}{m}}, \ldots\ldots\ldots\ldots, s_{\frac{n}{m}}$ represent the accumulated values for the 1st, 2nd, 3rd, …., nth adjustments.

$$where\ s_{1_m} = \begin{Bmatrix} \text{Year} & \text{Quarter 1} & \text{Quarter 2} & \text{Quarter 3} & \text{Quarter 4} & . \\ 1 & af\ (1,1) & af\ (1,2) & af\ (1,3) & af\ (1,4) & \\ 2 & af\ (2,1) & af\ (2,2) & af\ (2,3) & af\ (2,4) & \\ . & . & . & . & . & \\ . & . & . & . & . & \\ . & . & . & . & . & \\ m & af\ (m,1) & af\ (m,2) & af\ (m,3) & af\ (m,4) & \end{Bmatrix} \quad \text{..... (3.3b)}$$

$af\ (1,1) = s_3 =$ accumulated contribution for the 1st quarter of year 1

The only difference between Models (3.2b) and (3.3b) is that there are no charges against (3.3b) since it has been made in (3.2b). By rule, any future adjustment should not be subjected to charges if double charges are to be avoided.

The positive and negative signs in Model (3.3a) indicate that the review in the contribution rates could be upwards or downwards. Where there is no future adjustment in contribution rate, then Model (3.3a) reverts back to Model (3.2b).

Results

The sum of the past and expected future years of contribution was used to arrive at total years of service. The average contributions based on employees' years of service is N6,839.77. This figure represents employee's monthly contribution. By implication, employee's monthly contribution to RSA is N13,679.52 (N6,839.77$\times 2$) since employer also contribute exact amount. Therefore, average monthly contribution per employee which was based on 15% of employee's basic salaries is N13,679.53. This figure was multiplied by an employee's years of service. That is, the past years of service and the expected future years of service were summed up and multiplied by N13,679.53 to arrive at N4,561,042.08 (Table 1). In PRA 2014, an employee's and employer's contribution rates were reviewed as 8% and 10% employee's monthly basic salaries respectively. The adjusted average monthly contribution starting from September, 2014 based on 18% yielded N15,845.46. The difference between N15,845.46 and N13,679.53 (i.e.N2,165.93) was commuted for 22 years (the future years) of expected contribution to arrive at N571805.52 (Table omitted). These figures N13,679.53 and N2,165.93 were fitted in to Model (3.3a) to arrive at a total of N5,132,847.60. Ignoring the administrative charges by the PFAs, an employee with a fixed contribution of N13,679.52 per month for 28 years (in

addition to N2,165.93 accumulated for 22 years) can only save up to N5,168,127.60 (this figure is the sum of N571,805.52 and N4,561,042.08)(See Table 1). N571,805.52 was arrived at by multiplying N2,165.93 by 264 months of contribution representing 22 years of future contribution. The 28 represents the average years of service for all employees. Since administrative expenses are charged, the total of N35,280 was deducted from N5,168,127.60 gross contribution to arrive at N5,132,847.60. Table 1 shows the net quarters and gross contribution throughout the years of service. The 28 years of service used in this study was arrived at by averaging individual employees' years of service. At a glance, employee with a fixed contribution of N13,679.52 can see how his/her contributions are growing. Model (3.3b) was used to arrive at N808,497.87 which was added to N7,849,182.90 to arrived at a total of N7,942,945.65. The monthly contribution can be varied for years of contribution. If the time value of money is recognized, then the total contribution after N35,280 has been charged is N7,849,182.90 (see Table 2). If no deduction is made, the gross contribution would have been N7,942,945.65.

For the stochastic monthly contribution starting from N13,000 with a fixed annual increment of N500 for 28 years, the total contribution for the years of service is $N13,872,579.68$ (Table 3). Similarly, if the rate of contribution were to be fixed at N13,679.52 but with varying interest, the total contributions for the year of service is N397,848,594.83 (as simulated in Table 5). In practice, these rates of interest are seemly unattainable but can be reviewed. What this mean is that, as rate of return increase, the contribution rate can be reduced and vice-versa.

Table 4 shows the deterministic net contribution with 2% interest rate per month. The purpose of this table is to show the cost implication of not remitting the employees' monthly contribution as and when due. In Pension Reform Act 2004, as earlier stated, there is provision for 2% fines per month to be charged against the defaulting employers and the 2% was used to simulate the figures displayed in Table 4 for different years of default. In some of the universities surveyed, there are evidences that some employees have not been credited with the amount deducted from their salaries for the past five years despite such contributions were deducted from their monthly salaries. For such employees with a fixed contribution of N13,679.52 per person, the total expected contribution is N1,548,196.04 per employee, and it will accumulate to N6,627,874.93 for the next five years (i.e. the total contribution for the first ten

years). If PenCom is to implement this rule of 2% fine, many defaulting employers are more likely to become insolvent. On the other hand, it will make them wakeup to the financial obligations to their employees. Unfortunately, there is no evidence that PenCom has taken any step to perform this statutory duty. Although this statutory rule could not be performed because the government that came up with the rule is the same government that put PenCom in place and has in one way or the other failed to remit employees contributions as and when due.

Conclusion

This study has carried out valuation of the employees' monthly contributions with the hope of determining the final accumulated funds for the years of service. This is an attempt to assist individual employees to know whether they need to increase their contribution in order to have sufficient funds after retirement. The valuation also shows what the costs will be if the regulatory body is willing to sanction the erring employers where employers default. For instance, any employer who fails to remit funds as and when due is to be fined for 3% of the amount not remitted on a monthly basis until the whole debt is remitted. Table 4 shows the cost implication to defaulting employers. If employee acquires right to sue the erring employer, then cost to individual employer for the period of default are shown in Table 4.

Since employees can only choose from either phased withdrawal or life annuity at retirement, they need to need to know which of the choices suitably meet their needs. It is important for employees who want to use their accumulated funds for phased withdrawal to get themselves acquainted with the financial models to be used by their PFAs so as to avoid being drained financially. Also, there is a need for the regulatory bodies to provide sound policy for the administration of pension scheme. Sound policy means providing written guidelines for all important decisions concerning the plan, its assets, and its management over time and in different financial markets. Policy should communicate the scope and objectives of the plan unequivocally to all stakeholders, plan managers, consultants and others for the sustainability of Defined Contribution in Nigeria.

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Table 1:Deterministic Net Contribution for the Quarters with free rate of interest

Year	Average Monthly Contribution	Fixed Charges	VAT	total months of contribution	Q1	Q2	Q3	Q4	NAC	Expected gross contribution
1	13679.53	100	5	12	40723.59	81447.18	122170.77	162894.36	1260.00	164154.36
2	13679.53	100	5	24	203617.95	244341.54	285065.13	325788.72	2520.00	328308.72
3	13679.53	100	5	36	366512.31	407235.90	447959.49	488683.08	3780.00	492463.08
4	13679.53	100	5	48	529406.67	570130.26	610853.85	651577.44	5040.00	656617.44
5	13679.53	100	5	60	692301.03	733024.62	773748.21	814471.80	6300.00	820771.80
6	13679.53	100	5	72	855195.39	895918.98	936642.57	977366.16	7560.00	984926.16
7	13679.53	100	5	84	1018089.75	1058813.34	1099536.93	1140260.52	8820.00	1149080.52
8	13679.53	100	5	96	1180984.11	1221707.70	1262431.29	1303154.88	10080.00	1313234.88
9	13679.53	100	5	108	1343878.47	1384602.06	1425325.65	1466049.24	11340.00	1477389.24
10	13679.53	100	5	120	1506772.83	1547496.42	1588220.01	1628943.60	12600.00	1641543.60
11	13679.53	100	5	132	1669667.19	1710390.78	1751114.37	1791837.96	13860.00	1805697.96
12	13679.53	100	5	144	1832561.55	1873285.14	1914008.73	1954732.32	15120.00	1969852.32
13	13679.53	100	5	156	1995455.91	2036179.50	2076903.09	2117626.68	16380.00	2134006.68
14	13679.53	100	5	168	2158350.27	2199073.86	2239797.45	2280521.04	17640.00	2298161.04
15	13679.53	100	5	180	2321244.63	2361968.22	2402691.81	2443415.40	18900.00	2462315.40
16	13679.53	100	5	192	2484138.99	2524862.58	2565586.17	2606309.76	20160.00	2626469.76
17	13679.53	100	5	204	2647033.35	2687756.94	2728480.53	2769204.12	21420.00	2790624.12
18	13679.53	100	5	216	2809927.71	2850651.30	2891374.89	2932098.48	22680.00	2954778.48
19	13679.53	100	5	228	2972822.07	3013545.66	3054269.25	3094992.84	23940.00	3118932.84
20	13679.53	100	5	240	3135716.43	3176440.02	3217163.61	3257887.20	25200.00	3283087.20
21	13679.53	100	5	252	3298610.79	3339334.38	3380057.97	3420781.56	26460.00	3447241.56
22	13679.53	100	5	264	3461505.15	3502228.74	3542952.33	3583675.92	27720.00	3611395.92
23	13679.53	100	5	276	3624399.51	3665123.10	3705846.69	3746570.28	28980.00	3775550.28
24	13679.53	100	5	288	3787293.87	3828017.46	3868741.05	3909464.64	30240.00	3939704.64
25	13679.53	100	5	300	3950188.23	3990911.82	4031635.41	4072359.00	31500.00	4103859.00
26	13679.53	100	5	312	4113082.59	4153806.18	4194529.77	4235253.36	32760.00	4268013.36
27	13679.53	100	5	324	4275976.95	4316700.54	4357424.13	4398147.72	34020.00	4432167.72
28	13679.53	100	5	336	4438871.31	4479594.90	4520318.49	**4561042.08**	35280.00	4596322.08
						571805.52	**4561042.08**	**5132847.60**		**5168127.60**

Source: Authors' Computation, 2015

Table 2:Deterministic Net Contributions for the Quarters with average contribution of with 3% nominal rate of interest 13,679.53 compounded monthly

Year	Average Monthly Contribution	Fixed Charges	VAT	Accumulated Factor	Interest rate	total months of contribution	Q1	Q2	Q3	Q4
1.00	13,679.53	100.00	5.00	1.00	0.0025	12.00	40,825.48	81,957.92	123,399.63	165,152.93
2.00	13,679.53	100.00	5.00	1.00	0.0025	24.00	207,220.16	249,603.68	292,305.88	335,329.14
3.00	13,679.53	100.00	5.00	1.00	0.0025	36.00	378,675.89	422,348.54	466,349.57	510,681.42
4.00	13,679.53	100.00	5.00	1.00	0.0025	48.00	555,346.60	600,347.61	645,686.96	691,367.22
5.00	13,679.53	100.00	5.00	1.00	0.0025	60.00	737,390.93	783,760.68	830,479.08	877,548.74
6.00	13,679.53	100.00	5.00	1.00	0.0025	72.00	924,972.31	972,752.44	1,020,891.82	1,069,393.15
7.00	13,679.53	100.00	5.00	1.00	0.0025	84.00	1,118,259.15	1,167,492.56	1,217,096.15	1,267,072.70
8.00	13,679.53	100.00	5.00	1.00	0.0025	96.00	1,317,425.00	1,368,155.90	1,419,268.22	1,470,764.85
9.00	13,679.53	100.00	5.00	1.00	0.0025	108.00	1,522,648.67	1,574,922.60	1,627,589.55	1,680,652.50
10.00	13,679.53	100.00	5.00	1.00	0.0025	120.00	1,734,114.42	1,787,978.30	1,842,247.17	1,896,924.08
11.00	13,679.53	100.00	5.00	1.00	0.0025	132.00	1,952,012.09	2,007,514.30	2,063,433.81	2,119,773.77
12.00	13,679.53	100.00	5.00	1.00	0.0025	144.00	2,176,537.34	2,233,727.70	2,291,348.05	2,349,401.65
13.00	13,679.53	100.00	5.00	1.00	0.0025	156.00	2,407,891.73	2,466,821.59	2,526,194.53	2,586,013.87
14.00	13,679.53	100.00	5.00	1.00	0.0025	168.00	2,646,282.99	2,707,005.26	2,768,184.08	2,829,822.89
15.00	13,679.53	100.00	5.00	1.00	0.0025	180.00	2,891,925.15	2,954,494.34	3,017,533.97	3,081,047.59
16.00	13,679.53	100.00	5.00	1.00	0.0025	192.00	3,145,038.75	3,209,511.04	3,274,468.08	3,339,913.53
17.00	13,679.53	100.00	5.00	1.00	0.0025	204.00	3,405,851.04	3,472,284.32	3,539,217.09	3,606,653.12
18.00	13,679.53	100.00	5.00	1.00	0.0025	216.00	3,674,596.18	3,743,050.09	3,812,018.69	3,881,505.85
19.00	13,679.53	100.00	5.00	1.00	0.0025	228.00	3,951,515.47	4,022,051.47	4,093,117.82	4,164,718.50
20.00	13,679.53	100.00	5.00	1.00	0.0025	240.00	4,236,857.52	4,309,538.95	4,382,766.84	4,456,545.32
21.00	13,679.53	100.00	5.00	1.00	0.0025	252.00	4,530,878.53	4,605,770.62	4,681,225.82	4,757,248.34
22.00	13,679.53	100.00	5.00	1.00	0.0025	264.00	4,833,842.46	4,911,012.47	4,988,762.71	5,067,097.53
23.00	13,679.53	100.00	5.00	1.00	0.0025	276.00	5,146,021.33	5,225,538.54	5,305,653.63	5,386,371.08
24.00	13,679.53	100.00	5.00	1.00	0.0025	288.00	5,467,695.42	5,549,631.23	5,632,183.09	5,715,355.64
25.00	13,679.53	100.00	5.00	1.00	0.0025	300.00	5,799,153.54	5,883,581.50	5,968,644.25	6,054,346.57
26.00	13,679.53	100.00	5.00	1.00	0.0025	312.00	6,140,693.27	6,227,689.19	6,315,339.21	6,403,648.25
27.00	13,679.53	100.00	5.00	1.00	0.0025	324.00	6,492,621.26	6,582,263.24	6,672,579.22	6,763,574.26
28.00	13,679.53	100.00	5.00	1.00	0.0025	336.00	7,165,858.42	6,947,622.01	7,040,685.03	7,134,447.78
								808,497.87	**7,849,182.90**	**7,942,945.65**

Source: Authors' Computation, 2015

Table 3: Stochastic Contributions for 28 years of service (336 months) with 3% annual interest rate compounded monthly

Year	Average Monthly Contribution (N)	Fixed Charges	VAT	Accumulated Factor	interest rate	total months of contribution	Q1	Q2	Q3	Q4
1	13,000.00	100.00	5	1.0025	0.0025	12	38,781.79	77,855.18	117,222.35	156,885.51
2	13,500.00	100.00	5	1.0025	0.0025	24	204,479.57	246,302.55	288,439.98	330,894.24
3	14,000.00	100.00	5	1.0025	0.0025	36	387,615.73	432,319.43	477,359.23	522,737.69
4	14,500.00	100.00	5	1.0025	0.0025	48	588,912.79	636,633.74	684,713.49	733,154.75
5	15,000.00	100.00	5	1.0025	0.0025	60	809,121.04	860,001.44	911,264.40	962,912.78
6	15,500.00	100.00	5	1.0025	0.0025	72	1,049,019.65	1,103,207.54	1,157,802.86	1,212,808.66
7	16,000.00	100.00	5	1.0025	0.0025	84	1,309,417.65	1,367,067.17	1,425,150.14	1,483,669.82
8	16,500.00	100.00	5	1.0025	0.0025	96	1,591,155.12	1,652,426.71	1,714,158.98	1,776,355.41
9	17,000.00	100.00	5	1.0025	0.0025	108	1,895,104.24	1,960,164.90	2,025,714.74	2,091,757.43
10	17,500.00	100.00	5	1.0025	0.0025	120	2,222,170.51	2,291,194.06	2,360,736.59	2,430,801.98
11	18,000.00	100.00	5	1.0025	0.0025	132	2,573,293.99	2,646,461.31	2,720,178.75	2,794,450.46
12	18,500.00	100.00	5	1.0025	0.0025	144	2,949,450.50	3,026,949.81	3,105,031.81	3,183,700.89
13	19,000.00	100.00	5	1.0025	0.0025	156	3,351,653.01	3,433,680.13	3,516,324.00	3,599,589.24
14	19,500.00	100.00	5	1.0025	0.0025	168	3,780,952.90	3,867,711.58	3,955,122.59	4,043,190.81
15	20,000.00	100.00	5	1.0025	0.0025	180	4,238,441.46	4,330,143.65	4,422,535.32	4,515,621.66
16	20,500.00	100.00	5	1.0025	0.0025	192	4,725,251.28	4,822,117.42	4,919,711.89	5,018,040.14
17	21,000.00	100.00	5	1.0025	0.0025	204	5,242,557.75	5,344,817.15	5,447,845.42	5,551,648.34
18	21,500.00	100.00	5	1.0025	0.0025	216	5,791,580.65	5,899,471.79	6,008,174.13	6,117,693.78
19	22,000.00	100.00	5	1.0025	0.0025	228	6,373,585.77	6,487,356.62	6,601,982.88	6,717,470.99
20	22,500.00	100.00	5	1.0025	0.0025	240	6,989,886.52	7,109,794.94	7,230,604.92	7,352,323.25
21	23,000.00	100.00	5	1.0025	0.0025	252	7,641,845.71	7,768,159.81	7,895,423.64	8,023,644.34
22	23,500.00	100.00	5	1.0025	0.0025	264	8,330,877.34	8,463,875.86	8,597,874.37	8,732,880.38
23	24,000.00	100.00	5	1.0025	0.0025	276	9,058,448.41	9,198,421.12	9,339,446.26	9,481,531.73
24	24,500.00	100.00	5	1.0025	0.0025	288	9,826,080.89	9,973,329.01	10,121,684.24	10,271,154.93
25	25,000.00	100.00	5	1.0025	0.0025	300	10,635,353.66	10,790,190.26	10,946,191.04	11,103,364.76
26	25,500.00	100.00	5	1.0025	0.0025	312	11,487,904.60	11,650,655.08	11,814,629.25	11,979,836.30
27	26,000.00	100.00	5	1.0025	0.0025	324	12,385,432.69	12,556,435.23	12,728,723.49	12,902,307.16
28	26,500.00	100.00	5	1.0025	0.0025	336	13,329,700.22	13,509,306.24	13,690,262.67	13,872,579.68

Source: Authors' Computation, 2015

Table 4: Net Contribution for the Quarters with 2% interest rate

Year	Average Monthly Contribution	Fixed Charges	VAT	Accumulated Factor	interest rate	total months of contribution	Q1	Q2	Q3	Q4
1	13679.53	100	5	1.02	0.02	12	41543.4916	85629.77726	132414.4963	182062.81
2	13679.53	100	5	1.02	0.02	24	234750.007	290662.0768	349996.4128	412962.48
3	13679.53	100	5	1.02	0.02	36	479782.584	550692.6082	625942.893	705799.1
4	13679.53	100	5	1.02	0.02	48	790543.14	880474.1961	975909.7523	1077186.7
5	13679.53	100	5	1.02	0.02	60	1184662.66	1298716.989	1419752.35	1548196
6	13679.53	100	5	1.02	0.02	72	1684501.52	1829149.979	1982652.082	2145549.7
7	13679.53	100	5	1.02	0.02	84	2318418.04	2501867.266	2696545.049	2903138.7
8	13679.53	100	5	1.02	0.02	96	3122377.47	3355035.446	3601933.947	3863944.6
9	13679.53	100	5	1.02	0.02	108	4141992.43	4437058.989	4750185.987	5082478.9
10	13679.53	100	5	1.02	0.02	120	5435110.72	5809326.469	6206447.215	6627874.9
11	13679.53	100	5	1.02	0.02	132	7075097.39	7549693.441	8053338.569	8587810.8
12	13679.53	100	5	1.02	0.02	144	9154997.02	9756899.572	10395643.37	11073483
13	13679.53	100	5	1.02	0.02	156	11792812.7	12556170.64	13366252.22	14225917
14	13679.53	100	5	1.02	0.02	168	15138200.7	16106323.2	17133702.52	18223966
15	13679.53	100	5	1.02	0.02	180	19380961.7	20608775.05	21911740.44	23294458
16	13679.53	100	5	1.02	0.02	192	24761808.4	26318972.67	27971447.84	29725068
17	13679.53	100	5	1.02	0.02	204	31586023.1	33560883.94	35656622.01	37880636
18	13679.53	100	5	1.02	0.02	216	40240777.5	42745378.49	45403281.11	48223869
19	13679.53	100	5	1.02	0.02	228	51217098.7	54393538.34	57764401.52	61341589
20	13679.53	100	5	1.02	0.02	240	65137727.9	69166221.49	73441291.06	77978029
21	13679.53	100	5	1.02	0.02	252	82792451.8	87901555.68	93323377.59	99077058
22	13679.53	100	5	1.02	0.02	264	105182910	111662489.5	118538670.7	125835729
23	13679.53	100	5	1.02	0.02	276	133579426	141797098.9	150517759.2	159772194
24	13679.53	100	5	1.02	0.02	288	169593074	180015070	191074975.9	202811837
25	13679.53	100	5	1.02	0.02	300	215267087	228484698.3	242511333.2	257396510
26	13679.53	100	5	1.02	0.02	312	273192779	289955906.6	307745071.2	326623075
27	13679.53	100	5	1.02	0.02	324	346656564	367916262.1	390477224.2	414419098
28	13679.53	100	5	1.02	0.02	336	536294571	466788843.3	495401598.3	525765683

Source: Authors' Computation, 2015

Table 5: Projected fixed contribution under varying rate of interest

Year	Average Monthly Contribution	Fixed Charges	VAT	Accumulated Factor	interest rate	total months of contribution	Q1	Q2	Q3	Q4
1	13679.53	100	5	1.0025	0.0025	336	6855253.48	6947622.01	7040685.03	7134447.78
2	13679.53	100	5	1.0030	0.0030	336	7525755.93	7634537.02	7744300.07	7855053.96
3	13679.53	100	5	1.0035	0.0035	336	8278914.50	8407014.00	8536463.25	8667276.49
4	13679.53	100	5	1.0040	0.0040	336	9125922.69	9276759.09	9429412.78	9583905.65
5	13679.53	100	5	1.0045	0.0045	336	10079569.13	10257163.69	10437166.58	10619610.46
6	13679.53	100	5	1.0050	0.0050	336	11154472.22	11363554.83	11575789.39	11791223.41
7	13679.53	100	5	1.0055	0.0055	336	12367349.91	12613483.56	12863700.79	13118069.36
8	13679.53	100	5	1.0060	0.0060	336	13737330.17	14027057.14	14322030.54	14622345.38
9	13679.53	100	5	1.0065	0.0065	336	15286308.24	15627321.86	15975028.56	16329559.70
10	13679.53	100	5	1.0070	0.0070	336	17039357.84	17440704.30	17850538.18	18269038.95
11	13679.53	100	5	1.0075	0.0075	336	19025204.54	19497519.96	19980542.37	20474514.50
12	13679.53	100	5	1.0080	0.0080	336	21276771.02	21832559.80	22401794.52	22984800.45
13	13679.53	100	5	1.0085	0.0085	336	23831804.86	24485766.79	25156546.89	25844577.69
14	13679.53	100	5	1.0090	0.0090	336	26733602.03	27503016.24	28293392.16	29105300.87
15	13679.53	100	5	1.0095	0.0095	336	30031840.31	30937016.32	31868235.69	32826247.75
16	13679.53	100	5	1.0100	0.0100	336	33783539.93	34848347.16	35945419.11	37075733.43
17	13679.53	100	5	1.0150	0.0150	336	116863589.51	122243065.88	127868267.98	133750420.17
18	13679.53	100	5	1.0200	0.0200	336	439826405.21	466788843.31	495401598.33	525765682.85
19	13679.53	100	5	1.0250	0.0250	336	1743225309.73	1877304743.47	2021693628.68	2177184665.51
20	13679.53	100	5	1.0110	0.0110	336	42918929.19	44392063.75	45914348.45	47487423.16
21	13679.53	100	5	1.0120	0.0120	336	54789301.84	56826694.59	58938317.15	61126874.00
22	13679.53	100	5	1.0130	0.0130	336	70252612.64	73069492.25	75997664.50	79041526.49
23	13679.53	100	5	1.0140	0.0140	336	90443409.28	94336757.75	98395926.83	102627978.94
24	13679.53	100	5	1.0150	0.0150	336	116863589.51	122243065.88	127868267.98	133750420.17
25	13679.53	100	5	1.0160	0.0160	336	151503296.56	158933808.52	166726722.13	174899712.47
26	13679.53	100	5	1.0170	0.0170	336	197002044.21	207262336.92	218054850.64	229407192.70
27	13679.53	100	5	1.0180	0.0180	336	256863561.96	271026824.73	285968752.98	301732156.05
28	13679.53	100	5	1.0190	0.0190	336	335742398.09	355287128.89	375967210.35	397848594.83

Source: Authors' Computation, 2015