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Investigating Trend in Defined Pension Contribution Based on Trend Projection Model

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Abstract
Forecast is simply predicting the future based on current information. Pension forecast help to predict the future with respect to some expected or proposed changes. This short note is designed to investigate trend in defined contribution (DC)/ defined benefit (DB) with regard to age falsification. The causes and effects of trends are investigated using trend projection model. The analysis is based on time series data to build and validate the model. SAS/IML software is used to program the projection model and the MATLAB software is used for the graphical analysis. Statistical summary and margin of error are computed to advice management on strategic future plans and expenditure. The duty of the analyst is to advice management based on the output of the simulation.

1. Introduction

Pension is an organized system of government that allows a retiree to earn regular income. Pension is categorized into state pension and private pension. Private pension is further divided into personal pension and occupational pension. This note is centered on trends in occupational pension with emphasis on defined pension contribution.

Over the years in Nigeria defined pension contributors has increased from 932,435 members in 2006 to 3,888,491 contributors in September 2009 with asset of #265billion in 2006 to #1.3 trillion in September 2009 [3]. This report represents upward trends. The focus is to apply statistical model to investigate trends and advice decision maker on further action. Trend projection is a veritable tool that aid management in future planning. Conventionally, the sample mean is meaningless to a non statistician, though on a detail observation the sample mean assist decision maker to take reasonable decision to enhance effective planning. Ordinarily, it helps to project the next phase of action. Forecasting technique based on moving or weighted average utilizes this beautiful bride. The sample mean is very vital in developing different statistical models. In practice, its instability helps to analyze trend overtime. Forecasting techniques are applied to predict future events or trends. Forecasting "is a planning tool that helps management in its attempts to cope with the uncertainty of the future, relying mainly on data from the past and present and analysis of trends" [5]. Forecasting process start with certain assumptions based on the management's experience, knowledge, and judgment. These estimates are projected into the coming months or years using statistical models.

The rest of this short note is organized as follows. Problem statement is contained in Section Two. Section Three contains the objective of the study. Pension is detailed in Section Four while trend projection model and trend in defined pension contribution are described in Sections Five and Six. Conclusions are made in Section Seven.

2. Problem statement

It has been observed that trends do occur in pension contribution and most authors have attributed this to number of contributors and value contributed per contributor. Large number of such writer restricts their understanding to monthly, annual and lifetime contributions. Beside the above, what are the other factors that necessitate trend in pension contribution? As contained below, so many factors may cause fluctuation in defined contribution (DC), say number of service years as defined by civil service rule, ill health, age and age falsification, etc. We also consider gender contribution and gender longevity in service as it affect DC.

This study will also investigate if there is established defined pension contribution benchmark relying on the fact that a career civil servant who has worked for 35 years should have DC benchmark with promotions and other factors considered. Same goes to those who have put in 33, 31, 30, 25, 20, 15 years, respectively. If DC benchmark is based on number of service years, starting grade/level, promotions, etc. what happens if some retiree's total DC exceeds the conventional benchmark? What are the causes of this discrepancy? How do we detect these causes? What is the cost implication to government? What is the consequence of such action on the public? An illustration of such scenario is contained in Table 1 and Table 2 (artificial data). Figure 1 and Figure 2 shows the upward trend and the cost implication to government. Apart from the graphical presentation, the projection model provides solutions to the above questions and at the sometime detect the causes keeping other factors constant. The model is also used to predict and estimate future plans and expenditures.

3. Objective

The purpose of this note is to provide management advice using trend projection model that utilizes time series data. Based on the simulation results, the analyst will advice management to effectively strategize for future planning and budgeting. The study can be applied to sample individual actual defined contribution with regards to the following factors, years of service, rank, promotion and monthly DC. This process will assist us to detect contributors that have contributed more than the DC benchmark, and reason for this investigated. This is also applicable to defined benefit (DB). This will assist decision makers to understand the trend and other anomalies within the system. The findings will automatically reveal the courses of downward or upward projection.

To achieve the above, as previously mentioned we apply statistical model. The model is used to project annual pension contribution and expenditure. The model is trained based on past data set and is validated using time series information. The estimated output is used to plan for the future. The model also aid in detecting irregular trends in defined pension contribution. This trend allows the analyst to investigate the causes and effects and advice management. The margin of error computed based on the summary statistics is useful for planning. This type of investigation is constrained due to lack of past information. Overall, the basis of this study is to estimate future cost or projection with time. In furtherance to planning, the trend projection model is used to estimate and predict future cost which will enhance effective strategic planning.

4. Pension

Pension forecast assist decision makers in regular financial planning process. In the recent past, various labor movement negotiation emphasize on pension agreements. Sze (1993) "stated in clear terms that there are no legal or accounting rules to pension projection" The focus is on the trend projection vis-à-vis downward or upward trend. Questions are asked about the pension trend with regard to age falsification, personal data manipulation or corporate extension of service years. Pension may be categorized into two, say: (i) State pension and (ii) private pension. Private pension can be broadened into two, say: (i) personal pension and (ii) occupational pension. This short note is centered on occupational pension with emphasis on defined pension contribution. Occupational pension is basically deducted from source.

i.) Public sector

Occupational pension (OP) is a pre-arrangement established by employers to provide pensions to their employees. For instance, in the public sector, occupational pension are strictly provided by the employer, local, state and federal government.

ii). Private sector

Occupational pensions are employer-sponsored schemes with scheme trustees that are set up under trust law by one or more employers for the benefit of their employees. Occupational pension can be categorized as,

a. Defined contribution (DC): In DC the employee, employer or both contribute, and then use the accumulated funds to provide an income at retirement. This type of pension is funded [1, 4].
b. Defined benefit (DB): This version of OP requires the employer to pay the individual a certain pension income at retirement, usually based on the number of years they have worked for the employer and their salary. DB is usually not funded [1].

iii. Causes of trend

This short note center on the usefulness of statistical model to investigate trends based on defined pension contribution. Certainly, trends in defined pension contribution maybe due to the following factors: (1) Age falsification, (2) Years of service, (3) Promotion, (4) Downsizing, (5) Voluntary/ unanticipated retirement/ill health, (6) Leave of absence, (7) Death. These factors may cause discrepancies in individual defined pension contribution or defined benefit. Thus, in the absence of the above except (factor 1), what is the cause(s) of upward projection keeping every other factor constant? Does it really mean factor 1 is the cause of upward projection or factor (4)? On the contrary, what is the cause(s) of downward projection, is it factor (2) through factor (7)? However, the focus is based on the application of statistical model to determine the nature of trend (say downward or upward) using artificial data set. The following section will illustrate the effect of the above factors using projection model.

5. Trend projection model

Previous data set on DC will aid in projecting the future pension trend. Negating past data set when investigating projection trend is worthless and hence produces worthless results [2]. Trend projection model is applied to identify grey area in DC/DB with respect to age falsification. Age falsification is vital in this investigation because of its negative economic implication and this is largely due to bloated wage bills. Other factors listed are

vital to enhance stable and accurate DC or DB. However, these factors allow government to save reasonable amount of money thereby creating new job opportunities.

The statistical model designed for this project will aid management to monitor DC trend and if necessary apply the contribution template to investigate the annual total and lifetime contribution and compared with the contribution benchmark and if the total contribution exceed the contribution benchmark, such a retiree will be requested to refund government fund due to his/her corporate age manipulation. Beautiful enough, this model will assist management to detect age falsification or service extension easily. This will give the analyst impetus to advice management on possible causes of trends and also help in trend projection and forecasting. Basically, the model is vital for projection and forecasting. Relying on the analyst advice, management can effectively project into the future.

The projection accuracy of this model can be determined by the value of the mean squared error (MSE). If the value of the MSE is small this implies that the projection is well established. On the other hand, margin of error can be computed using information from past data set via t-distribution at various levels of significance. The margin of error can be used by management to plan for the future. The analyst based on the output of the model can advise management on the next line of action. The performance of the model is determined by the data set used to train and validate the model or simply put the sign of the slope. Early projection can be done using the value of the slope. Negative slope indicate downward projection and positive slope implies upward projection, the reverse of both is possible.

Based on the information from previous data set and the output, the analyst can advice management on future plan relying strictly on the confidence limit. The software used for this project is SAS/IML. The statistical model is coded using SAA/IML programming language. The simulation is performed using time series information. Summary statistics is computed based on SAS/IML program. The graphs are plotted using MATLAB software and programming language, respectively.

Table 1 and Table 2 below contain artificial data for two groups of retirees based on total defined contribution. The aim is to investigate the cause of the bloated total DC in group two. As an illustration, suppose the expected lifetime pension contribution benchmark for career civil servant is contained in Tables 1 and 2.

Table 1: Normal defined contribution

Years of service	DC (Millions)
35	7.0
33	6.5
31	6.0
30	4.5
25	4.0
20	3.5
15	3.0
	34.5

Table 2: DC based on age falsification

Years of service	DC (Millions)
35	8.6
33	8.3
31	7.8
30	7.5
25	6.9
20	6.3
15	5.8
	51.2

Mean value for group one is 4.93m and mean value for group two is 7.31m. It is clear that those in group two may probably falsify their age or extended their years of service or probably are employed with higher ranks/ higher degrees. The mean difference between the two groups is 2.38m. Figure1 revealed DC trend based on years of service with all factors. Green line indicates higher DC and blue line indicate moderate DC. The red line indicates difference in DC for both categories. The implication of this is that age manipulation or extending years of service is a major barrier in pension projection and administration. This type of study will enable management to investigate thoroughly and develop a template for lifetime DC or DB. The analysis is not just for

upward projection but also includes downward projection. If the years of service, promotion and contribution template is well documented and presented, government will be able to detect employee who falsify their age for longer service or other factors as may apply.

The margin of error for group one is ± 1.586m and the minimum projection is 3.344m as against the observed 3m. The maximum projection is 6.516m as against 7m. For group two, the margin of error is ± 1.045m and the minimum projection is 6.256m as against 5.8m while the maximum projection is 8.355m as against 8.6m. Based on the above information, decision analyst will advise management on the effect of age manipulation or other factors with respect to DC benchmark. It is interesting to observe that retirees in group two over contributed and this is questionable because the contribution is based on source rather than individual contribution. This illustration revealed the causes of upward trend in DC. Under normal condition with due retirement age and well documented promotion and other factors in place, the trend ought to be uniformly upward. Note :F1 is factor one (age falsification).

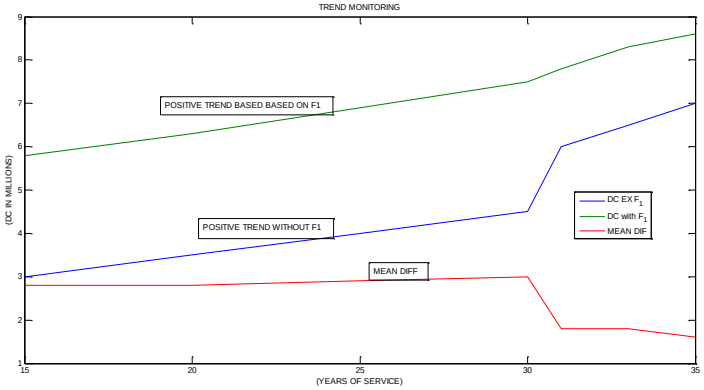

Figure 1. Trends of DC based on service years.

The illustration indicates that when age is falsified, the DC will exceed the conventional benchmark. If factor 1 is well monitored, government will save reasonable amount of money in millions, and this can be channeled towards other sector for quality services. The analysis revealed that as from 30 years above DC will increase based on this artificial data.

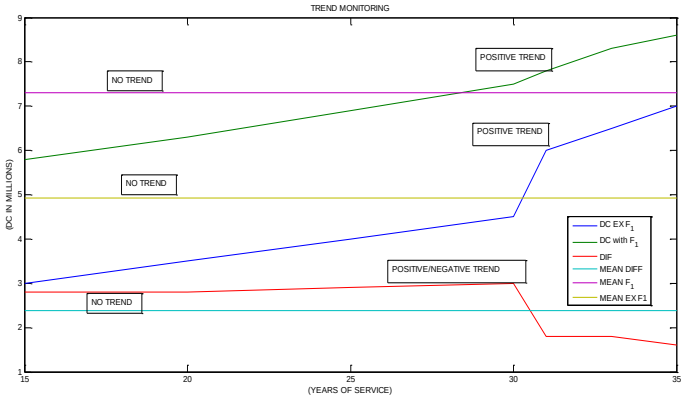

Figure 2. Mean projection

Table 3. DC annual and total contribution (AD)

Years	Annual DC(Thousand)	Total DC (Million)
1990	#215	#1.50
1991	#225	#1.60
1992	#235	#1.65
1993	#245	#1.75
1994	#255	#1.80
1995	#50	#1.80
1996	#50.1	#1.50
1997	#50.3	#1.50
1998	#40.2	#1.25
	#1,365.6	#14.35

AD: artificial data

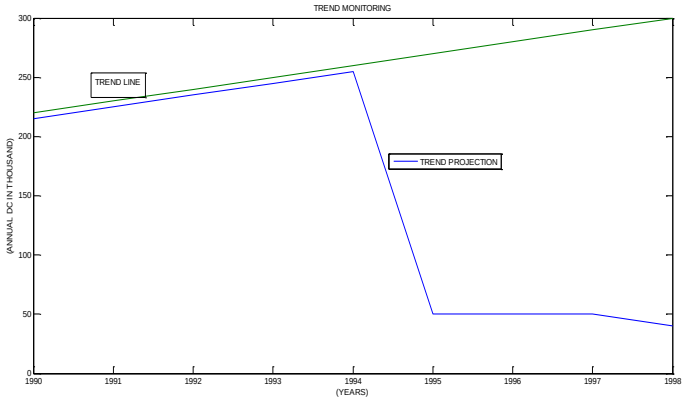

Figure 3. Annual DC

The model projected 25,000 for 1999 which implies downward projection for annual DC when compared to the previous value. The slope indicate decline in DC annually. The model predicted 1.46million for 1999, which implies upward trend. Projection error can easily be computed using the difference between observed values and the projected values.

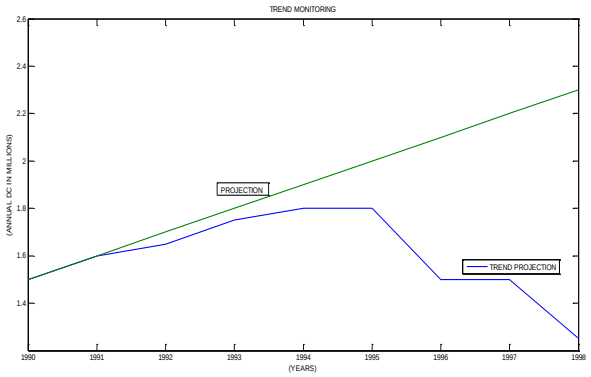

Figure 4. Total DC

6. Trend in defined pension contribution

It is conventional to determine longevity between male and female and to study the trend of gender contribution. We are also keen to investigate the gender that has the highest trend projection and age manipulation. The templates below will aid us further.

Table 3. Number of contributors by Gender

Years	Male	Female	Total
*	*	*	*

*:Data not available.

Table 4. Gender monthly contribution

Month	Male	Female	Total
*	*	*	*

Table 5. Gender yearly contribution

Year	Male	Female	Total
*	*	*	*

Table 6. Summary table

Years	Gender		Ministries	Starting rank	Retirement rank	DC benchmark	Total
	Male	female	Commissions				
*	*	*	*	*	*	*	*

7. Conclusion

Projection output is based on estimate. A projection or forecast result is based on time series data and may cover ten years or more. Projection is one of the best procedures to prosecute future plan. Most often, financial analyst uses projection or forecasting to make future financial projection on a regular basis. Financial analyst find pension projection as a very reliable means of making future projection than other procedures based on estimate. The analysis presented above revealed the causes of trends in DC. As discussed previously, trend projection can be applied to investigate age manipulation if super upward projection is observed in individual defined contribution provided other factors remain constant. The simulation performed using time series data revealed that projection model can be applied to forecast future trend. As shown using the above illustrations, if annual DC decline it does not translate automatically that the total individual DC will decrease. The illustration revealed that if bloated DC is observed, this model can be used to investigate the trend and hence allows the analyst to advice management. The projection model presented is a veritable tool for strategic planning for the future.

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