International Journal of Finance and Accounting 2016, 5(4): 202-208
DOI: 10.5923/j.ijfa.20160504.05

Pricing and Profit Testing of "key man" Life Policy of Insurance Companies in Ghana

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Abstract The pricing and profitability of a good insurance product depends greatly on some key factors such as the investment rate, shareholders rate, expense rate, commission rate, surrender and death benefits. Profit testing of "key man" product was run on three insurance companies in Ghana using the modern method of profit testing under the asset share models and the results obtained indicated that an increase in premium was not enough to increase effciency and profit. Instead, the investment rate had to be increased and expense decreased whiles giving shareholders substantial dividend rate. The study revealed that the investment rate has a great effect on profit of the product and also illustrated that it was expedient to spread out the expense over a longer period of time with the first two years having the greater share of the expense followed by a low constant expense rate for the continuing years. The amount paid as dividend should motivate and attract investors while the commission rate should motivate agents to bring more clients on board and at the same time there should be a strong reserve to cater for claim payments while the surrender and death benefits should be well allocated. These factors are nesssary to keep an insurance company to run efficiently, irrespective of the claims that it must has to pay.

Keywords Asset share model, Premium, Reserve, Key man, Pricing and profit testing

1. Introduction

A 'key man' life insurance policy is basically a life insurance policy on the key employee which lists the employee's firm as the beneficiary. On the death of that employee, the corporation receives the face value of the insurance policy. A key person insurance is required for a sudden loss of a key executive, which would have a large negative effect on the company's operations. The payout provided from the death of the executive essentially gives the company time to find a new person or to implement other strategies to save the business.

The research on key man product insurance is based on the five pillars in actuarial science. These are:

- The theory of solid calculus of probability by Fermat and Pascal.
- John Graunt's descriptive statistical analysis of demographic data in his "Observation made upon the Bills of Mortality".
- A probabilistic interpretation of Graunt's tables by the Huyghen brothers.
- Mortality table based on the yearly number`s of death observed in the city of Breslau by Edmond Halley.
- Jan de Witt's compound interest technique for the value of an annuity.

All these elements were put together and they became the fundamental pillars for the sound management of life insurance. The proposers of these concepts, James Dodson, Richard Price and William Morgan, are said to be the first actuaries (ASTIN BULLETIN, 1993). The method of profit testing was introduced by James Anderson in his study on "Gross premium calculations and profit measurement for non-participating insurance", which the Triennial Price for 1959-61 (Anderson, 1959).

An insurance system is a mechanism for reducing the adverse financial impact of random events that prevents the fulfillment of reasonable expectation (Bowers, 1989). The factors people consider before buying a life insurance product are the financial strength, the claims delivery and the price of the life insurance product. (New York Life Insurance Company, 2010). In a report by Wharton University (2006), it says, "There is no right price of insurance: there is simply the ***transacted market price*** which is high enough to bring forth sellers and low enough to induce buyers." The question, however is "How does one determine this transacted market price?".

An operating business must also know if their products are profitable. This is extremely difficult if the product is a long-term life product. Following the normal procedure, one can know if a business is profitable after the business has gone off the books, and for some life products, it can take a lifetime. Clearly, a differently more sophisticated approach

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Published online at http://journal.sapub.org/ijfa

is needed to assess the profitability of such products before writing and producing a life product in the first place. This is where profit testing becomes necessary.

Profit testing is the process of assessing the profitability of an insurance contract in advance of being written (Richard, 2006). Insurance profit testing is about considerations that are taken before any insurance product is priced, which includes how stakeholders are properly rewarded for the risks that they take. Profit testing is therefore used as an assessment as well as a pricing tool. The main factors that impact on profit testing are mortality, investment earning, expenses and persistence (New York Life Insurance Company, 2010). Thus, the importance of profit testing cannot be underestimated in any way as the consequence of ignoring it is detrimental to the economy. Profit testing and pricing are essential to the insurance industry and much research on this subject matter is needed to inform in life insurance companies in Ghana. In this study, we aim to assess the profitability of "key man" life insurance product using the modern method of profit testing under the asset share models.

2. Methodology

In calculating the profitability and pricing efficiency of key man" insurance policy, data were collected from three life insurance companies in Ghana. The parameters considered are commission paid, expense fee charged, premium, interest rate, investment rate earnings, and shareholders' interest rate. The modern method of profit testing under the asset share model was used to determine the suitable pricing to be derived while theory of interest techniques were used to calculate the profit rate and profit margin. The model was used to illustrate the following:

- Incidence and timing of profit.
- Future state of the insurance office in terms of investment strategy.
- Impact of surrenders
- Capital required using a more practical assessment

This model is flexible, adequate and very simple to use. A contingency margin of 0.005 is included to cover for any lack in persistency. The reserve and premium were estimated using the actuarial and the modern profit testing models presented in the following sections.

2.1. Actuaial Models

Techniques used in calculating minimum premium may be divided into two main forms: Asset share and formula techniques. The formula technique matches to the calculation of a net premium such that at the interest chosen, the present value of death, survival and disability benefit plus expense is not greater than the present value of premium. The asset share technique is more composite and incorporates many explicit parameters, as well as the statutory reserves. The profit criteria, particularly, for this method can be expressed as:

- Asset share at certain duration should be at least say 110% of reserves.
- Asset share should be at least equal to reserve or surrender value by not later than certain duration.

2.1.1. Traditional Method of Profit Testing

In prevoius models of profit testing the equivalence principle was used to obtain the traditional margin and this led to profit testing. Equivalence principle states that the actuarial present value (APV) of premiums is equal to the actuarial present value of benefits plus the actuarial present value of charges (Derbally, 2001). It can also be stated as the required reserve plus actuarial present value of future premium is equal to actuarial present value of future outgo (Whelan, 2010). This design requires little data and could be used in group data. It is simple, yet very powerful. Using endowment we have:

$$P''\ddot{a}_{\overline{x:n|}} = A_{\overline{x:n|}} + \lambda + \gamma\ddot{a}_{\overline{x:n|}} \tag{1}$$

and the traditional margin:

$$P''\ddot{a}_{\overline{x:n|}} - TM = A_{\overline{x:n|}} + \lambda + \gamma\ddot{a}_{\overline{x:n|}} + \sum_{k=0}^{n-1} V^{k+1} L_{x+k}\, \mu_{x+k}\, {}_k p_x + \sum_{k=0}^{n-1} V^{k} B_k\, {}_k p_x \tag{2}$$

where:

TM = traditional margin;

B_k = bonus;

L_{x+k} = lapse or surrender

λ = acquisition expense;

γ = administration expense;

μ_{x+k} = probability to lapse

The traditional way was however not suitable for modern evaluation due to fact it was challenging to use different discount rates in valuation. Secondly, the equation of value did not depict cash flows over the course of the contract so capital requirement was not explained. Capital is a rare resource with alternative uses. Modern management would need a more precise valuation of the capital requirement, as well as its timing and return on capital. Lastly, embedded options could not be valued.

2.1.2. Modern Method of Profit Testing

The modern method of profit testing has a generic form:

$$\sum_{t=0}^{\infty} CF_t / (1+i)^t \tag{3}$$

which amends the traditional, but has reserves added to it. Its principle states that the APV of premiums is equal to the APV of outgo + APV of contribution to profit. The formula is:

$$\begin{cases} \sum_{k=0}^{n-1} [P'' \, {}_k p_x - \gamma \, {}_k p_x - \nu q_{x+k} \, {}_k p_x - \nu L_{x+k} \mu_{x+k} \, {}_k p_x \\ -B_k \, {}_k p_x - (\nu \, {}_{k+1}V \, {}_{k+1} p_x - {}_k V \, {}_k p_x) + I_k - G_k] v^k \\ - v^n \, {}_n p_x - \alpha \end{cases} \quad (4)$$

where:

G_k = profit; B_k = bonus

L_{x+k} = lapse/surrender

λ = acquisition expense

γ = administration expense

μ_{x+k} = probability to lapse

V_k = reserve I_k = interest earned

$v^k = (1+i)^{-1}$ = the discount factor

2.1.3. Premium for Endowment

Premium is the amount of money paid by the insured in periodic interval in order to obtain a form of insurance cover. Using the equivalence principle:

E(loss) = E(PV of benefit) – E(PV of premium) = 0 or E(PV of benefit) = E (PV of payments):

$$\begin{aligned} E(L) &= A_{\overline{x:n|}} - P_{\overline{x:n|}} \ddot{a}_{\overline{x:n|}} = 0 \\ A_{\overline{x:n|}} &= P_{\overline{x:n|}} \ddot{a}_{\overline{x:n|}} \end{aligned} \quad (5)$$

The premium for endowment is given by:

$$P(A_{\overline{x:n|}}) = b_t \left(\frac{A_{\overline{x:n|}}}{\ddot{a}_{\overline{x:n|}}} \right), \quad (6)$$

where b_k is the benefit to be paid to the insured in the event of death as long as a premium has been paid.

2.1.4. Reserves

It is sensible for the insurance company to allocate some of the premium received for future payment of maturity benefit. The allocation process is called reserving. A benefit reserve at time t is the difference between the expected value of future benefits and the expected value of future premium:

${}_tV$ = E(*PV* of future benefit) - E(*PV* of future premiums). Then the reserve for endowment becomes:

$${}_tV(A_{\overline{x:n|}}) = b_t . A_{\overline{x+t:n-t|}} - P_{\overline{x:n|}} \ddot{a}_{\overline{x+t:n-t|}} \quad (7)$$

2.1.5. Minimum Death Benefit Guaranteed

A benefit term that guarantees that the beneficiary, as named in the contract, will receive a death benefit if the annuitant dies. The minimum death benefit guaranteed is:

$$D_b = max\left[P_{\overline{x:n|}} t, b_k (t/n) \right] \quad (8)$$

t is number of payments made and n is total number of payments for the endowment.

2.1.6. Surrender Benefit

A policy is said to be surrendered when the insured ends the policy before the end of the term of the contract. The surrender benefit, Sb_{x+t} is defined as:

$$Sb_{x+t} = SF_{x+t} . \phi . {}_tV(A_{\overline{x:n|}}) . p'_x \quad (9)$$

where:

SF_{x+t} = surrender factor

ϕ = rate of surrender

${}_tV(A_{\overline{x:n|}})$ = resrve

p_x = serve probability of survival

2.1.7. Commission

Commission is the fee paid to a broker for executing a transaction for the insurance company. It is a percentage of premiums that the insured pays to the insurance company, defined by (10):

$$Cm_{x+t} = c\% . P_{\overline{x:n|}} \quad (10)$$

2.1.8. Expense Charged

Expense is defined as the cost incurred in running the insurance company:

$$Exp_{x+t} = e\% P_{\overline{x:n|}} \quad (11)$$

2.1.9. Investment Rate Earning

The investment rate earning (i_a) is the rate at which the company invests in order to make some profit. Most companies diversify their investments in order to reduce the risk associated with the investments. Hence the rate used is the average rate at which the companies invest.

2.2. Cash Flow for Insurance Pricing

Cash flow in insurance pricing measures how much profit the insurance company is making yearly. In insurance pricing techniques one is interested not only in the price of the premium but the expense exhibited in order to know the internal rate of return. This guides the company to the minimum investment rate required in order to make the policy profitable. Cash flow is defined as:

$$CpF_{x+1} = P_{\overline{x:n|}} - Cm_{x+1} - Exp_{x+1} - {}_tV(A_{\overline{x:n|}}) \quad (12)$$

$$\begin{aligned} CpF_{x+t} &= P_{\overline{x:n|}} - Cm_{x+t} - Exp_{x+t} - \\ &\left[{}_{t+1}V(A_{\overline{x:n|}}) - {}_tV(A_{\overline{x:n|}}) \right] + i_a \cdot {}_tV(A_{\overline{x:n|}}) \end{aligned} \quad (13)$$

The first year cash flow for insurance pricing, per equation (12), considers the first reserve as an expense as it is the amount that the company has to take out of its budget and set aside for any eventualities. For the rest of the years, increase in reserve is the one considered as a liability. Premium is paid at the beginning and benefits are paid at the end. The interest accrued is started from the end, hence at time zero (12), there is no interest. To enable a company obtain any interest, it invests portions of its reserve in short term and long term basis depending on the strategies of the company, keeping in mind that at any time the duty would be laid on it to pay claims.

2.2.1. Internal Rate of Return

The internal rate of return (IRR) is defined as the discount rate at which net present value (NPV) is zero. The internal rate of return is basically the rate of return on an investment. Internal rate of return:

$$\sum_{t=0}^{n} \frac{CpF_{x+t}}{(1+i)^t} = 0 \tag{14}$$

2.3. Cash Flow for Profit Testing

These requirements of good profit testing methods, flexibility and completeness tend to be antagonistic to each other. The more complete a profit test is, the less flexible, and vice versa. It is the work of an actuary to strive to maintain a balance between the two (Easton, 2007).

The formulae for profit testing:

- Cash flow for profit testing (15):

$$CptF_{x+t} = CpF_{x+t\ t}\, p'_x \partial_{x+t} - Db_{x+t\ t}\, d_x \partial_x - Sb_{x+t} \partial_x \tag{15}$$

where ∂_x is number of active policy at age *x*.

- The net present value (NPV) for premium:

$$NPV(P_{\overline{x:n|}}) = \sum_{t=o}^{n} \frac{P_{\overline{x+t:n-t|}}}{(1+i_{rdr})^t} \tag{16}$$

- The net present value of cash flow:

$$NPV(CptF_{x+t}) = \sum_{t=0}^{n-1} \frac{CptF_{x+t}}{(1+i_{rdr})^t} \tag{17}$$

- The profit margin is defined by (18):

$$Profit = \frac{NPV(CptF_{x+t})}{NPV(P_{\overline{x:n|}})} \tag{18}$$

3. Results

The data collected from the three insurance companies were as classified company A, company B and company C. The analysis were then performed under the following ass assumptions:

- The pricing rate is 5% for all company analysis.
- The number of policies in force at the start of the policy period is hundred (100).

A profit testing program, written in Visual Basic coupled with Microsoft Excel, were used to implement the actuarial models (in section 2) for a period of 45 years. The results obtained for the various parameters of the "keyman" product computed for three companies are presented in Table 1 and Figure 1. An ideal model based on results from the three companies have also been obtained.

3.1. Results for Company A

Company A has an average commission rate, average investment rate, a high first year expense of 70 which is fixed irrespective of the premium paid, hence the huge loss of GH¢188.56 for the first year (see Table 1 and Figure 1). The rest of the cash flows are positive since the expenses charged for the rest of the years are very low. The internal rate of return is 86.41% which greater than the shareholder's interest rate of 12.5%, meaning that the profit obtained exceeds the profit expected. The interest given to shareholders (also referred to as discount risk) is moderate, leaving a substantial profit after dividends have been paid. The 72.67% profit obtained means that 72.67% of the present value of the total premium calculated is converted to positive cash flow. Analyzing the graph of the cash flows (see Figure 1), we observe a loss of 188.57 cedis (-GH¢188.57) in the first year but goes up in the second year and continues to increase steadily to 2,589.26 cedis in the forty fifth year. However, a depression is observed in the nineteenth year, an indication that the company made a higher provision for surrendering, which slightly reduces the cash flow exhibited for the year.

Company A has a profitable "key man" product and is efficient. It makes high provision for expense to run the company, pays moderate commission to its agents to motivate them, pays its shareholders at a rate to sustain a moderate flow of capital and has less investment rate, hence less funds available to pay claims promptly. Its gives out more of its money, makes higher provision and receives moderately less funds. This product model for the company is moderately attractive and can be improved by increasing the investment.

3.2. Results for Company B

The results for company B (see Table 1 and Figure 1) exhibit a different pattern from that for company A, which could be attributed to its huge investment rate of 90% and lack for provision for expense. The expense charge is rather added to the amount to be invested, increasing the cash flows considerably. The premium paid is the same GH¢ 813.14, since the same pricing rate used for company A. The internal rate of return is huge, which reflects its extremely huge profit of 692.18%. The shareholders are paid low interest, relative to the company's high investment rate. The 692.18% of the present value of the premium expected is converted to

positive cash flow. In such a situation, the company can increase the percentage of shareholders' rate to enable clients get more profit. Company B exhibits this investment policy because of the way expense is ignored. From the cash flows graph (Figure 1), the first year has a negative value of 179.55 cedis, which is extremely low. This is due to the huge expense, accounting for a chunk of the negativity in the first year. Interest and cash flows values increase at faster rates and also higher compared with company A, which has less steeper slope in cash flows. The cash flows increase from -179.55 cedis at the first year to 27,446.76 cedis at the final year. The provision factors for the product in the company appears to be the same as in company A. However, there was no depression at any of the years, simply because of the high investment rate of 90% which might have over shadowed a depression. This means that interest obtained at the nineteenth year is so huge to cover up the surrender value, a liability to the company for making interest rise steadily throughout.

Company B has an extremely profitable "key man" product by its profit margin. It has huge amount of reserves accumulated to pay claims. However, there is no provision made for expenses, rather they are invested, which accounts for the huge profit margin. So expense is paid out of the profit gained, which is a very risky venture since a fall in the investment made would be a huge impediment to the smooth running of the company. Payment of salaries of workers would be at a standstill, expenses would not be paid and the amount reserved to pay claims would be highly inadequate. This model can be classified as efficient only when the investment rate is so high.

3.3. Results for Company C

The results for company C (see Table 1 and Figure 1) have similar pattern to that for company A due to the fact that they have same investment rate and the commission rates are almost close. However, the expenses for the first year is relatively lower, compared to company A while for its continuing years company C has a higher expenses. The premium is GH¢ 813.14 (just as recorded for the other two companies) with internal rate of return of 243.34%, which is higher than that was observed in company A but lesser than in company B. The company recorded a profit of 92.57% compared with 72.67% and 692.18% for company A and company B, respectively, and paid the lowest shareholders' rate of 10.5%. Analyzing the graph of the cash flows (Figure 1), we find interest for the first and second years to be negative but increases in the subsequent years, following the same pattern as for company A. One can therefore conclude that the product in company A and in company C are very similar.

Company C, has a profitable product which is efficient. It caters for expenses, gives low commission and pays lowest shareholders' rate. The company gives out less of the premiums charged in order to increase profit. The efficiency of the model of the data in this company can be improved by increasing the investment rate, which would make more provision for an increase in rate given to shareholders and agents to motivate them.

3.4. Ideal Model

The ideal model is one which incorporates all the parameters in a particular balance to increase profit, provide high shareholder rate, high commission to motivate agents, reduce expense while not affecting the smooth run of the company and at the same time having a good amount of funds to pay all claims promptly. In the light of this, we obtained the parameter values (see Table 1 and Figure 1) for such a model for the product based on results for the three companies.

Table 1. Model parameter values for pricing and profit testing of "key man" product for insurance companies A, B, C, and ideal model

Parameter	Company A	Company B	Conpany C	Ideal Model
Age	30	30	30	30
No. of payments	30	30	30	30
Sum assured (GH¢)	50,000.00	50,000.00	50,000.00	50,000.00
Investment rate (%)	18.00	90.00	18.00	24.00
Shareholder's rate (%)	12.50	13.00	10.50	15.00
Commission for year 1 (%)	17.50	25.00	10.00	25.00
Commission for year 2 (%)	7.00	7.00	7.50	12.50
Commission for year 3 (%)	7.00	5.00	5.00	5.00
Expense for year 1	GH¢ 70.00	0.00	GH¢ 4.45	50.00%
Expense for year 2+	7.50%	0.00	GH¢ 4.45	15%
Expense for year 3+	-	-	-	7%
Premium (GH¢)	813.14	813.14	813.14	813.14
Internal rate of return (%)	86.41	47079	243.34	58.27
NPV of premium (GH¢)	4,347.18	5.783.54	6,917.05	5,096.77
NPV of cash flow (GH¢)	5,982.38	40,032.54	6,403.04	5,109.55
Profit magin (%)	72.67	692.18	92.57	100.25

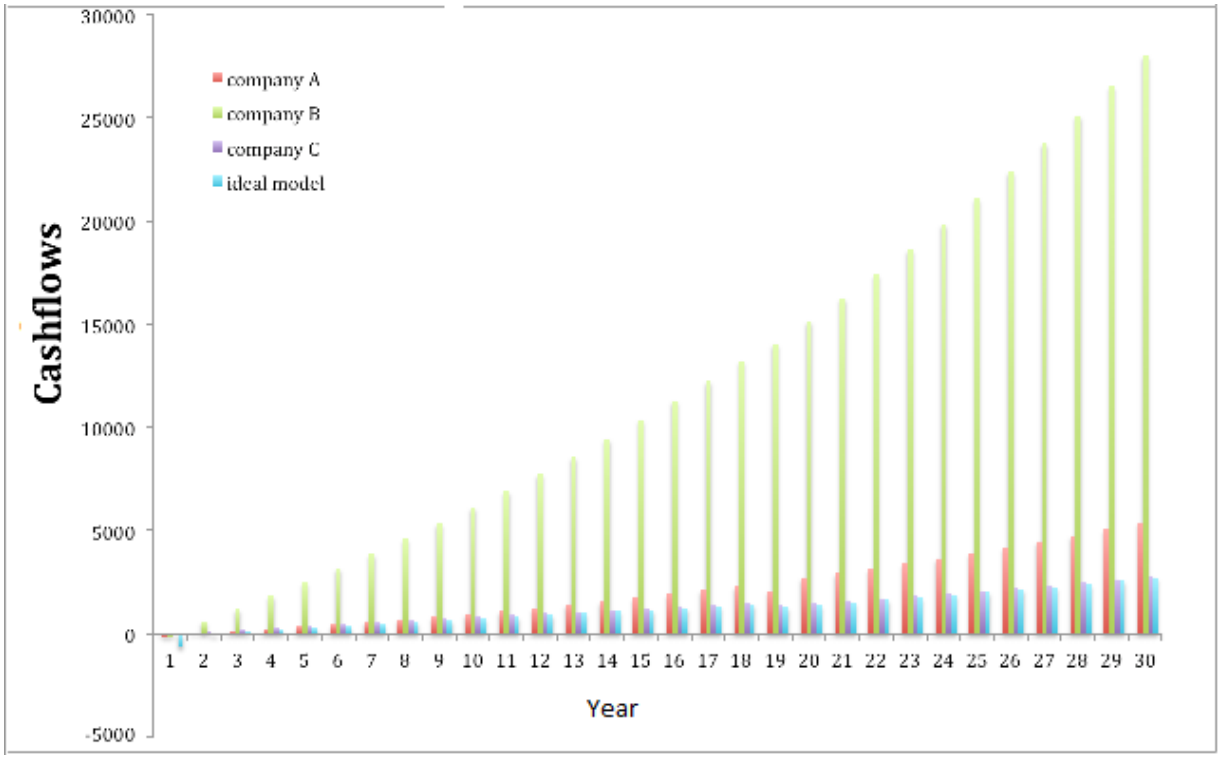

Figure 1. Cash flows after profit testing of "key man" product for insurance companies A, B, C and ideal model

From the ideal model results (Table 1), we notice a high investment rate of 24%, which is achievable with an average lending rate of 24–35%, an attractive shareholders' rate of 15%, a commission paid to agents being 25%, 12.5% and 5% for the first, second and third year, respectively, which are above the average rate of 17.5%, 7% and 5%,, respectively. The expense charged is lower than the average ones used. Secondly, the expense is spread out over three years instead of the two years companies A, B and C used. This model has a first year espense of 50 which is higher than the average of 70, second year expense of 1, which is higher than the average used of 7 and the third year expense of 7, being 12 less than the average used. The profit margin is 100.25%, which is very high and all stakeholders benefit from this model. This model is effective, profitable and has a substantial amount to pay claims.

4. Conclusions

The data collected from three insurance companies in Ghana on the "key man" product, namely the expense rate, commission rate, shareholders' rate and investment rate, have been analyzed and appropriate conclusions reached. An ideal model was obtained after the analysis of the product from the three insurance companies. The results showed a 100.25% profit, which indicated that the investment rate has the most effect on the profit margin, followed by the shareholders' rate, expense charge and commission paid. The premium charged plays a significant role, however, the same premium can produce a very high profit margin if the investment rate is increased and expenses spread over the years.

In view of the recent economic changes around the world, insurance companies are demanding for an increase in premium in order to increase their profitability. However, from the results obtained in this study, in order to achieve this aim, insurance companies should not only concentrate on the premium increase but also increase rate of investment, reduce the expense charged, spread the expense over a longer period of three years, and charge a substantial shareholders' rate to attract investors.

The study has provided useful analytical tool for insurance companies and their policyholders, which the whole Ghanaian community stands to benefit if the findings herein are implemented. Indeed, it will lead to high profit margin, higher dividends and commission, and satisfaction and prompt claim payments, to improve efficiency in the sale of "key man" as life insurance product in Ghana.

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