Location Based Assignment

The State of Ghana's Life Insurance Industry

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Dear Sir/Madam

REPORT TO THE NATIONAL INSURANCE COMMISSION:
PROFITABILITY OF LIFE INSURANCE COMPANIES IN GHANA

Introduction

The National Insurance Commission recently announced it would be passing a mandatory minimum capital requirement for all insurance firms. In 2019, despite a 21% increase in gross written premiums, Ghana's insurance penetration rate dropped lower than 1% for the first time in years. Studies have detailed how many insurance companies do not hold sufficient capital to pay claims and meet liabilities (Ansah-Adu, Andoh and Abor, 2012). In 2013, Akotey and Abor found that the insurance sector "does not manage risks proactively" but rather does so in reactive response to regulatory requirements. Consequently, the industry is characterized by operational inefficiencies and a general lack of trust. In the past, many NIC policies have been suggestive rather than mandatory, however this appears to be changing. This report analyzes profitability factors of life insurers in Ghana and uses the results to make various policy recommendation to improve the sector.

Data

Data has been sourced from the NIC's 2018 Annual Report and Financial Statements which provides comprehensive data from 2014 to 2018 for 51 life and non-life insurance providers and 77 insurance brokers currently operating in Ghana. Data points include number of customers, number of partnered brokers, gross premiums, equity to liability ratio, and numerous other statistics relevant to understanding the business environment of insurance companies.

Due to the format of the NIC report, a considerable amount of data cleaning had to take place before running any analysis. This included converting all PDF tables into excel format, removing typos, merging data (oftentimes manually, as some data were missing or inconsistently ordered) and making the final set suitable for use on Stata.[1]

In addition, extreme outliers such as those in Fig. 1 and Fig. 2 were removed from all variables to improve the external validity of results.

[1] **#sourcequality:** This HC is applied to how I handled the quality of the data provided to make it suitable for regression analysis. The NIC report itself is of a high source quality – it is the topmost reporting authority in Ghana for insurance companies and therefore contains the most comprehensive database on the entire industry. However, the format of the data was very difficult to work with as it did not exist in readily exportable format; I therefore spent over six hours cleaning data and fixing frequent manual errors such as typos.

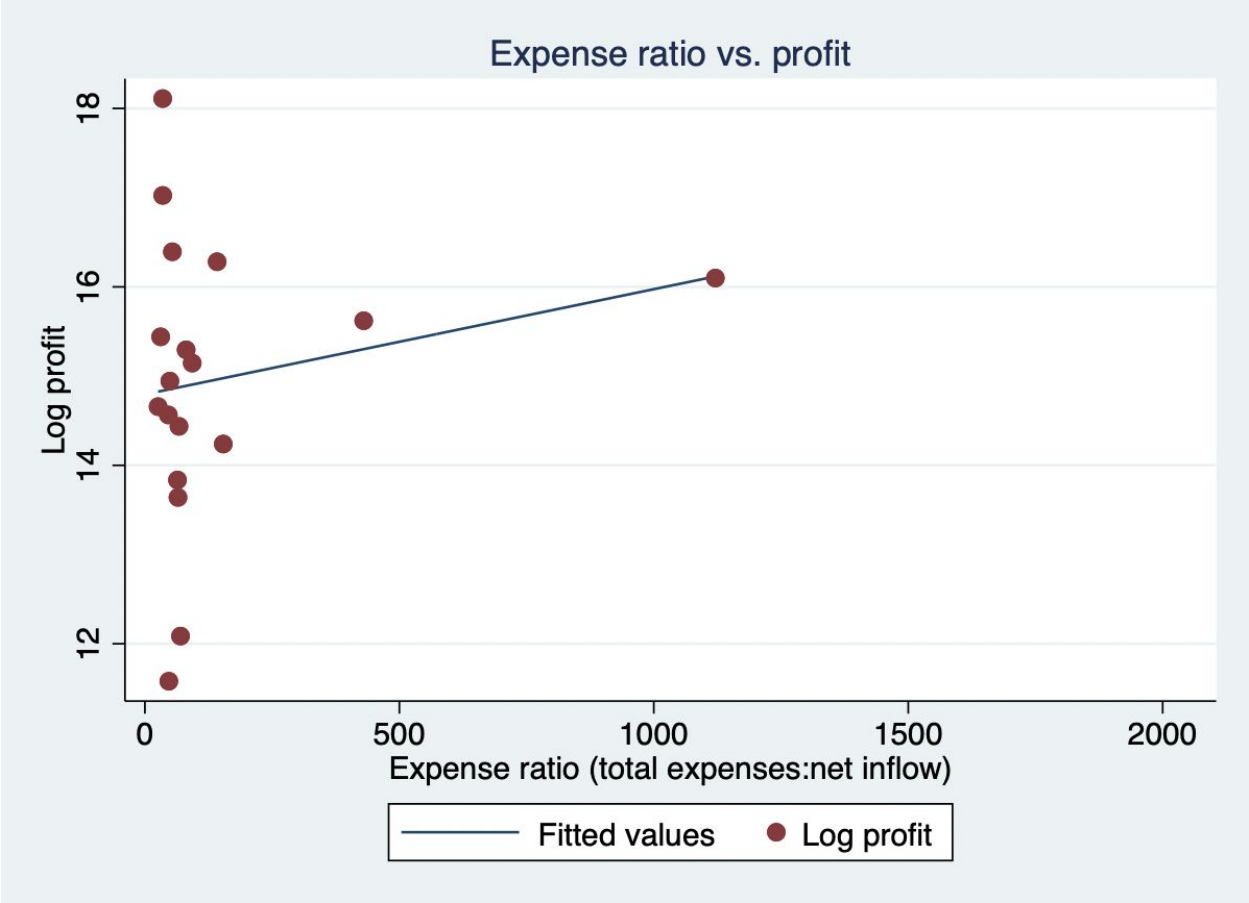

Fig. 1: Expense ratio vs. profit. Both visible extreme outliers that have the highest ratio of expenses to net inflow happen to be subsidiaries of large international insurance providers. The NIC states the worldwide acceptable expense ratio is 40% – a ratio that exceeds this amount "indicates inefficiency on the part of the insurance company in handling its activities and may also suggest most of the premium received is catering for expenses and not necessarily building up policyholders' benefit reserves." Putting this in context, it makes sense that only subsidiaries of large multinationals can afford such a skewed ratio. Allianz is owned by a German conglomerate and Hollard is owned by a South African conglomerate.

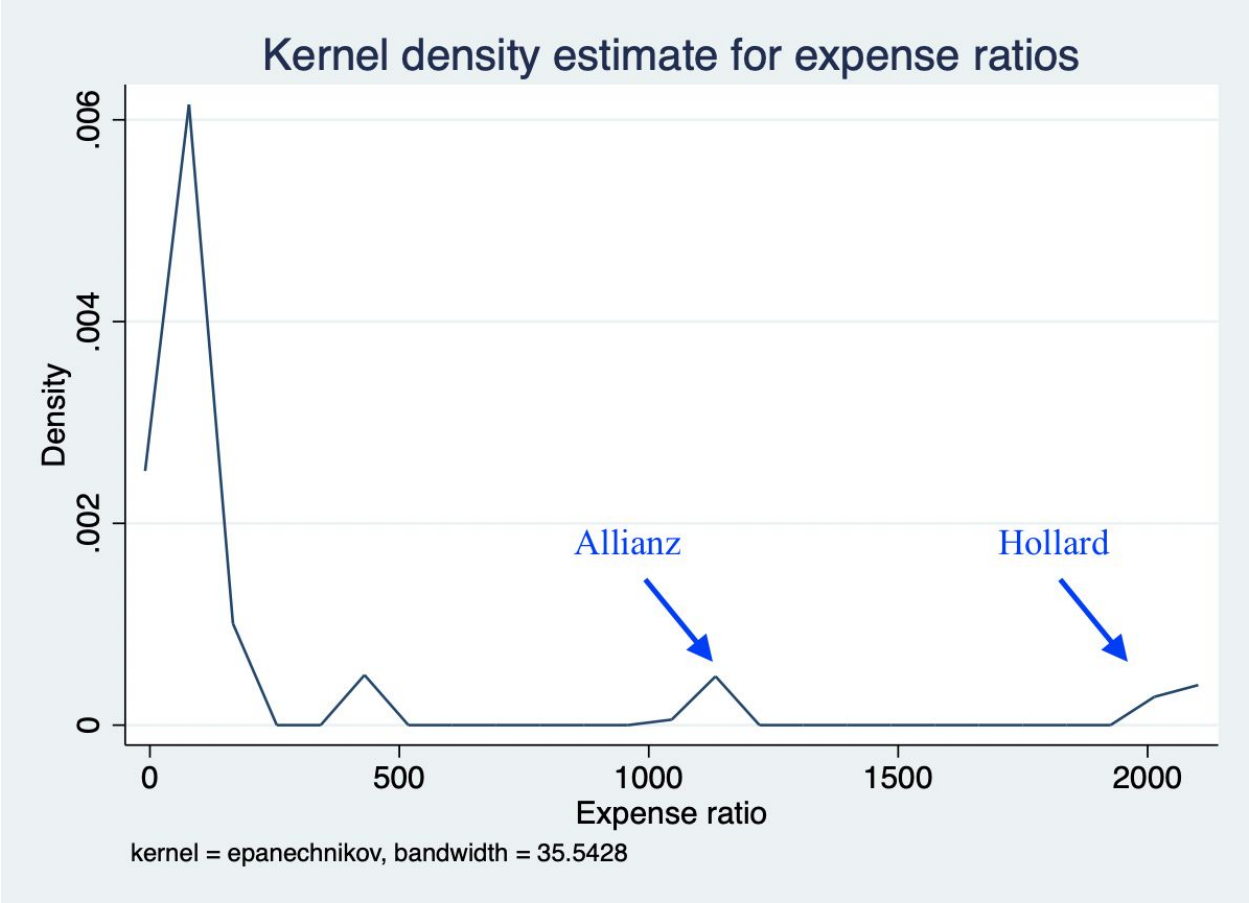

Fig 2. Extreme outliers are both subsidiaries of international conglomerates, which may explain why they can afford to have much higher ratio of expenses to net inflows.[2]

[2] **#levelsofanalysis:** This HC is applied by looking beyond the parameters of the data and digging into the specifics of the observations involved. Here and throughout the paper, data results are interpreted first numerically (strength of bivariate relationships, statistical significance, etc.), then theoretically (based on knowledge of various business metrics), and then empirically (based on specific knowledge of the sector and the companies being analyzed). For this purpose, I not only pulled and cleaned the data, but read the entire NIC report as well to capture any relevant background knowledge.

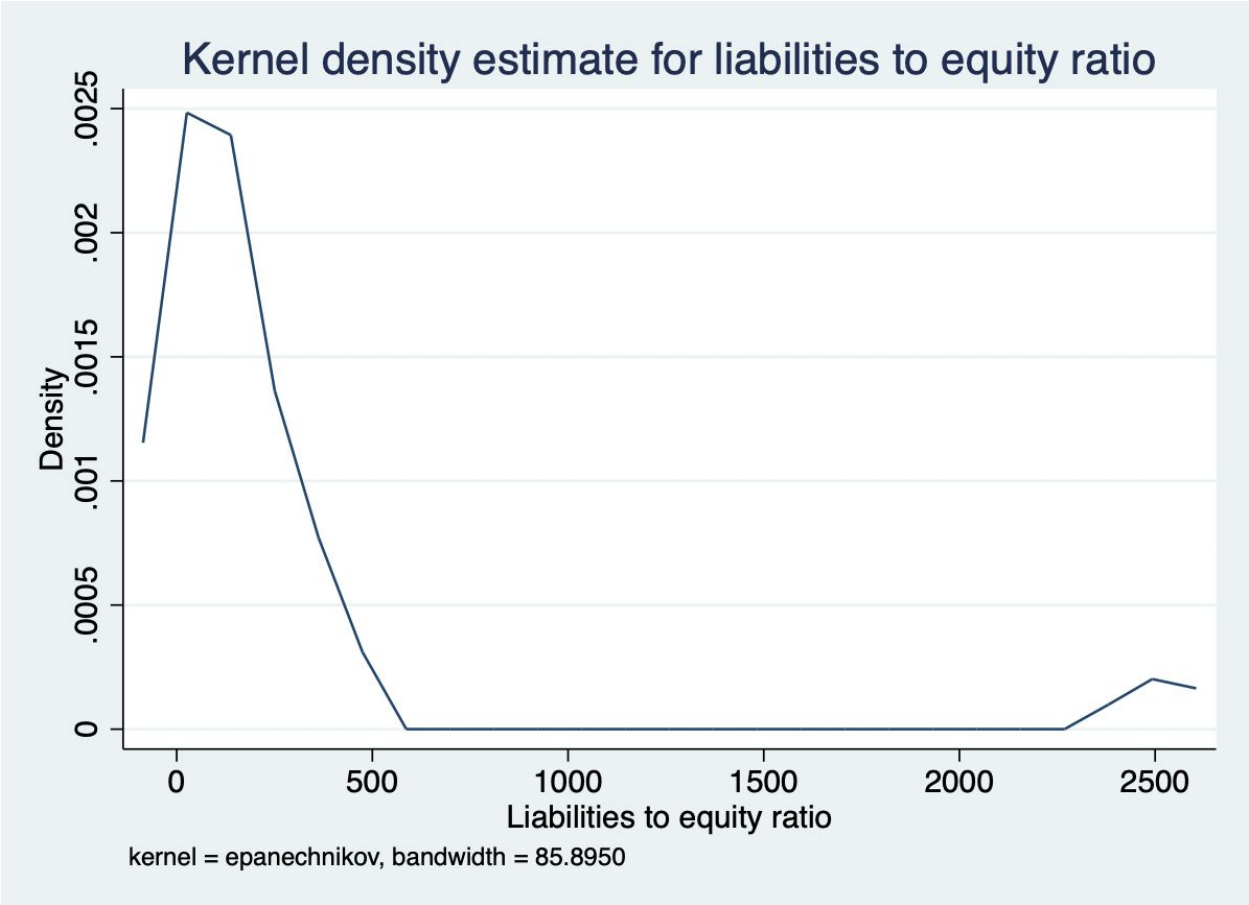

Fig. 3: Extreme outliers for the liabilities to equity ratio. The NIC states that liabilities that total more than 300% of a company's total equity creates serious financial risk; however the extreme outlier in this case (SIC Insurance) has a ratio of 2,519%.

Model selection

Fig. 4 suggests that there is a positive relationship between profit and gross premiums[3], however it is possible that discrepancies can be attributed to variables such as expenses and return on investments. Fig. 5 shows a stronger relationship between profit and the investment to equity ratio, suggesting that this variable may hold more explanatory power.

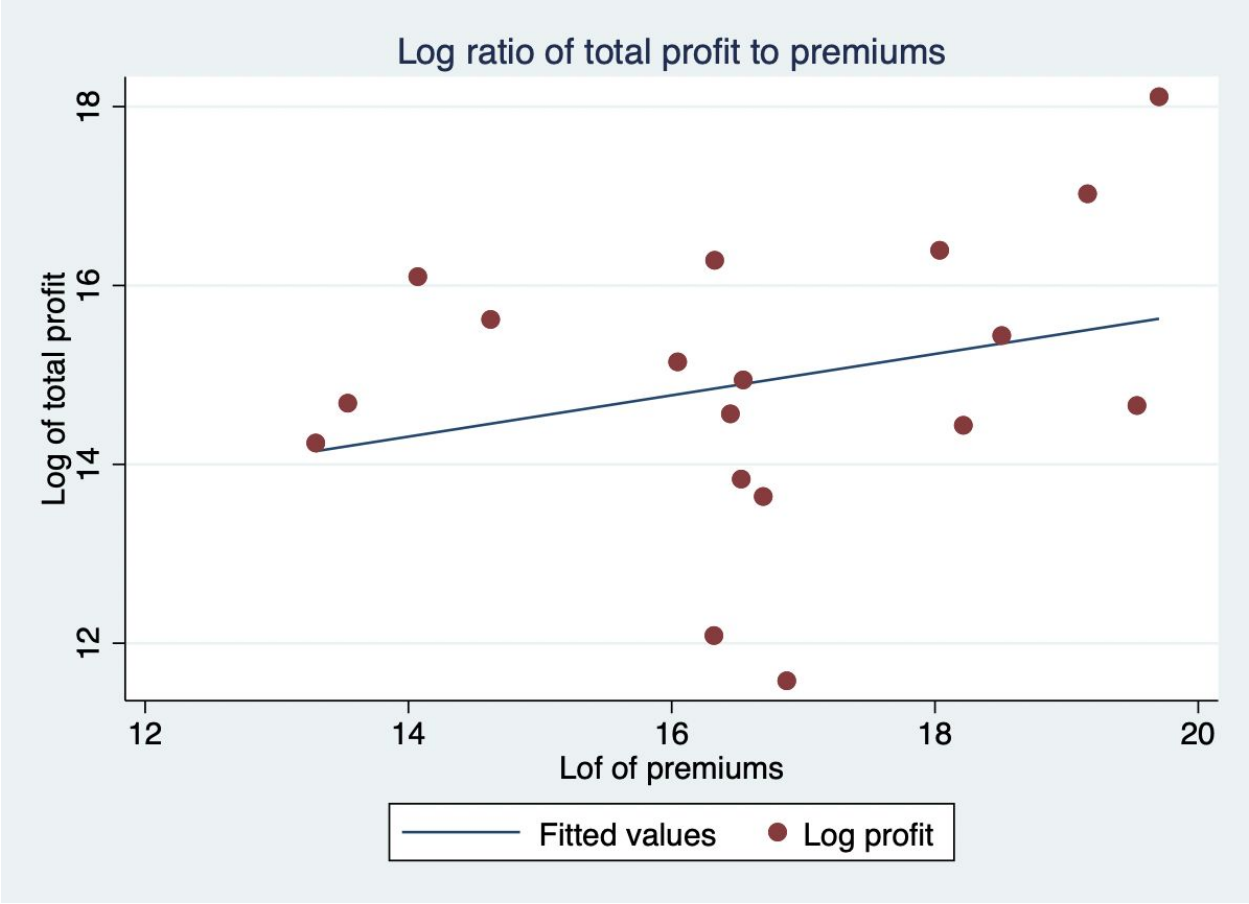

Fig 4. Profit vs. premiums

[3] Gross premium is defined as the total premium paid by the policy owner to the insurance company, before brokerage or discount deductions.

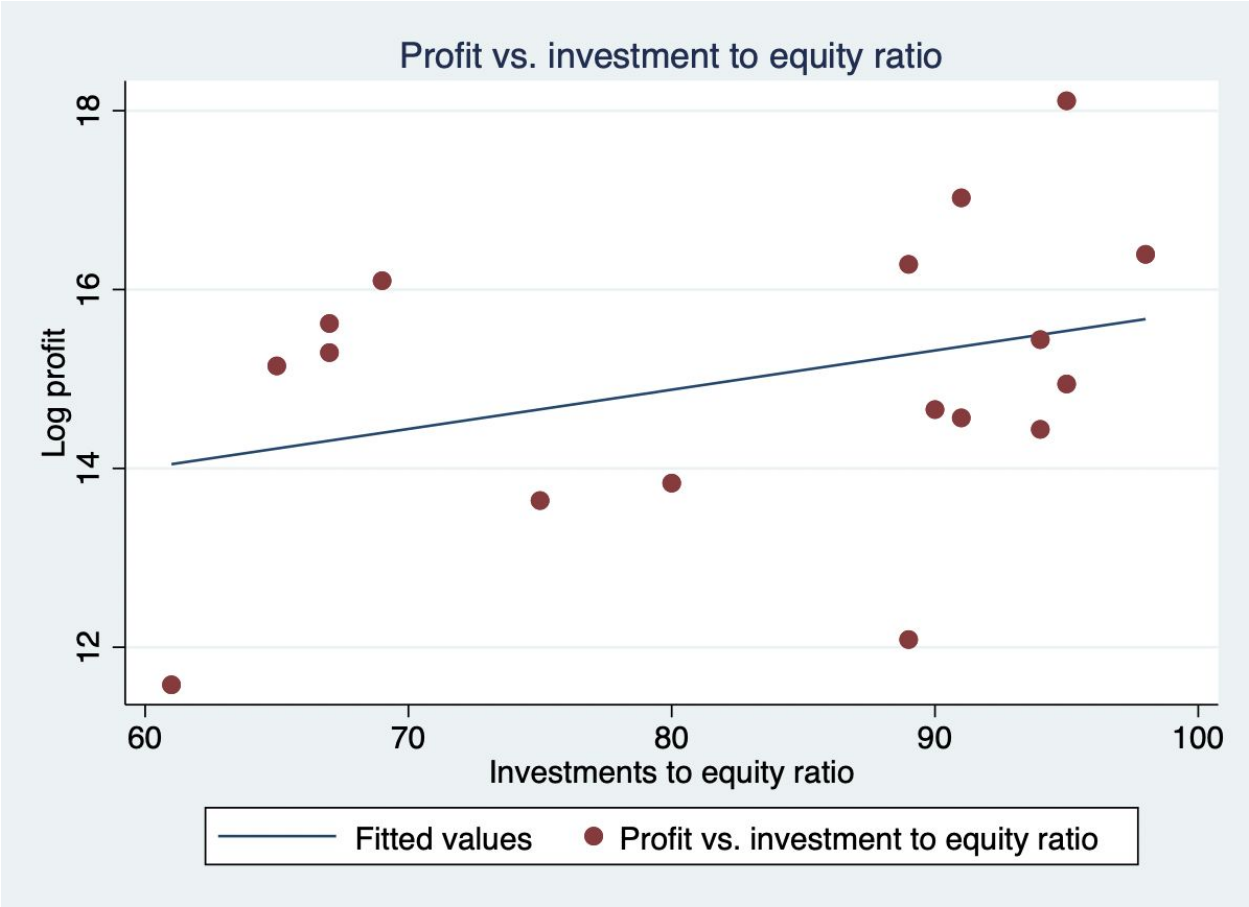

Fig. 5: Profit vs. investment to equity ratio

The variables under consideration for this model are listed in Table 1.

Variable	**Description/justification**
log(*profit*)	Dependent variable of interest
number of customers	Possible explanatory variable
% *change in policyholder inflow*	Measures growth of client base in the past year
log(*gross premiums*)	Measure of assets; total premiums owed to the insurer by policyholders
expense ratio	Serves as a check on operating efficiency by calculating expenses incurred as a percentage of total net inflows received from policyholders
investments to equity ratio	Percentage of the company's assets that are in investments as opposed to operational assets. Investment assets are generally kept to meet liabilities and so a high ratio shows a more positive financial position.
liabilities to equity ratio	Measures the company's ability to absorb unexpected shocks; when liabilities are more than 300% of the company's equity, it is considered very risky.
return on investments (*ROI*)	Yield of total investments

Table 1: Variables under consideration for regression model

A basic log-linear regression model produces the following results:

Source	SS	df	MS		
Model	36.8694419	6	6.14490698	Number of obs	= 13
Residual	4.89052045	6	.815086742	F(6, 6)	= 7.54
				Prob > F	= 0.0134
Total	41.7599623	12	3.47999686	R-squared	= 0.8829
				Adj R-squared	= 0.7658
				Root MSE	= .90282

lnprofit2018	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
numberofcustomers	6.12e-09	1.08e-07	0.06	0.957	-2.59e-07	2.71e-07
lnpremiums2018	1.302626	.552616	2.36	0.056	-.0495764	2.654829
expenseratio2018_clean	.0194715	.0053387	3.65	0.011	.0064082	.0325349
inveq2018_clean	.0728244	.0318422	2.29	0.062	-.0050907	.1507395
le2018_clean	.002935	.0032411	0.91	0.400	-.0049956	.0108656
roi2018	.2067171	.1311442	1.58	0.166	-.1141813	.5276155
_cons	-18.58991	10.66737	-1.74	0.132	-44.69202	7.512202

"Number of customers" is not a statistically significant variable, as the p value for a 95% confidence interval is far greater than 0.05 and the coefficient term is so low. However, it is surprising that R^2 – which indicates how well the model measures variability in the independent variable – is so high (0.88). Running a joint hypothesis test on these variables produces a p value just smaller than 0.05, therefore we reject the null hypothesis; the difference between the Sum of Squared Errors in the restricted model and the Sum of Squared Errors in the unrestricted model is significantly large enough to imply that these restrictions reduce the ability of the model to fit the data.

```
F(  1,     6) =    5.99
      Prob > F =    0.0499
```

While it is promising that the distribution of residuals takes on a generally normal distribution (see Fig. 6 below), when comparing these residuals to individual variables with the highest explanatory power, such as premiums in Fig. 7, it is evident that heteroskedastic errors might violate the assumption of constant variance.

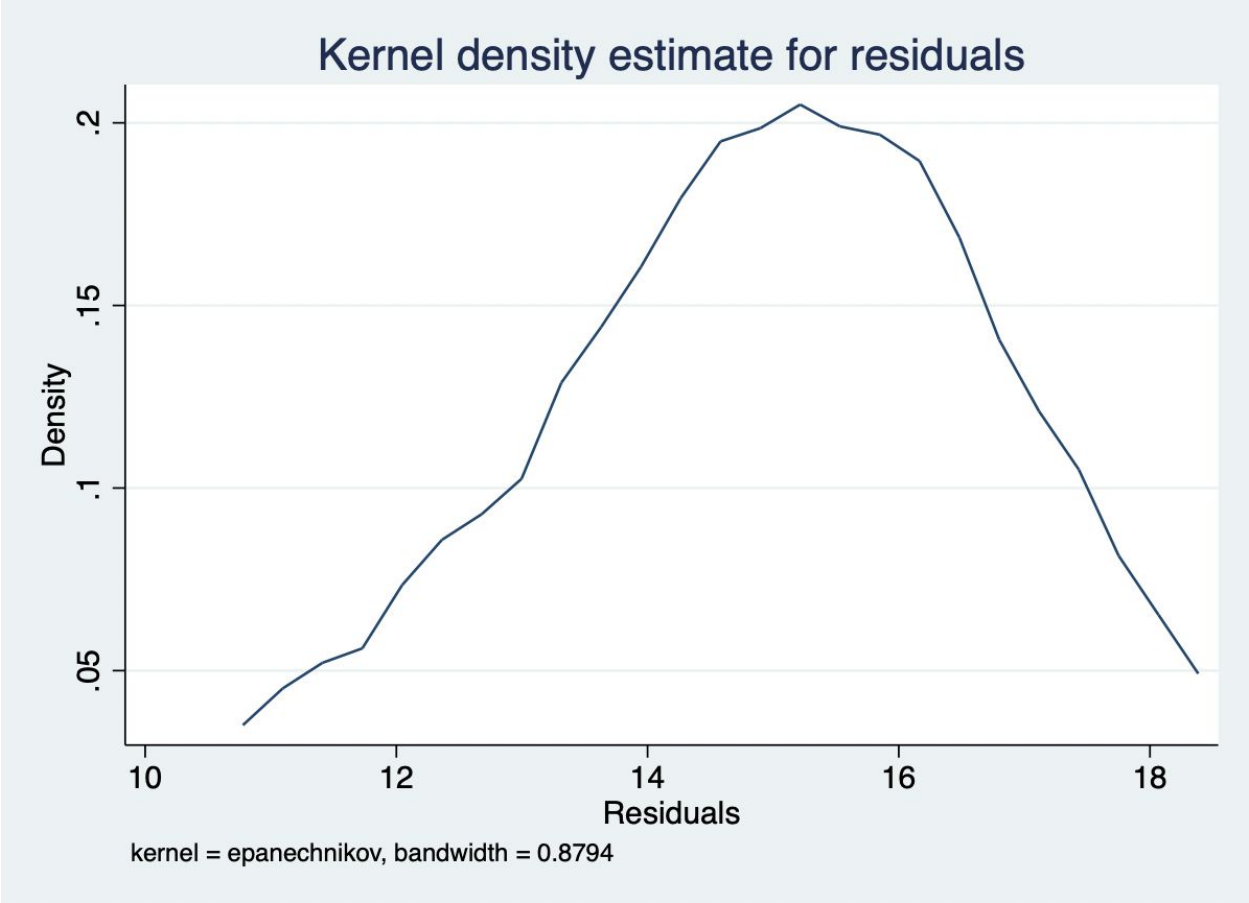

Fig. 6: Distribution of residuals for the log-linear model.

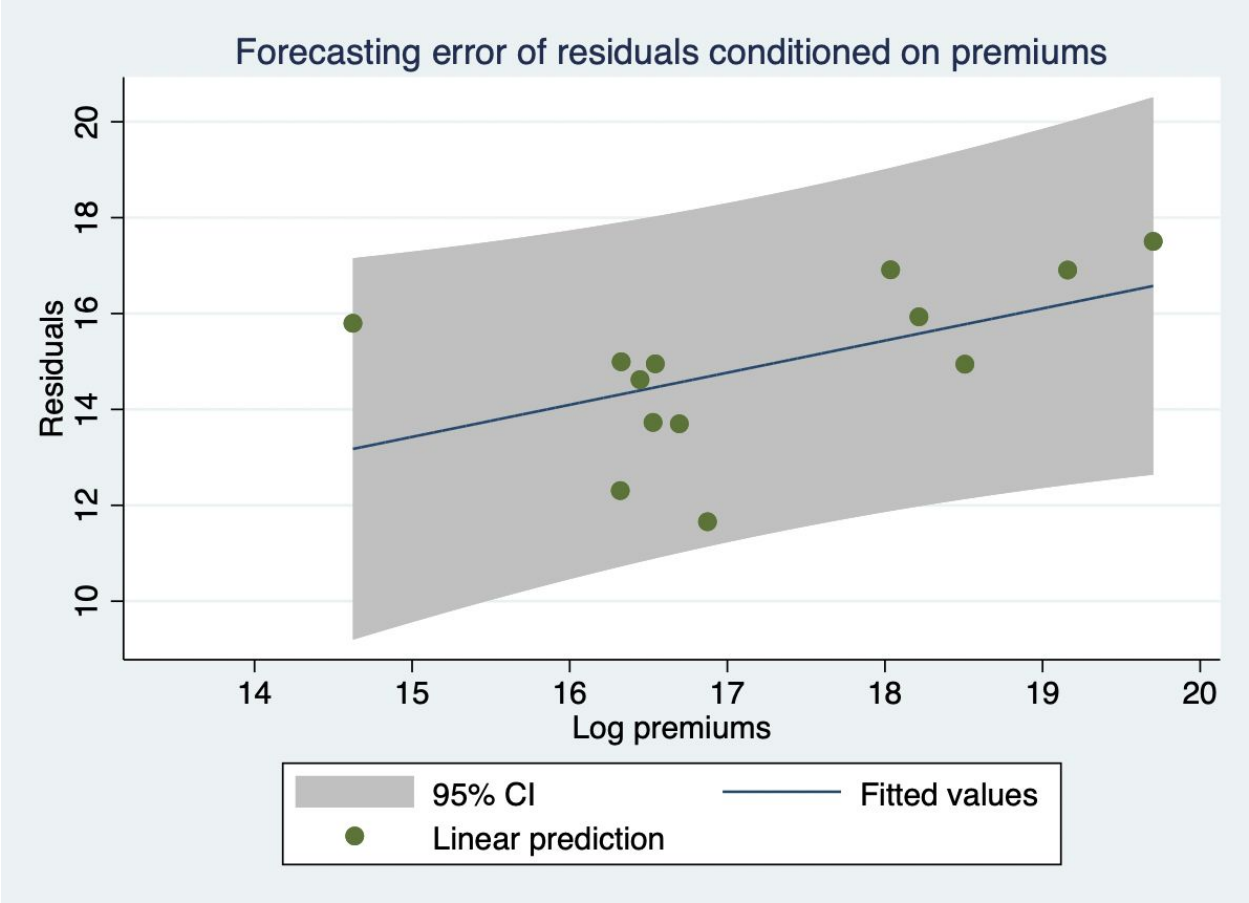

Fig. 7: Forecasting error of regression residuals conditioned on premiums alone. Not only does uncertainty grow for lower and high premiums, but the residuals themselves appear to increase with an increase in premiums. This is a strong indicator for heteroskedasticity issues.[4]

The model can be improved by incorporating a "life cycle effect" by adding a square term for the number of customers. If $\alpha_2 > 0$ and $\alpha_3 < 0$, this indicates diminishing returns for having a larger number of customers. This is a more realistic approach to modelling the relationship between number of customers and profit, as not all customers buy the same products with the same value.

[4] **#confidenceintervals/#dataviz:** I use the uncertainty of the forecasting error conditioned on the log of premiums to visualize the heteroskedasticity violations of the model.

Results

$$ln(PROFIT) = \alpha_1 + \alpha_2 CUST + \alpha_3 CUST^2 + \alpha_4 ln(PREM) + \alpha_5 EXPENSERATIO + \alpha_6 INVTOEQUITY + \alpha_7 LIABTOEQUITY + \alpha_{10} ROI$$

Source	SS	df	MS	Number of obs	=	13
				F(7, 5)	=	7.70
Model	38.2158033	7	5.45940047	Prob > F	=	0.0195
Residual	3.54415904	5	.708831807	R-squared	=	0.9151
				Adj R-squared	=	0.7963
Total	41.7599623	12	3.47999686	Root MSE	=	.84192

lnprofit2018	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
numberofcustomers	1.08e-06	7.84e-07	1.37	0.228	-9.37e-07	3.09e-06
cust2	-7.66e-14	5.56e-14	-1.38	0.227	-2.20e-13	6.63e-14
lnpremiums2018	1.894094	.6706379	2.82	0.037	.1701647	3.618024
expenseratio2018_clean	.0285617	.0082638	3.46	0.018	.007319	.0498045
inveq2018_clean	.0694337	.029796	2.33	0.067	-.0071594	.1460269
le2018_clean	.0033316	.0030361	1.10	0.323	-.004473	.0111362
roi2018	.4526321	.216322	2.09	0.091	-.1034412	1.008705
_cons	-33.52367	14.70961	-2.28	0.072	-71.33593	4.288595

Under the new model, the p value at a 95% confidence level for "number of customers" has decreased from 0.957 to 0.228, so the variable is still not statistically significant. All other variables except "le_clean2018" (the outlier-removed data for the liabilities to equity ratio) and return on investments have become statistically significant. The log of gross premiums, the expense to net inflow ratio and the ratio of investments to equity appear to be the most influential variables in the model with p values of 0.037, 0.18 and 0.67 respectively. A 1 unit increase in gross premiums leads to a 1.89% increase in profit and a 1 unit increase in the investments to equities ratio leads to a 6.9% increase in profit. At a 5% level of significance, the p value

produced by a joint hypothesis test allows us to reject the null assumption that these variables have a zero coefficient. We can thus conclude that they ought to be included in the model.[5]

```
. test lnpremiums expenseratio2018_clean inveq2018_clean

 ( 1)  lnpremiums2018 = 0
 ( 2)  expenseratio2018_clean = 0
 ( 3)  inveq2018_clean = 0

       F(  3,     5) =    6.68
            Prob > F =    0.0336
```

The forecasting error of this new model is greatly improved, with a fairly normalized distribution of residuals for all values of the log of gross premiums. In addition, the residuals i.e. error terms are greatly reduced and generally fall in the (-1, 1) range for all explanatory variables.

[5] **#significance:** p values between the two models are compared to measure the accuracy of each approach. The changes made to the basic log-linear model resulted in a statistically significant difference in p values, therefore this strengthens the interpretation of the results.

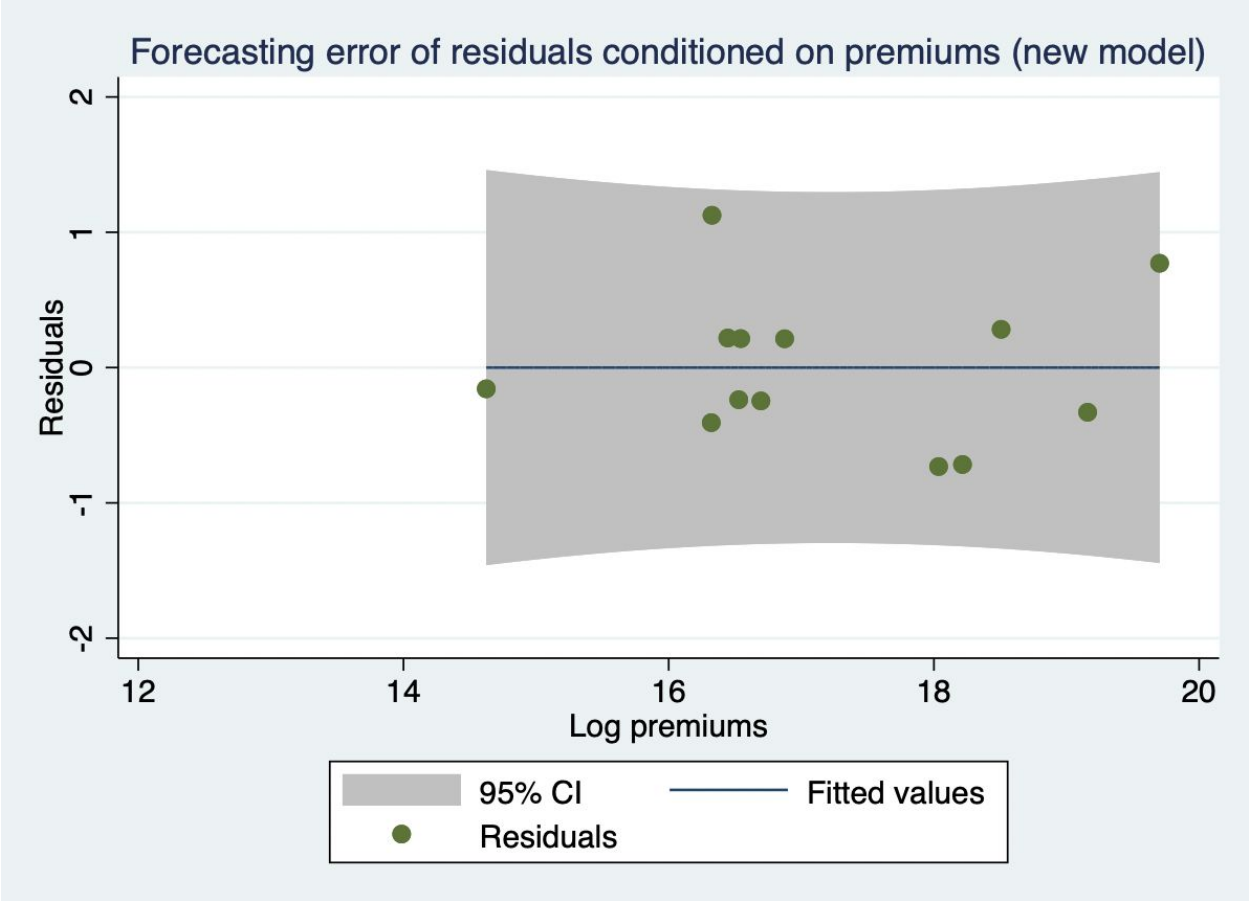

Fig. 8: *Forecasting error of regression residuals conditioned on premiums alone (new model). Residuals are now restricted to the range (-1, 1) instead of (10, 20) as before, suggesting that there is less uncertainty associated with the model and fewer heteroskedasticity violations.*

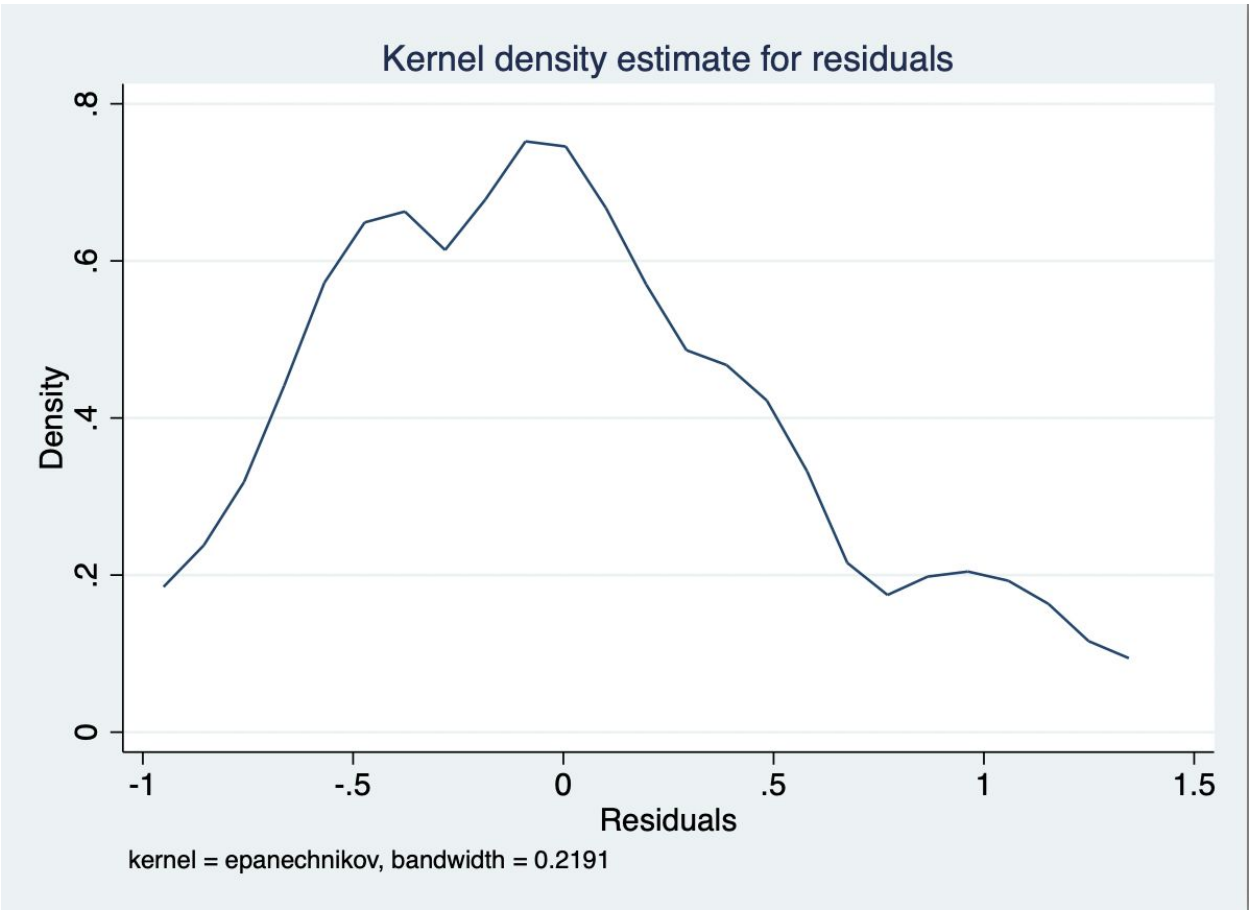

Fig. 9: Kernel density of residuals (new model). The distribution of the error term is now far closer to a standard normal distribution with the mean centered at one, therefore satisfying the assumption under the Gauss Markov Theorem that $E = 0$.

Discussion

One drawback of this model is that the number of independent variables may create noise. This is why the adjusted R^2 is lower. One interpretation of this model is that business efficiency and asset reserves in the form of investments are far more important for the profitability of insurance companies than number of customers. In addition, correct pricing of premiums can have a profound effect on profitability. Akotey et al. recommend that insurers have better-resourced actuary departments "to perform price validation of all policies in order to prevent over-trading and price undercutting by insurance marketing agents." These conclusions supports the findings

of Akotey et. al (2013), that “whereas gross written premiums have a positive relationship with insurers' sales profitability, its relationship with investment income is a negative one” – the coefficient of return on investment in this model is both surprisingly low and statistically insignificant. Rather, it seems that the expense to equity ratio matters far more – a variable that measures operating efficiency.

Conclusion

The implications of these findings paint a serious picture for the state of the Ghanaian insurance sector. The NIC’s most recent policy decision is therefore a step in the right direction as it shifts the industry focus to better risk management practices, however we recommend that the NIC enforce international standards on business metrics to prevent unprofitable and undercapitalized companies operating in the sector.

[Word count: 1,046]

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