“Assessment of measurement and ranking of technical efficiencies of Ethiopian general insurers”

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ASSESSMENT OF MEASUREMENT AND RANKING OF TECHNICAL EFFICIENCIES OF ETHIOPIAN GENERAL INSURERS

Abstract

The non-life insurance companies indemnify the properties from the risk of being damaged due to unforeseen events like natural calamity or accidents. The probability of bankruptcy is imminent on account of large, unprecedented claims. As a risk saver of various society stakeholders, these insurers must be efficient while managing the insurance business. The present research thrusts upon to evaluate the efficiency and decomposition that would further direct the insurers towards achieving optimal scale. Thus, the captioned research aims to measure and rank the technical efficiency of the general insurance firms of Ethiopia and evaluate and analyze their relative efficiencies. The research adopts a quantitative approach and deploys descriptive analysis by a panel data of 17 Ethiopian general insurers for the period 2005-2016 on the input-output-oriented approach of Data Envelopment Analysis (DEA). The data of general insurance are obtained using stratified sampling from the mix of life and general category. The inputs employed are total expenses, total liabilities, and shareholder's fund, while net premiums earned and income from investments are used as outputs. The findings reveal that the public insurer is technically efficient by operating at an optimal scale as compared to all private insurers who, in turn, experience pure technical inefficiency to scale inefficiency due to poor management practices and erroneous utilization of input materials. Increasing Returns to Scale (IRS) witnessed a major form of scale inefficiency in 2016. Private insurers should increase capital and size of assets, cost efficiency, and improve key management skills.

Keywords Data Envelopment Analysis (DEA), Pure Technical Efficiency (PTE), Scale Efficiency (SE), Variable Returns to Scale (VRS), Constant Returns to Scale (CRS), Increasing Returns to Scale (IRS)

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INTRODUCTION

A country's financial system comprises financial institutions, financial assets, and organized capital markets through a blend of financial services. The motto behind the financial system is to transform and channelize the spare capital from the hoarders to the scarcity sectors to balance capital distribution, thus fueling economic growth. The insurance sector is an integral chunk of the financial system and becomes an apparatus for the nations' economic growth by indemnifying the individuals' risks, assets, and corporates at large. Insurance plays a dynamic role among stakeholders such as investors, customers, policymakers, administrators, managers, governments, and after all, the communities to safeguard them from unforeseeable risk. The policymakers also expect the insurance companies to perform in the best interest of society's social cause.

The insurance sector acts as a cushion to mitigate the perils of risks associated with people, the property of a country, the absence of which could derail economic growth. Because of huge insurance claims due

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to frequent natural catastrophes in Ethiopia, the risk of bankruptcy of insurance companies is very high, necessitating the insurance companies to be efficient in enhancing return on investment. Further, the social obligation of the insurers is imminent for the welfare of society. Hence, management expects the organizations to be cost-efficient and profitable to accomplish social obligations while remaining technically efficient. The insurers should bear the risk burden by compensating adequately for the insured from the customers' perspective. Feyen et al. (2011) noted the evidence of a causal relationship between insurance sector development and economic growth. Udaibir et al. (2003), cited in Meher and Zewudu (2020, p. 72), observed insurance as a source of financial system vulnerability. They further noted the insurance sector's failure due to the "assimilation of banking activities, investing in risky assets like real estate and junked bonds, cross-shareholding with banks increases the risk of systemic vulnerability."

The history of insurance in Ethiopia was initiated way back in 1905 during King Minilik II; the Bank of Abyssinia's first insurance business started. During the regime of Hailessalssie after Ethiopia became liberated from Italian occupation in 1941, many private insurance companies have become operational. From 1974, in pursuance of proclamation No. 261/1975, thirteen private insurance companies had been nationalized under the Federal Democratic Republic of Ethiopia (NBE, n.d.).

1. LITERATURE REVIEW

The following empirical studies confirm the relevance of insurance companies' technical efficiency in the regional and global context.

Kumbhakar (1987) noted that in pursuance of the competition amongst the rival firms, the insurance firms wanted to maximize profits to remain technically efficient by adopting an output-oriented approach to DEA. A sample of Nigerian insurance firms has been taken for study from 1994 to 2005 and observed declining efficiency largely attributable to inadequate management strategy and scale inefficiency (Barros & Obijiaki, 2007). The panel data of 30 insurance companies of Ghana has been analyzed in DEA from 2006 to 2008 and concluded that the life insurance business's technical efficiency score is better than the general insurance business (Ansah-Adu et al., 2013). The insurance companies in the Gulf Cooperation Council (GCC) region are moderately efficient, and there is enough scope for improvement (Al-Amri et al., 2012). Chinese insurance firms are studied with 22 insurers from 1999 to 2004 using DEA and found improved technical efficiency with these firms, especially big insurers, and are better efficient than small insurers (Yao et al., 2007). The performance of the standalone Life Insurance Company of India was examined for 19 years and showed the declining performance after 1994–1995 due to modernization incurring huge fixed costs but showing signs of improvement from 2000 to 2001 (Tone & Sahoo, 2005).

Sinha (2015) has studied a sample of 14 Indian life insurance companies using a dynamic DEA model and observed significant fluctuation of mean technical efficiency over the period of study.

The German property liability market has been analyzed thoroughly, with 148 insurance firms from 1995 to 2006 using DEA. The authors claimed that companies undertaking specialized insurance services are technically and cost-wise efficient than companies with various business verticals (Eling & Luhlen, 2010). Greek general insurance companies were studied from 1991 to 1996 and observed wide fluctuation inefficiency among the general insurers (Noulas et al., 2001). The Chinese insurance market was examined to estimate the efficiency of foreign and domestic life insurance firms. The authors argued that domestic insurance firms are efficient than foreign insurers due to dominance by the former. However, both the categories have experienced decreasing returns to scale (Chen et al., 2009). Bawa and Navjeet (2014) have taken 4 Indian public general insurers for 21 years consisting of pre- and post-reform period and found that these insurers were comparatively better in the pre-reform period as the percentage of wastages of resources was less in this period.

1.1. Problem statement

As a part of underwriting services, the insurers should demonstrate the momentum of proficiency for long-term sustainability while shielding from the menaces of bankruptcy in the episode of huge claims due to natural misfortunes. To meet such unforeseeable claims, the insurance companies also need to retain their efficiency in such cases by shifting their risk burden to the giant insurers through reinsurance. Due to the underwriting nature of service to the insured, insurance companies must be efficient, which becomes a relevant part of contemporary research in every country.

This research distinguishes from the former empirical literature in several ways and explores the existing literature. Firstly, the research has included selective output and input variables, which other researchers have not taken. Secondly, this study measures 17 Ethiopian insurance companies' technical efficiency but limited to general insurance activities only keeping in mind the probability of most likely insurance claims due to frequent natural calamity as experience from the past. Further, it is common in Ethiopia that whenever a bank is formed, the insurance company will be formed simultaneously as a sister company as a form of bancassurance. It becomes vital for the later in fulfilling the social objectives and being profitable in the future. Numerous studies have been done in earlier times on financial performance in the Ethiopian context. Still, no study has been undertaken on measurement, ranking, and relative TE of general insurers in the Ethiopian context. This knowledge gap motivates the researcher to study Ethiopia's general insurance to assess the measurement, ranking of technical efficiencies, and decomposition from 2005 to 2016 using an input-output-oriented approach through DEA.

1.2. Objectives of the study

- To identify various input and output variables that determine the technical efficiency of general insurance companies.
- To evaluate the technical efficiency and ranking of insurance companies.
- To study the year-wise decomposition of all insurance companies' technical efficiency and firm-wise decomposition for 2016.

2. METHODS

This study of general insurance companies' technical efficiency adopts a quantitative research approach followed by descriptive analysis (Creswell, 2009). All the insurance companies registered under the National Bank of Ethiopia (NBE) constitute a study (NBE, n.d.). Seventeen insurance companies are registered at the National Bank of Ethiopia, consisting of one public and sixteen privately-owned companies. Stratified sampling has been deployed to obtain a sample of only general insurance companies from the composite activities of life and general insurance business. Panel data of 17 insurance companies from 2005 to 2016 have been taken since their inception undertaking the general insurance business (see Appendix A). The secondary data have been sourced from the reports of the financial statements of the insurers.

Evaluating financial institutions' efficiency is done by a parametric approach called Stochastic Frontier and a non-parametric approach called Data Envelopment Analysis (DEA). DEA is deployed to analyze the efficiencies of financial institutions. The DEA is vividly presented by Lovell (1993), Charnes et al. (1995), Seiford (1996), Seiford and Thrall (1990), Ali and Seiford (1993). DEA applies linear programming through multiple inputs and output data to find the relative ranking of institutions under the same industry, whereas SFA examines the institutions' absolute economic efficiency (Berger & Humphrey, 1992; Coelli et al., 1998; Coelli, 1996). However, Bauer et al. (1998) have found that both methods complement the efficiency and generally give similar results.

Since the insurance companies in Ethiopia provide various financial services as part of the people's social obligation and economic well-being, it complicates the deployment of a parametric way to test TE. Thus, the input approach DEA is preferred since the insurance companies' managers have more preference to optimize the outputs by lessening the input resources or with an agreed input.

This study has been analyzed in two stages. Charnes et al. (1978) has developed the Data Envelopment Analysis Program (DEAP) called CCR model, where initially, the scores of efficiency of 17 insurance companies taken as Decision-Making Units (DMU) are calculated and analyzed.

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Secondly, Gollani and Roll (1989) noted the overall efficiency of each DMU into Pure Technical Efficiency (PTE) and Scale Efficiency (SE) by CCR model assuming Constant Returns to Scale (CRS). Further, efficiency scores have been calculated and analyzed through Variable Returns to Scale (VRS) developed by Banker et al. (1984) called BCC model to estimate Pure Technical Efficiency only.

2.1. Model specification

This study has been designed to implement the CRS and VRS model outlined by Fare et al. (1994) to evaluate technical efficiency and scale efficiency.

The model specification of Constant Returns to Scale (CRS) is given for each Decision-Making Unit (DMU) to measure the technical efficiency measured as the ratio of all outputs over all inputs is obtained. The optimal weight of each DMU is described as follows:

$$Max_{u,v}\left(u'_{Yi} / v' x_i\right),$$
$$St\ u'_{Yi} /\ v' x_i \le 1,\ \text{where } I = 1,\ 2,\ 3,\ ...,\ N,$$
$$u,\ v\ \ge\ 0,$$

where, u is the $M\,XI$ vector of output weights, v is the KXI vector of input weights.

The model specification for VRS is given as 'the CRS linear programming problem can be easily modified to account for VRS by adding the convexity constraint' (Dutta & Sengupta, 2011, p. 420).

$$N1'\lambda = 1 \text{ to provide below:}$$
$$Min_{\theta,\lambda}\ \theta,$$
$$st\ _{-Yi} + Y\lambda \ge 0,$$
$$\theta_{xi} - X\lambda \ge 0,$$
$$N1'\lambda = 1,$$
$$\lambda \ge 0,$$

where $N1$ is an N x 1 vector of ones.

When all the 17 insurance companies are operating at an optimal scale, then CRS is deemed appropriate. However, this is not practical due to imperfect competition and inadequate finance. In such cases, Banker et al. (1984) argued for VRS to evaluate technical efficiency devoid of scale efficiency. This view is supported by Coelli (1996).

The technical efficiency of all the insurance firms has been divided into Overall Technical Efficiency, Pure Technical Efficiency, and Scale Efficiency. The Overall Technical Efficiency (OTE) indicates the number of inputs that could be reduced without affecting the insurance companies' output levels. An organization is technically efficient if it produces output with a given input (Marwa & Aziakpono, 2016).

Pure Technical Efficiency is defined as the additional consumption of the input resources for a specified output due to operational efficiency. Additionally, it is the management's skill to save the input from producing a certain output or producing more output with a given input. Pure Technical Efficiency (PTE) indicates the extent of overall inefficiency caused by managerial inefficiency or wastage of resources without scale effect. Pure Technical Efficiency of the insurance companies is measured using the BCC model. Farell (1957), Kounetas and Tsekouras (2007) defined Scale Efficiency as the extent of productivity a firm could achieve to reach optimal scale size. This is the point of time that average productivity will be at its peak level. Scale Efficiency (SE) measures the extent of overall inefficiency caused due to the wrong choice of scale of the insurance company's operation. The insurance firms' Scale Efficiency is calculated by dividing the efficiency scores as per the CCR model with technical efficiency using the VRS model.

The study subdivides the variables of inputs into three main categories: business services and materials, capital, and labor. It is considered necessary to improve the scheme of input choice by mixing labor and business services and materials in operating expenses. This improvement is made in efficiency studies of the insurance sector observed (Diacon et al., 2002; Eling & Luhnen, 2010). Furthermore, many research works have considered equity capital a relevant input (Cummins & Weiss, 2000; Eling & Luhnen, 2010). Finally, debt capital is utilized as an input in numerous insurance studies (Leverty & Grace, 2010). Thus, entire liabilities, full expenses, and shareholder funds act as inputs for this research.

The outputs are the intermediation approach, the user cost method, and the value-added approach

in insurance firms (Brocket et al., 1998). The user cost approach is based on financial products as input or output based on its net contribution to its revenue, which looks theoretically sound but practically difficult (Cummins & Weiss, 2000).

The value-added approach specifies three main services offered by insurers as outputs: risk pooling/bearing services, intermediation, and financial services related to incurred losses. The insurance policy premium is the common proxy of indemnifying the insured (Cummins & Weiss, 2000). Investment income is a good proxy for the intermediation function and is often utilized in the literature (Cummins & Santomero, 1999; Berger et al., 2008). The common output variables are premiums income and investment income in numerous insurance efficiency studies (Saad, 2012; Abduh et al., 2012; Eling & Luhnen, 2010).

Thus, income from investment and premiums earned is taken as the output for this research. The elements of the resources of input and output are stated in Appendix B. Further, in 2016 concerning 17 insurance companies DMUs, the scale economies, namely IRS, DRS, and CRS, have been evaluated.

3. RESULTS AND DISCUSSION

The descriptive analysis of input and outputs has been analyzed as per Table 1.

Table 1 reveals that based on the minimum, the maximum, mean, and standard deviation of variables of outputs; there is a wide variation observed of investment income and net premium earned amongst the general insurers. A similar trend has been observed for input variables, such as total expenses, total liabilities, and total shareholder's fund during the period under study.

The technical efficiency and ranking of general insurance companies are analyzed under CCR model (Charnes et al., 1978) and BCC model (Banker et al., 1984).

3.1. Efficiency results under the Constant Returns to Scale (CCR model)

The defined variables of input and yield are entered into DEA under the CCR model to compute all general insurance companies' technical efficiency.

Table 1. Descriptive analysis of inputs and outputs of general insurers

Source: Computation using Excel from annual reports of insurance companies from 2005 to 2016.

	Inputs (ETB)			Outputs (ETB)	
	Total expenses	Total liabilities	Total shareholder's fund	Net premiums earned	Investment income
Mean	49,019,507.52	148,096,858.51	90,581,735.82	125,807,825	18,404,984.41
SD	31,496,137.58	96,641,115.81	24085377.18	107,055,066.90	11257134.35
Min	3,856,263.00	3,002,806.00	7,420,743.05	3,750,000	108,421.00
Max	410,237,883.00	1,670,874,922.59	498,242,158.00	1,829,611,00	175,100,622.89

Table 2. Technical efficiency of insurance companies under the CRS (CCR model)

Source: Annual report of Ethiopian insurance companies computed by DEAP version 2.1.

Year	No of DMUs	Number of efficient companies	Maximum efficiency score	Minimum efficiency score	SD	Mean of efficiency	Mean of inefficiency (1–M)/M	% of the DMUs in 1
2005	9	4	1	0.51	0.19	0.83	0.20	0.44
2006	9	4	1	0.79	0.09	0.91	0.10	0.44
2007	9	4	1	0.55	0.18	0.84	0.19	0.44
2008	9	6	1	0.46	0.18	0.93	0.08	0.67
2009	10	4	1	0.61	0.13	0.90	0.11	0.40
2010	10	7	1	0.62	0.13	0.94	0.06	0.70
2011	11	5	1	0.66	0.13	0.89	0.12	0.45
2012	11	7	1	0.81	0.06	0.98	0.02	0.64
2013	15	7	1	0.21	0.11	0.94	0.06	0.47
2014	16	5	1	0.52	0.17	0.83	0.20	0.31
2015	17	3	1	0.28	0.22	0.71	0.41	0.18
2016	17	2	1	0.44	0.19	0.72	0.39	0.12
Mean	12	5	1	0.54	0.21	0.84	0.16	0.29

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Table 3. Company-wise rank and relative efficiency of the insurance companies under the Constant Returns to Scale (CCR model)

Source: Annual report of Ethiopian insurance companies computed by DEAP version 2.1.

S.N.	DMUs	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Mean	Rank
1	EIC	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1
2	Awash	0.64	0.79	0.69	0.95	0.93	1.00	0.77	1.00	0.94	0.97	0.95	0.56	0.85	8
3	Global	0.51	1.00	1.00	0.46	0.6	0.62	0.78	0.81	1.00	0.83	1.00	1.00	0.80	10
4	Nile	1.00	1.00	1.00	1.00	0.88	1.00	1.00	1.00	1.00	1.00	0.79	0.71	0.95	2
5	Nice	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96	0.84	0.63	0.62	0.921	4
6	Africa	0.78	0.71	0.81	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.94	3
7	Nib	0.64	0.80	0.58	0.98	0.78	0.80	0.66	0.97	0.70	0.79	0.71	0.88	0.774	12
8	Nyala	0.90	0.89	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.57	1.00	0.70	0.9216	5
9	Unic	1.00	1.00	1.00	1.00	0.97	1.00	0.92	0.98	0.74	0.87	0.56	0.60	0.89	7
10	Lion	–	–	–	–	0.87	1.00	0.77	1.00	1.00	0.72	0.60	0.78	0.84	9
11	Oromia	–	–	–	–	–	–	–	1.00	1.00	0.84	0.86	0.84	0.91	6
12	Abay	–	–	–	–	–	–	–	–	0.52	0.58	0.58	0.90	0.65	14
13	Berhan	–	–	–	–	–	–	–	–	0.86	0.69	1.00	0.53	0.77	11
14	Tsehay	–	–	–	–	–	–	–	–	0.61	1.00	0.73	0.46	0.70	13
15	Ethio	–	–	–	–	–	–	–	–	0.32	0.52	0.65	0.63	0.53	15
16	Lucy	–	–	–	–	–	–	–	–	0.21	0.28	0.28	0.60	0.34	17
17	Bunna	–	–	–	–	–	–	–	–	–	–	0.32	0.44	0.38	16

The results in Table 2 show that the average technical efficiency of the insurance companies ranges from a minimum of 0.71 (71%) in 2015 to a maximum of 0.98 (98%) in 2012, with an average efficiency of 0.84 (84%). This implies that the Ethiopian insurance companies have scope to increase their mean technical efficiency by 16% (1-0.84) in maximizing their output without adding any additional resources or at a certain level of inputs. Besides that, the mean, standard deviation of 0.21 (21%) specifies a moderate dispersion of the general insurance firms' technical efficiencies during the period under review.

The relative technical efficiency company-wise and their ranks from highest to lowest based on the mean score are described in Table 3.

Table 3 shows that EIC (1st rank) is the most competitive insurance firm in all the twelve consecutive years, having an efficiency score of 1 (100%), followed by Nile (2nd rank) and Africa (3rd rank) with an average technical efficiency 0.95 (95%) and 0.94 (94%), respectively. On the other hand, Lucy (17th rank) is the least competent insurance firm observed with an average TE of 0.34 (34%), followed by Bunna (16th rank) with 0.38 (38%).

Source: Annual report of GICs computed by DEAP version 2.1.

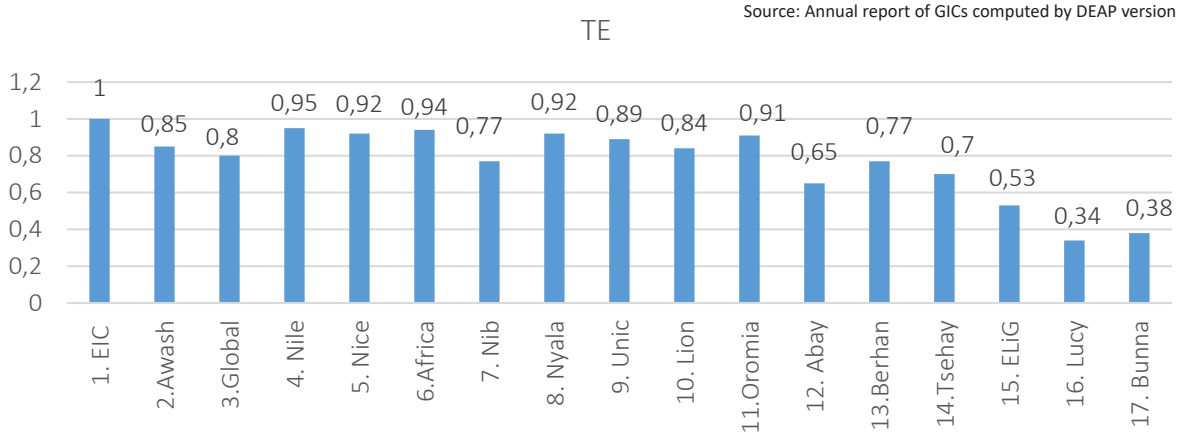

Figure 1. Relative technical efficiency score under CCR model

Figure 1 reveals the frequency distribution of the relative technical efficiency of the insurance firms. The average relative technical efficiency is 35.24% in the range above 90%, followed by 53% in the range from 50% to 90%, and lastly, 11.76% in the range below 50%. This implies that technical efficiency scores are tilted towards higher efficiency in 6 insurance companies above 90% range and moderate efficiencies in 9 insurance companies between 50% to 90% range trailed by 2 insurance companies below 50% range.

The efficiency of general insurance companies has been computed under Variable Returns to Scale (VRS) under BCC model shown further.

3.2. Efficiency results under the VRS (BCC model)

Table 4 shows that the average TE of the general insurers ranges from a minimum of 0.84 (84%) in the years 2005, 2007, and 2013 to a maximum of 0.98 (98%) in 2012 with an overall mean efficiency of 0.89 (89%). It means the insurance companies have scope to increase their average TE by 11% (1-0.89) by maximizing their output without adding any added resources or a given level of inputs. The average SD of 0.09 (9%) displays a low dispersion of TE of the insurance companies.

Table 4. Technical efficiency of insurance companies under the VRS (BCC model)

Source: Annual report of insurance companies computed by DEAP version 2.1.

Year	No of DMUs	Number of efficient companies	Maximum efficiency score	Minimum efficiency score	SD	Average of efficiency M	% of the DMUs in 1
2005	9	4	1	0.51	0.20	0.84	0.44
2006	9	4	1	0.79	0.21	0.93	0.44
2007	9	4	1	0.55	0.20	0.84	0.44
2008	9	6	1	0.46	0.18	0.94	0.67
2009	10	4	1	0.61	0.13	0.90	0.40
2010	10	7	1	0.62	0.13	0.94	0.70
2011	11	5	1	0.66	0.13	0.90	0.45
2012	11	7	1	0.81	0.06	0.98	0.64
2013	15	7	1	0.21	0.26	0.84	0.47
2014	16	5	1	0.52	0.16	0.85	0.31
2015	17	3	1	0.56	0.15	0.87	0.18
2016	17	2	1	0.62	0.13	0.90	0.12
Mean	12	5	1	0.71	0.09	0.89	0.29

Table 5. Company-wise rank and relative efficiencies of the insurance companies under VRS (BCC model)

Source: Annual report of GICs computed by DEAP version 2.1.

S.N.	DMUs	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Mean	Rank
1	EIC	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1
2	Awash	0.64	0.79	0.69	0.98	0.94	1.00	0.80	1.00	0.97	1.00	0.96	0.68	0.87	11
3	Global	0.51	1.00	0.55	0.46	0.61	0.62	0.78	0.81	1.00	0.83	1.00	1.00	0.76	15
4	Nile	1.00	1.00	1.00	1.00	0.88	1.00	1.00	1.00	1.00	1.00	0.91	0.75	0.961	3
5	Nice	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96	0.84	0.71	1.00	0.959	2
6	Africa	0.78	0.82	0.71	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.943	6
7	Nib	0.64	80	0.58	0.98	0.78	0.80	0.66	1.00	0.70	0.89	0.75	0.90	0.79	13
8	Nyala	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97	1.00	0.57	1.00	0.76	0.941	5
9	Unic	1.00	1.00	1.00	1.00	0.97	1.00	0.99	1.00	0.74	0.87	0.56	0.62	0.90	8
10	Lion	–	–	–	–	0.85	1.00	0.77	1.00	1.00	0.84	0.65	1.00	0.89	10
11	Oromia	–	–	–	–	–	–		1.00	1.00	0.91	0.88	0.94	0.95	4
12	Abay	–	–	–	–	–	–	–	–	0.75	0.62	0.71	0.91	0.75	16
13	Berhan	–	–	–	–	–	–	–	–	0.86	0.74	1.00	1.00	0.90	8
14	Tsehay	–	–	–	–	–	–	–	–	0.61	1.00	0.85	0.98	0.86	12
15	Ethio	–	–	–	–	–	–	–	–	0.32	0.52	1.00	1.00	0.71	17
16	Lucy	–	–	–	–	–	–	–	–	0.21	1.00	0.86	1.00	0.77	14
17	Bunna	–	–	–	–	–	–	–	–	–	–	1.00	0.81	0.91	7

http://dx.doi.org/10.21511/ppm.18(4).2020.27

Source: Annual report of GICs computed by DEAP version 2.1.

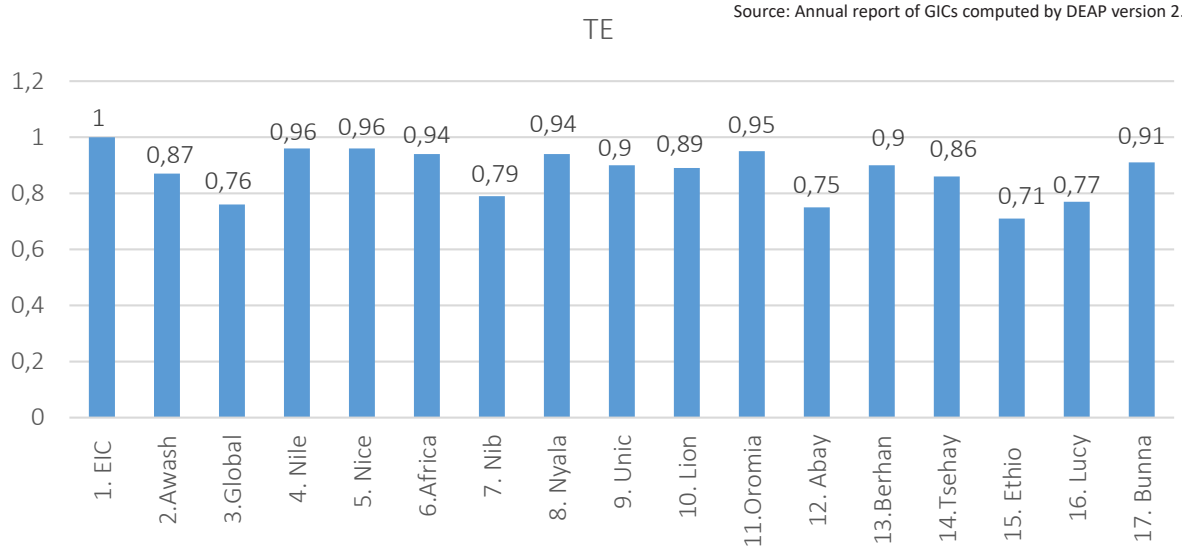

Figure 2. Relative technical efficiency under BCC model

The rank and relative efficiency of the general insurance companies under Variable Returns to Scale (VRS) under the BCC model are computed and shown in Table 5.

The Variable Returns to Scale (VRS) as per Table 5 demonstrates that EIC (1st rank) is the most competitive insurance firm with a technical efficiency score of 1 (100%), followed by Nice (2nd rank) and Nile (3rd rank) with an average technical efficiency score of 0.961 (96.1%) and 0.959 (95.9%), respectively. In other words, Ethio (17th rank) was the least efficient insurance company with an average technical efficiency of 0.71 (71%), followed by Abay (16th rank) and Global (15th rank) with an average technical efficiency score of 0.75 (75%) and 76% (0.76), respectively, amongst all the general insurers.

Figure 2 reveals the frequency distribution of relative technical efficiency scores under the Ethiopian general insurance companies' BCC model. The average technical efficiency score of 9 insurance companies is skewed towards 53% in the range above 90%, followed by 8 insurance companies by 47% in the range from 50% to 90%. Further, no average TE of insurance companies is observed in the range below 50%.

3.3. Comparison of relative technical efficiency under CCR and BCC model

The comparison of efficiency scores under CRS and VRS is discussed further to understand the insurers' ranking. Bunna is the least efficient company (38%) under CRS, whereas it has become the most efficient company (81%) under VRS. This infers that the inefficiency caused at Bunna is because of inappropriate size from scale inefficiency rather than management practice. Further, it is observed that the distribution of relative TE score of 89% (0.89) under the VRS (BCC model) is forward-looking and better than the efficiency scores 84% (0.84) under CRS (CCR model).

3.4. Decomposition of technical efficiency

To ascertain the main source of general insurance companies' inefficiency, the year-wise technical efficiency has been decomposed into OTE, PTE, and SE and described in Table 6.

The average TE of the whole insurance companies over the study period is 84 percent. The PTE is 89 percent and SE 95 percent on average (see Appendix C). Table 6 reveals that the average pure technical inefficiency accounts for 11% (1-0.89) compared to the average scale inefficiency as 5% (1-0.95). This implies that the technical inefficiency is large because of the pure technical inefficiency. Additionally, the relatively greater pure technical inefficiency proposes that inefficiency is caused mostly due to inadequate management practices or improper utilization of input resources rather than the inappropriate size of the general insurers emanating from scale inefficiency.

Table 6. Decomposition of year-wise Overall Technical Efficiency (OTE), Pure Technical Efficiency (PTE), and Scale Efficiency (SE)

Source: Annual report of GICs computation through DEAP version 2.1.

Year	OTE under CRS scale	PTE under VRS scale	SE = OTE/PTE
2005	0.83	0.84	0.99
2006	0.91	0.93	0.98
2007	0.84	0.84	1.00
2008	0.93	0.94	0.99
2009	0.9	0.9	1.00
2010	0.94	0.94	1.00
2011	0.89	0.9	1.00
2012	0.98	0.98	1.00
2013	0.94	0.84	1.00
2014	0.83	0.85	0.98
2015	0.71	0.87	0.82
2016	0.72	0.9	0.80
Average efficiency	0.84	0.89	0.95
Average inefficiency	–	0.11	0.05

The comparison amongst the average TE, PTE, and SE is described in Figure 3. The figure portrays the highest scores of Scale Efficiency (SE) of the general insurers compared to efficiency scores under CRS (CCR model) and VRS (BCC model) in all the years except 2015 and 2016. This implies that the general insurance firms have enormous growth in size by increasing the branches from 2005 to 2014. This has resulted in increased Pure Technical Efficiency (PTE) during 2015 and 2016.

3.5. Decomposition of firm-wise technical efficiency for 2016

Further, concerning Returns to Scale (RTS), a study has been conducted for 2016 to understand the Scale Efficiency for the general insurance companies as some companies have started just before 2016. Table 7 shows all general insurance companies' decomposition into overall TE, pure TE, SE, and increasing, decreasing, and constant returns to scales in 2016. As far as Scale Efficiency is concerned, 18% of total insurance companies, namely EIC, Global, and Africa, are scale efficient, having a relative Scale Efficiency score of 100% (1.00). The rest of the insurance firms constituting 82% have Scale Efficiency of below optimal scale means less than 100% (1), out of which 11 general insurance companies constituting 65% are operating at IRS, signifying that these general insurers can increase their technical efficiency by increasing their size of the operation. The remaining general insurers

Source: Annual report of GICs computed by DEAP version 2.1.

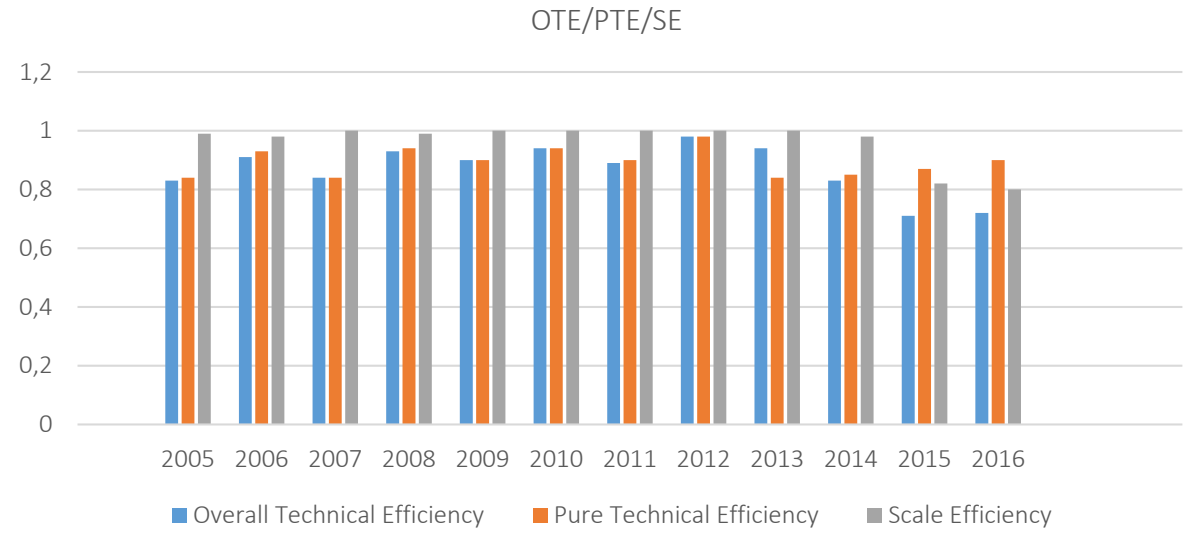

Figure 3. Average TE, PTE, and SE

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Table 7. Decomposition of firm-wise technical efficiency for 2016

Source: Annual report of GICs computed by DEAP version 2.1.

No.	DMU	OTE	PTE	SE	RTS
1	EIC	1.00	1.00	1.00	CRS
2	Awash	0.56	0.68	0.83	IRS
3	Global	1.00	1.00	1.00	CRS
4	Nile	0.71	0.75	0.95	IRS
5	Nice	0.62	1.00	0.62	IRS
6	Africa	1.00	1.00	1.00	CRS
7	Nib	0.88	0.90	0.98	DRS
8	Nyala	0.70	0.76	0.91	IRS
9	Unic	0.6	0.62	0.98	DRS
10	Lion	0.78	1.00	0.78	IRS
11	Oromia	0.84	0.94	0.89	IRS
12	Abay	0.9	0.91	0.99	DRS
13	Berhan	0.53	1.00	0.53	IRS
14	Tsehay	0.46	0.98	0.46	IRS
15	ELiG	0.63	1.00	0.63	IRS
16	Lucy	0.6	1.00	0.60	IRS
17	Bunna	0.44	0.81	0.54	IRS
Average		0.71	0.90	0.79	IRS

constituting 17% are operating at DRS, implying that they can increase their technical efficiency by decreasing their operation size. Thus it is evident that the IRS is the predominant form of scale inefficiency seen with these companies for 2016. However, an opposite finding had been revealed by Owusu-Ansah et al. (2010) who observed that a good number of Ghanaian insurance companies were operating with professionally high managerial skills.

CONCLUSION

The study's findings demonstrate that all the insurance companies doing general insurance business activities suffer technical inefficiency by 16% under CRS and 11% under VRS. The government-run Ethiopian insurance company has achieved an optimal scale during the study period compared to the private insurers operating below optimal scale. Hence, the private general insurers can achieve optimal scale either through professional management practice and proper utilization of resources or by growing the general insurance business's size by penetrating the market. This result is consistent with Kao and Hwang (2008) who observed that none of his study's general insurers were found to achieve full efficiency.

The pure technical inefficiency of insurance companies is predominant over the scale inefficiency from 2005 to 2016, which implies that by and large, the general insurance companies should emphasize operations through effective deployment of resources if they want to achieve optimal scale. The scale economies for the year 2016 for all insurance companies reveal the prominence of IRS over DRS, which indicates that the insurance companies can enhance their technical efficiency by increasing the size operation of the general insurance business in Ethiopia. Thus, the measurement, ranking, relative TE, and decomposition into pure TE and SE, coupled with IRS, VRS, and CRS of general insurers, have met the study's objectives. However, the research has the following limitations. The software used to evaluate TE does not support the data having negative numbers. The study focuses on the general insurance business but fails to measure the TE of the life insurance business run by some insurance companies having a composite business. Newly started insurance companies take time to demonstrate efficiencies, so they are not free from such bias. The insurance risk and efficiency could not be tested here and hence left scope for further researchers. The study hangs around the outcome of technical efficiency, which is

relevant for current operation by the manager by constantly striving for efficiency in a competitive market but fails to focus on the financial sustainability of insurance companies as advocated by Meher and Getanah (2019) on the financial sustainability of commercial banks of Ethiopia. This implies that managers focus on achieving a short-term goal to remain technically efficient by sacrificing the long-range goal of financial sustainability. The outcome of the study recommends that to reach an optimal scale. The private insurers should work towards enhancing capital by infusing adequate equity and also a debt to garner the benefit of leverage, increase the size of assets by expanding the business to reap the benefit of economies of scale, ponder on cost efficiency and improve the skills on key strategy, investment and financing decision-making. This result aims at future policy initiatives and found to be consistent with Dutta and Sengupta (2011) who observed that efficiency was the basic concern of policymakers to encourage further development of the insurance industry and the managers to be profitable in the insurance business. The study suffers from the limitation of recent data as data availability is up to the year 2016. The research is pertinent from the community's points of view as the insurers being the risk savers of society. This study has thrown light on the perception of various stakeholders about the well-being of the insurance business and their credibility, creating a way to meet their expectations.

AUTHOR CONTRIBUTIONS

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Project administration: Kishor Meher.
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Software: Kishor Meher.
Supervision: Kishor Meher, Sanjay Kumar Satapathy.
Validation: Maheswaran Muthuraman, Sanjay Kumar Satapathy.
Visualization: Maheswaran Muthuraman, Sanjay Kumar Satapathy.
Writing – original draft: Abebe Asfawu.
Writing – review & editing: Kishor Meher.

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APPENDIX A

Table A1. Ethiopian general insurance companies, their establishment period and observations

Source: National Bank of Ethiopia (2019).

S.N.	Name	Types of insurance contract	Establishment year	Data period	Observations (No. of years)
1	Ethiopian Insurance Corporation	Composite	1975	2005–2016	12
2	Africa Insurance Company	Composite	1994	2005–2016	12
3	Awash insurance company S.C.	Composite	1994	2005–2016	12
4	National Insurance Company of Ethiopia S.C.	General	1994	2005–2016	12
5	Nyala Insurance Company S.C.	Composite	1995	2005–2016	12
6	Nile Insurance Company S.C.	Composite	1997	2005–2016	12
7	The United Insurance S.C.	Composite	1997	2005–2016	12
8	Global Insurance Company S.C.	General	1997	2005–2016	12
9	NIB insurance Company	Composite	2002	2005–2016	12
10	Lion Insurance Company S.C.	General	2007	2009–2016	8
11	Oromia Insurance Company S.C.	Composite	2010	2011–2016	6
12	Ethio-Life and General Insurance S.C.	Composite	2008	2013–2016	4
13	Abay Insurance Company	General	2010	2013–2016	4
14	Birhan Insurance Company S.C.	General	2011	2013–2016	4
15	Tsehay Insurance S.C.	General	2012	2013–2016	4
16	Lucy Insurance Share Company	General	2012	2013–2016	4
17	Buna Insurance Company	General	2012	2015–2016	2
Total observations		–	–	2005–2016	143

APPENDIX B

Table B1. The selected variables of inputs and outputs along with definition

	Variables	Definition
Inputs	Total operating expenses	Expenses related to operations of the insurance companies, such as salaries and employees benefit, administrative and general expense, office rent expense financial charge, directors fixed remuneration, office supplies, depreciation of fixed assets, amortization of intangible assets, bad debt written off, provision for bad debts, board fee, audit fee and other expense such as commissions.
	Total Liability	Liabilities such as technical provision, inward business reserve, special reserve-guarantee bonds, special reserve disputed claims, outstanding claims, bank overdraft, short-term loan, due to reinsurers, due to ceding companies, provision for tax, dividend payable and director's remuneration, creditors and accruals, employees liabilities, current account (non-life) and others.
	Total Shareholder's fund	Shareholder's fund such as paid up capital, share premium, legal reserve, general reserve, retained earnings, inter business current account, and others.
Outputs	Net Premium Earned	It is the difference between gross earned premiums and reinsurance premiums ceded, or gross earned premiums minus reinsurance premiums ceded.
	Investment Income	Income including dividend income, interest income, rent income, and other income.

APPENDIX C

Table C1. Nature of returns to scale from 2005 to 2016

Year	Company	CRS	VRS	SE	RTS
2005	EIC	1.00	1.00	1.00	Constant
2006	EIC	1.00	1.00	1.00	Decreasing
2007	EIC	1.00	1.00	1.00	Constant
2008	EIC	1.00	1.00	1.00	Constant
2009	EIC	1.00	1.00	1.00	Constant
2010	EIC	1.00	1.00	1.00	Constant
2011	EIC	1.00	1.00	1.00	Constant
2012	EIC	1.00	1.00	1.00	Constant
2013	EIC	1.00	1.00	1.00	Constant
2014	EIC	1.00	1.00	1.00	Constant
2015	EIC	1.00	1.00	1.00	Constant
2016	EIC	1.00	1.00	1.00	Constant
2005	Awash	0.64	0.64	0.99	Constant
2006	Awash	0.79	0.79	1.00	Constant
2007	Awash	0.69	0.69	1.00	Constant
2008	Awash	0.95	0.98	0.97	Decreasing
2009	Awash	0.93	0.94	0.99	Decreasing
2010	Awash	1.00	1.00	1.00	Constant
2011	Awash	0.77	0.80	0.97	Decreasing
2012	Awash	1.00	1.00	1.00	Constant
2013	Awash	0.94	0.97	0.98	Decreasing
2014	Awash	0.97	1.00	0.97	Decreasing
2015	Awash	0.95	0.96	0.99	Increasing
2016	Awash	0.56	0.68	0.83	Increasing
2005	Global	0.51	0.51	1.00	Constant
2006	Global	1.00	1.00	1.00	Constant
2007	Global	1.00	0.55	1.81	Constant
2008	Global	0.46	0.46	1.00	Constant
2009	Global	0.61	0.61	1.00	Constant
2010	Global	0.62	0.62	1.00	Constant
2011	Global	0.78	0.78	1.00	Constant
2012	Global	0.81	0.81	1.00	Constant
2013	Global	1.00	1.00	1.00	Constant
2014	Global	0.83	0.83	1.00	Constant
2015	Global	1.00	1.00	1.00	Increasing
2016	Global	1.00	1.00	1.00	Constant
2005	Nile	1.00	1.00	1.00	Constant
2006	Nile	1.00	1.00	1.00	Constant
2007	Nile	1.00	1.00	1.00	Constant
2008	Nile	1.00	1.00	1.00	Constant
2009	Nile	0.88	0.88	1.00	Constant
2010	Nile	1.00	1.00	1.00	Constant
2011	Nile	1.00	1.00	1.00	Constant
2012	Nile	1.00	1.00	1.00	Constant
2013	Nile	1.00	1.00	1.00	Constant
2014	Nile	1.00	1.00	1.00	Constant
2015	Nile	0.79	0.91	0.87	Decreasing
2016	Nile	0.71	0.75	0.95	Increasing
2005	Nice	1.00	1.00	1.00	Constant
2006	Nice	1.00	1.00	1.00	Constant
2007	Nice	1.00	1.00	1.00	Constant
2008	Nice	1.00	1.00	1.00	Constant

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Table C1 (cont.). Nature of returns to scale from 2005 to 2016

Year	Company	CRS	VRS	SE	RTS
2009	Nice	1.00	1.00	1.00	Constant
2010	Nice	1.00	1.00	1.00	Constant
2011	Nice	1.00	1.00	1.00	Constant
2012	Nice	1.00	1.00	1.00	Constant
2013	Nice	0.96	0.96	1.00	Constant
2014	Nice	0.84	0.84	1.00	Decreasing
2015	Nice	0.63	0.71	0.89	Increasing
2016	Nice	0.62	1.00	0.62	Increasing
2005	Africa	0.78	0.78	1.00	Decreasing
2006	Africa	0.81	0.80	1.01	Decreasing
2007	Africa	0.71	0.71	1.00	Constant
2008	Africa	1.00	1.00	1.00	Constant
2009	Africa	1.00	1.00	1.00	Constant
2010	Africa	1.00	1.00	1.00	Constant
2011	Africa	1.00	1.00	1.00	Constant
2012	Africa	1.00	1.00	1.00	Constant
2013	Africa	1.00	1.00	1.00	Constant
2014	Africa	1.00	1.00	1.00	Constant
2015	Africa	1.00	1.00	1.00	Constant
2016	Africa	1.00	1.00	1.00	Constant
2005	Nib	0.64	0.64	1.00	Constant
2006	Nib	0.80	0.82	0.98	Constant
2007	Nib	0.58	0.58	1.00	Constant
2008	Nib	0.98	0.98	1.00	Constant
2009	Nib	0.78	0.78	1.00	Constant
2010	Nib	0.80	0.80	1.00	Constant
2011	Nib	0.66	0.66	1.00	Constant
2012	Nib	0.97	0.97	1.00	Constant
2013	Nib	0.70	0.70	1.00	Constant
2014	Nib	0.79	0.89	0.89	Constant
2015	Nib	0.71	0.75	0.96	Decreasing
2016	Nib	0.88	0.90	0.98	Decreasing
2005	Nyala	0.90	0.91	0.99	Decreasing
2006	Nyala	0.89	1.00	0.89	Decreasing
2007	Nyala	1.00	1.00	1.00	Constant
2008	Nyala	1.00	1.00	1.00	Constant
2009	Nyala	1.00	1.00	1.00	Constant
2010	Nyala	1.00	1.00	1.00	Constant
2011	Nyala	1.00	1.00	1.00	Constant
2012	Nyala	1.00	1.00	1.00	Constant
2013	Nyala	1.00	1.00	1.00	Constant
2014	Nyala	0.57	0.57	1.00	Constant
2015	Nyala	1.00	1.00	1.00	Decreasing
2016	Nyala	0.70	0.76	0.91	Increasing
2005	Unic	1.00	1.00	1.00	Constant
2006	Unic	1.00	1.00	1.00	Constant
2007	Unic	1.00	1.00	1.00	Constant
2008	Unic	1.00	1.00	1.00	Constant
2009	Unic	0.97	0.97	1.00	Constant
2010	Unic	1.00	1.00	1.00	Constant
2011	Unic	0.92	0.99	0.92	Decreasing
2012	Unic	0.98	1.00	0.98	Constant
2013	Unic	0.74	0.74	1.00	Constant
2014	Unic	0.87	0.87	1.00	Constant

Table C1 (cont.). Nature of returns to scale from 2005 to 2016

Year	Company	CRS	VRS	SE	RTS
2015	Unic	0.56	0.56	1.00	Decreasing
2016	Unic	0.60	0.62	0.98	Decreasing
2009	Lion	0.85	0.85	1.00	Constant
2010	Lion	1.00	1.00	1.00	Constant
2011	Lion	0.77	0.77	1.00	Constant
2012	Lion	1.00	1.00	1.00	Constant
2013	Lion	1.00	1.00	1.00	Constant
2014	Lion	0.72	0.84	0.86	Increasing
2015	Lion	0.60	0.65	0.92	Increasing
2016	Lion	0.78	1.00	0.78	Increasing
2012	Oromia	1.00	1.00	1.00	Constant
2013	Oromia	1.00	1.00	1.00	Constant
2014	Oromia	0.84	0.91	0.92	Increasing
2015	Oromia	0.86	0.88	0.98	Increasing
2016	Oromia	0.84	0.94	0.89	Increasing
2013	Abay	0.58	0.75	0.77	Increasing
2014	Abay	0.58	0.62	0.94	Decreasing
2015	Abay	0.58	0.71	0.81	Increasing
2016	Abay	0.90	0.91	0.99	Decreasing
2013	Berhan	0.86	0.86	1.00	Constant
2014	Berhan	0.69	0.74	0.93	Decreasing
2015	Berhan	1.00	1.00	1.00	Increasing
2016	Berhan	0.53	1.00	0.53	Increasing
2013	Tsehay	0.61	0.61	1.00	Constant
2014	Tsehay	1.00	1.00	1.00	Constant
2015	Tsehay	0.73	0.85	0.85	Increasing
2016	Tsehay	0.46	0.98	0.46	Increasing
2013	ELiG	0.32	0.32	1.00	Constant
2014	ELiG	0.52	0.52	1.00	Constant
2015	ELiG	0.65	1.00	0.65	Increasing
2016	ELiG	0.63	1.00	0.63	Increasing
2013	Lucy	0.21	0.21	1.00	Constant
2014	Lucy	0.28	1.00	0.28	Constant
2015	Lucy	0.28	0.86	0.33	Increasing
2016	Lucy	0.60	1.00	0.60	Increasing
2015	Bunna	0.32	1.00	0.32	Increasing
2016	Bunna	0.44	0.81	0.54	Increasing
Average		0.84	0.89	0.95	–

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