Expert Subjective Ranking of Listed Banks in Ghana: Use of Analytical Hierarchy Process

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Abstract

Financial performance and investor suitability evaluation is very crucial for selecting assets in any industry to form a portfolio in a highly competitive environment. An optimum portfolio must be built from individual stocks that have good financial measures. Therefore, a precise and correct performance evaluation of any given stock is critical for portfolio selection and reflects the competitiveness of a company. The study seeks to analyze whether the Analytical Hierarchy Process (AHP) combined with financial ratios as decision-making criteria can be used to determine the stock rank in the financial industry. A structured questionnaire were given to a randomly selected investment professionals both in academia and the industry to solicit their views in selecting one specific stock that has best financial performance given the performance evaluation criteria.

The result revealed ..

Keywords: Financial Performance, Analytical Hierarchy Process, Listed Banks, Ghana Stock Exchange

JEL Codes: G11

1.0 Introduction

In an attempt to optimize investment returns, institutional and individual investors alike build portfolios made up of asset mix that suits this objective. Optimization of investment returns, therefore, calls for a good strategy in selecting stocks with good financial performance. In Ghana, several studies have been conducted to examine the performance of listed companies using a number different financial measures as evaluation criteria (Sarpong et al (2014); Winful et al (2012); M (19FF); P (1900)). Most of these studies have centered predominantly on evaluation of pairwise comparison of listed companies across different sectors of the stock exchange. However, none of these studies were specifically directed towards the ranking of stocks considered in absolute terms considering all evaluation criteria. This apparently makes it difficult to objectively select the best listed company on the Ghana Stock Exchange (GSE) considering all evaluation criteria. More so, these studies employ the use of secondary data specifically with respect to the considered companies. However with the inclusion of expert subjective opinions about the evaluation criteria, it is possible to extend these studies by applying the Analytical Hierarchy Process proposed by Saaty (1980).

The Analytical Hierarchy Process (AHP) is a decision-making aiding method developed by Thomas Saaty (Saaty 1977, 1980, 1988, 1995). The AHP model works on the three basic principles of logical analysis: the principle of constructing hierarchies, the principle of establishing priorities and the principle of logical consistency (Saaty 1980). It is a technique for organizing the information and judgements used in making complex decisions. The AHP provides a decision framework which enables one to logically breakdown a decision into its less complex component parts, arrange these parts into a hierarchic order, quantify subjective judgement tradeoffs and synthesize the judgements to determine the best decision. Given a set of alternatives on a ratio scale, AHP helps in prioritizing choices in a consistent manner. Structuring the hierarchies is breaking down the problem to it separate elements and levels. Priorities are based on pairwise comparisons which create a rank of the elements in order of importance. The consistency of grouping and ranking are mathematically checked for perfect coherence. It is a very intuitive approach and augment

decision-making

However AHP has also received strong criticisms. AHP uses a weight allocation technique without any reference to the ranges of performance of the alternatives under consideration (Lenzen, 2006). Saaty (1994) states that ratio scales are the only possible measurement if we want to be able to aggregate measurement, as in a weighted sum. However, Triantaphyllou (2000) observes that there is no documented reason for instance why the scale should be evenly distributed from 1 to 9 but not between 1/9 and 1 or otherwise. Sometimes, the decision-maker might find it difficult to distinguish among them and tell for example whether one alternative is 10 or 11 times more important than another. Dodd & Donegan (1995) have also criticised the absence of a zero in the preference scale. This approach, according to Macharis et al. (2004) has the disadvantage that the number of pairwise comparisons to be made, may become very large (n (n−1)/2), and thus become a lengthy task.

Moreover, the rank reversal in AHP is a very critical issue. The rank reversal occurs especially when the ranks of an existing set of alternatives are changed whenever other alternatives are added or deleted. This occurs under the normal version of AHP where the normalisation is done by dividing the local eigenvector by the sum. To avoid the rank reversal completely in AHP, a version of AHP uses a direct rating technique. In this method, alternatives are directly rated under each criterion based on a common, predefined scale instead of using a pairwise comparison and eigenvector values. This helps reduce the number of comparisons significantly and is useful especially in problems with a large numbers of alternatives. Despite the shortcomings, AHP has continue to be used extensively by a number of researchers in different fields.

In a similar approach to avoid the rank reversal, Saaty (2006) proposes a variation of AHP known as the ideal mode or the revised AHP method. In the new proposed approach, the right eigenvector of the comparison matrix is normalised by dividing by the largest element instead of the total sum as the case in the initial approach. This ensures that no rank reversal occurs.

The AHP methodology has been widely used extensively in solving significant number of decision problems across different fields including economics, medicine, manufacturing, engineering and environment (Shim 1989; Saaty 2006; Fulop 2005; Triantaphyllou 2000). Because of its intuitive appeal and flexibility, many corporations and governments routinely use AHP for making major policy decisions (Elkarmi and Mustafa, 1993). Generally, AHP helps to capture both subjective and objective evaluation measures. While providing a useful tool for checking the consistency of the evaluation measures and alternatives, AHP reduces bias in decision-making. In addition, the AHP approach has the distinct advantage that it decomposes a decision problem into its constituent parts and builds hierarchies of criteria. Here, the importance of each element (criterion) becomes clear (Macharis et al. 2004).

The result of the ranking process of AHP can be fundamental in selecting a number of stocks based on expert subjective ranking given a selection criteria to form a portfolio. The methodology generally simplify and boost the investor selection process especially on financial score. In a similar fashion, Tarmizi (2007) used the AHP methodology to compare listed tobacco companies on the Jakarta Stock Exchange. Financial ratios such as current ratio, acid test ratio, operating profit margin, debt to equity, return on equity, price earnings ratio and price to book value were used as a proxy to solicit respondent's views to capture financial score of considered assets. The expert opinions about companies' financials were analyzed using the AHP approach. It was found that HMSP was the most recommended tobacco company by respondents (31.7%) and operating profit margin was the most recommended financial ratio by respondents (37.5%).

The objective of this study is to determine the rank of selected domestic listed banks in the financial industry of the Ghana Stock Exchange according to the companies' financial ratios using the AHP method. This paper consists of five (5) sections. In the current section (1), Analytical Hierarchy Process modeling approach was reviewed and the objective of the study has been explicitly stated. The section again outlined the structure of the paper. Section 2 presents the Analytical Hierarchy Process (AHP) modeling approach and also specifies key steps for the study. Results and discussion of the AHP modeling approach are presented in section 3 of the paper. Lastly, concluding remarks and acknowledgements are presented in sections 4 and 5 respectively.

2.0 Materials and Method

This study employed data on banks listed on the Ghana Stock Exchange over a period of four (4) years spanning from 2008 to 2011. The data were collected from different sources including audited accounts of the listed banks as well as from the fact book of the Ghana Stock Exchange. These banks are: Ghana Commercial Bank (GCB), Cal Merchant Bank (CAL), HFC Bank, Societe Generale Ghana (SGG) and Eco Bank Ghana (EBG). A randomly sample of 150 investment professional both in academia and industry from Ghana were chosen for the purpose of the study to solicit their opinions on selected financial ratios with respect to the listed banks. The financial ratios considered in this study includes: return on asset, return on equity, income/gross income, non-interest expense/gross income, capital adequacy ratio, liquid assets to total assets, foreign exchange exposure ratio.

A structured questionnaire was administered to the respondents (investment professionals) who were asked to rank the importance of the financial ratios in terms of the ratios' contribution to optimizing portfolio's stock returns. Data was analysed using only quantitative approach. The geometric means for all responses were tabulated and rounded to the nearest integer due to the fact that the AHP model requires only a discrete scale from 1 through 9 (Bahmani et al, 1987). Pairwise comparisons and consistency ratios were then performed on the matrices.

2.1 Scale Ranging

The relative importance of the criteria were ranked by the nine point scale proposed by Saaty (1980) as shown in Table 1, which indicated that the level of relative importance from equal, moderate, strong, very strong to extreme level by 1, 3, 5, 7 and 9 respectively. The intermediate values between two adjacent arguments are represented by 2, 4, 6 and 8.

Table 1: The AHP pair-wise comparison scale (Saaty 1980)

Given values (1 - 9)	**Explanation**
1 – Equal	Equal alternatives have equal importance
3 – Moderate	One of the alternatives have slightly more importance than the other
5 – Strong	One of the alternatives is judged as slightly more important than the other by experts
7 - Very strong	One of the alternatives is judged as very strongly important compared to the other
9 - Extreme importance	One alternative is strictly superior to the other one
2,**4**,**6**,**8** - Intermediate values	used for compromised judgements when necessary

2.2 Hierarchy Structure

The decision-making problem in this study is decomposed into a hierarchy of criteria and alternatives as presented in figure 1 below. Level 1 is the goal of the analysis. Level 2 is multi-criteria that consist of several criterions whiles the last level is the alternative choices. The seven (7) covering criteria used in this study include: return on asset, return on equity, income/gross income, non-interest expense/gross income, capital adequacy ratio, liquid assets to total assets, Foreign exchange exposure ratio. All five (5) listed banks on the Ghana Stock Exchange (GSE) are considered as alternative choices. These includes: Ghana Commercial Bank (GCB), Cal Merchant Bank (CAL), HFC Bank, Societe Generale Ghana (SGG) and Eco Bank Ghana (EBG).

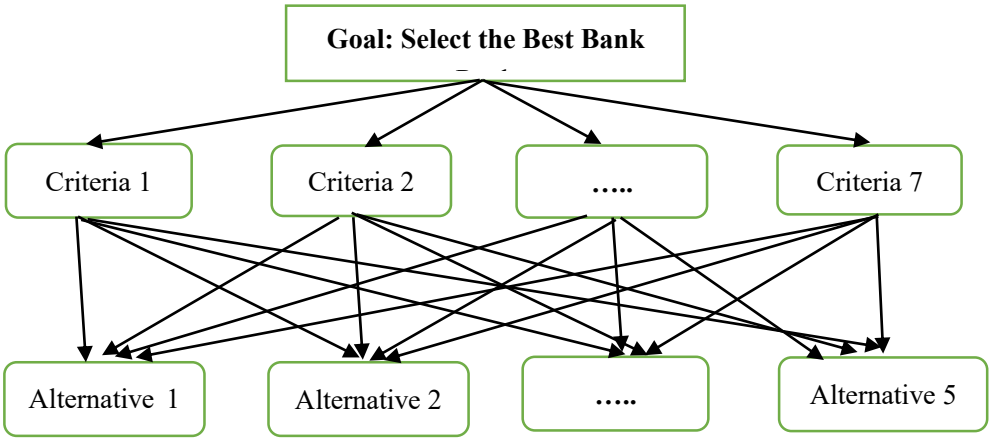

Fig 1: The decision hierarchy for selecting the best listed bank

2.3 Analytical Hierarchy Process Modeling Approach

The methodology is based on the observation that humans are more capable of making relative judgments than absolute judgments (Saaty, 2006).

A description of the steps in applying AHP based on Saaty (2006) is hereby outlined:

1. Problem formulation:
   Define the problem, set the goal and possible alternatives or solutions.
2. Building a hierarchy:
   Analyze and decompose the problem into smaller components, constructing a hierarchy structure that adequately represents the problem consisting of the goal, criteria, sub criteria and alternatives in multiple levels.
3. Perform pairwise comparison:
   At each level, construct a pairwise comparison matrix to compare elements with each another based on each criterion using AHP's fundamental scale for comparative judgments (see Table 2 from Saaty (2006)).

For a level in the hierarchy having *n* elements, the total number of comparisons needed is n (n-1)/2. A comparison matrix is used with the main diagonal elements equal 1 and half of the elements are the reciprocals of the other comparisons (principle of consistency). See Table 2

Table 2: Pairwise Comparison Matrix

Importance	$\mathbf{A_1}$	..	$\mathbf{A_j}$	..	$\mathbf{A_n}$
$\mathbf{A_1}$	1	..	a_{ij}	..	a_{1n}
.	..	1	..	..	..
$\mathbf{A_j}$	$1/a_{ij}$	..	1	..	..
.	..	..	..	1	..
$\mathbf{A_n}$	$1/a_{1n}$	..	..	..	1

4. Evaluate consistency of pairwise comparisons. Consistency for a comparison matrix is measured by calculating the consistency index (CI).

$$CI = (\lambda_{max} - n)/(n-1)$$

n is the number of elements and λ_{max} is the maximum eigenvalue of the comparison matrix. This consistency index is then compared to a random index (RI). The RI is the average CI of randomly generated reciprocal matrices using the scale 1/9, 1/8. . . 8, 9. The random consistency index for different dimensions n is given in Table 3 (from Saaty (2006)).

Table 3: Random Consistency Index

n	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
RI	0	0	0.52	0.89	1.11	1.25	1.35	1.4	1.45	1.49	1.51	1.54	1.56	1.57	1.58

The consistency ratio is defined as $CR = CI/RI$. For $n = 3$ and $n = 4$, conventionally it is required that $CR \leq 0.05$ and 0.08 respectively to be acceptable. For $n \geq 5$, a consistency ratio of 0.10 or less is acceptable.

5. Determine the local priority (local weight)
Based on the comparison matrix, a priority vector is derived using an eigenvector method. Eigenvectors for the matrix are given by:

$$A.\boldsymbol{w} = \lambda_{max}.\boldsymbol{w}$$

where A is the pairwise comparison matrix, $w = (w_1, w_2, \ldots, w_n)$ is the right principal eigenvector and λ_{max} is the maximum eigenvalue of matrix A. Normalizing w by dividing each element by the sum of the elements, ensures they are in the range between 0 and 1. This is referred to as the local priority vector of one level with respect to the upper level.

6. Calculate global priorities (total performance scores):
Each alternative is assigned a global score by aggregating local priorities weighted by the importance of the respective criteria:

$$x_i = \sum_{j=1}^{m} k_j w_{ij}, \quad for\ i = 1, \ldots, n$$

where x_i is the global priority score of alternative i, w_{ij} is the local priority of i with respective to criterion j, k_j is the importance weight (local priority) of criterion $j, j = 1, \ldots, m$. Global priority values are ranked in the range between 0 and 1 and measured in (dimensionless) priority units.

3.0 Results and Discussion

The analysis of the study was carried out based on the results obtained from the administered structured questionnaire.

3.1 Descriptive Statistics

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3.2 Analytical Hierarchy Process Results

Table 1a: Stock Pairwise Comparison Matrix - Return on Asset

Stock	**Return on Asset**				
	GCB	CAL	HFC	SGG	ECO BANK
GCB	**1**	1	1	1/2	1/3
CAL	1	**1**	1	1/2	1/3
HFC	1	1	**1**	1/2	1/3
SGG	2	2	2	**1**	1/2
ECO BANK	3	3	3	2	**1**
TOTAL	**8**	**8**	**8**	**4 1/2**	**2 1/2**

Table 1b: Normalised Matrix - Return on Asset Ratio

Stock	**Return on Asset**						
	GCB	CAL	HFC	SGG	ECO BANK	TOTAL	**Local Priority**
GCB	0.13	0.13	0.13	0.11	0.13	0.62	**0.12**
CAL	0.13	0.13	0.13	0.11	0.13	0.62	**0.12**
HFC	0.13	0.13	0.13	0.11	0.13	0.62	**0.12**
SGG	0.25	0.25	0.25	0.22	0.20	1.17	**0.23**
ECO BANK	0.38	0.38	0.38	0.44	0.40	1.97	**0.39**
TOTAL	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**5.00**	**1.00**

Table 2a: Stock Pairwise Comparison Matrix - Return on Equity Ratio

Stock	**Return on Equity**				
	GCB	CAL	HFC	SGG	ECO BANK
GCB	**1**	1/2	1/3	1/2	1/3
CAL	2	**1**	1/2	1	1/2
HFC	3	2	**1**	2	1
SGG	2	1	1/2	**1**	1/2
ECO BANK	3	2	1	2	**1**
TOTAL	**11**	**6 1/2**	**3 1/3**	**6 1/2**	**3 1/3**

Table 2b: Normalised Matrix - Return on Equity Ratio

Stock	Return on Equity						
	GCB	CAL	HFC	SGG	ECO BANK	TOTAL	**Local Priority**
GCB	0.09	0.08	0.10	0.08	0.10	0.44	**0.09**
CAL	0.18	0.15	0.15	0.15	0.15	0.79	**0.16**
HFC	0.27	0.31	0.30	0.31	0.30	1.49	**0.30**
SGG	0.18	0.15	0.15	0.15	0.15	0.79	**0.16**
ECO BANK	0.27	0.31	0.30	0.31	0.30	1.49	**0.30**
TOTAL	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**5.00**	**1.00**

Table 3a: Stock Pairwise Comparison Matrix - Income to Gross Income Ratio

Stock	Income / Gross Income				
	GCB	CAL	HFC	SGG	ECO BANK
GCB	**1**	3	2	1	2
CAL	1/3	**1**	1/2	1/3	1/2
HFC	1/2	2	**1**	1/2	1
SGG	1	3	2	**1**	2
ECO BANK	1/2	2	1	1/2	**1**
TOTAL	**3.33**	**11.00**	**6.50**	**3.33**	**6.50**

Table 3b: Normalised Matrix for the Income to Gross Income Ratio

Stock	Income / Gross Income						
	GCB	CAL	HFC	SGG	ECO BANK	TOTAL	**Local Priority**
GCB	0.30	0.27	0.31	0.30	0.31	1.49	**0.30**
CAL	0.10	0.09	0.08	0.10	0.08	0.44	**0.09**
HFC	0.15	0.18	0.15	0.15	0.15	0.79	**0.16**
SGG	0.30	0.27	0.31	0.30	0.31	1.49	**0.30**
ECO BANK	0.15	0.18	0.15	0.15	0.15	0.79	**0.16**
TOTAL	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**5.00**	**1.00**

Table 4a: Stock Pairwise Comparison Matrix - Non-Interest Expense to Gross Income Ratio

Stock	Non-Interest Expense / Gross Income				
	GCB	CAL	HFC	SGG	ECO BANK
GCB	**1**	2	1	1/2	1
CAL	1/2	**1**	1/2	1/3	1/2
HFC	1	2	**1**	1/2	1
SGG	2	3	2	**1**	2
ECO BANK	1	2	1	1/2	**1**
TOTAL	**5 1/2**	**10**	**5 1/2**	**2 5/6**	**5 1/2**

Table 4b: Normalised Matrix - Non-Interest Expense to Gross Income Ratio

Stock	Non-Interest Expense / Gross Income						
	GCB	CAL	HFC	SGG	ECO BANK	TOTAL	**Local Priority**
GCB	0.18	0.20	0.18	0.18	0.18	0.92	**0.18**
CAL	0.09	0.10	0.09	0.12	0.09	0.49	**0.10**
HFC	0.18	0.20	0.18	0.18	0.18	0.92	**0.18**
SGG	0.36	0.30	0.36	0.35	0.36	1.74	**0.35**
ECO BANK	0.18	0.20	0.18	0.18	**0.18**	0.92	**0.18**
TOTAL	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**5.00**	**1.00**

Table 5a: Stock Pairwise Comparison Matrix - Capital Adequacy Ratio

Stock	Capital Adequacy Ratio				
	GCB	CAL	HFC	SGG	ECO BANK
GCB	**1**	1/2	1/2	1/2	1/3
CAL	2	**1**	1	1	1/2
HFC	2	1	**1**	1	1/2
SGG	2	1	1	**1**	1/2
ECO BANK	3	2	2	2	**1**
TOTAL	**10**	**5 1/2**	**5 1/2**	**5 1/2**	**2 5/6**

Table 5b: Normalised Matrix - Capital Adequacy Ratio

Stock	Capital Adequacy Ratio						
	GCB	CAL	HFC	SGG	ECO BANK	TOTAL	**Local Priority**
GCB	0.10	0.09	0.09	0.09	0.12	0.49	**0.10**
CAL	0.20	0.18	0.18	0.18	0.18	0.92	**0.18**
HFC	0.20	0.18	0.18	0.18	0.18	0.92	**0.18**
SGG	0.20	0.18	0.18	0.18	0.18	0.92	**0.18**
ECO BANK	0.30	0.36	0.36	0.36	**0.35**	1.74	**0.35**
TOTAL	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**5.00**	**1.00**

Table 6a: Stock Pairwise Comparison Matrix - Liquid Asset to Total Asset Ratio

Stock	**Liquid Asset / Total Asset**				
	GCB	CAL	HFC	SGG	ECO BANK
GCB	**1**	2	3	2	2
CAL	1/2	**1**	2	1	1
HFC	1/3	1/2	**1**	1/2	1/2
SGG	1/2	1	2	**1**	1
ECO BANK	1/2	1	2	1	**1**
TOTAL	**2 5/6**	**5 1/2**	**10**	**5 1/2**	**5 1/2**

Table 6b: Normalised Matrix - Liquid Asset to Total Asset Ratio

Stock	**Liquid Asset / Total Asset**						
	GCB	CAL	HFC	SGG	ECO BANK	TOTAL	**Local Priority**
GCB	0.35	0.36	0.30	0.36	0.36	1.74	**0.35**
CAL	0.18	0.18	0.20	0.18	0.18	0.92	**0.18**
HFC	0.12	0.09	0.10	0.09	0.09	0.49	**0.10**
SGG	0.18	0.18	0.20	0.18	0.18	0.92	**0.18**
ECO BANK	0.18	0.18	0.20	0.18	**0.18**	0.92	**0.18**
TOTAL	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**5.00**	**1.00**

Table 7a: Stock Pairwise Comparison Matrix - Foreign Exchange Exposure Ratio

Stock	**Foreign Exchange Exposure Ratio**				
	GCB	CAL	HFC	SGG	ECO BANK
GCB	**1**	1	1	1	1
CAL	1	**1**	1	1	1
HFC	1	1	**1**	1	1

SGG	1	1	1	**1**	1
ECO BANK	1	1	1	1	**1**
TOTAL	**5**	**5**	**5**	**5**	**5**

Table 7b: Normalised Matrix - Foreign Exchange Exposure Ratio

Stock	**Foreign Exchange Exposure Ratio**						
	GCB	CAL	HFC	SGG	ECO BANK	TOTAL	**Local Priority**
GCB	0.20	0.20	0.20	0.20	0.20	1.00	**0.20**
CAL	0.20	0.20	0.20	0.20	0.20	1.00	**0.20**
HFC	0.20	0.20	0.20	0.20	0.20	1.00	**0.20**
SGG	0.20	0.20	0.20	0.20	0.20	1.00	**0.20**
ECO BANK	0.20	0.20	0.20	0.20	0.20	1.00	**0.20**
TOTAL	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**5.00**	**1.00**

Table 8a: Preference Vector for Each Criterion

Stock	**Ratio**								
	RA	RE	I/GI	NIE/GI	CAR	LA/TA	FEER	TOTAL	**PRIORITY**
RA	**0.30**	0.09	0.20	0.22	0.44	0.18	0.20	1.64	**0.23**
RE	0.30	**0.09**	0.30	0.27	0.02	0.03	0.23	1.25	**0.18**
I/GI	0.06	0.03	**0.10**	0.27	0.33	0.03	0.10	0.93	**0.13**
NIE/GI	0.07	0.02	0.02	**0.05**	0.06	0.09	0.07	0.38	**0.05**
CAR	0.07	0.47	0.03	0.11	**0.11**	0.55	0.20	1.55	**0.22**
LA/TA	0.15	0.28	0.30	0.05	0.02	**0.09**	0.17	1.06	**0.15**
FEER	0.05	0.01	0.03	0.03	0.02	0.02	**0.03**	0.19	**0.03**
TOTAL	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**7.00**	**1.00**

Table 8b: Stock Rank

Stock	**Priority Vector**	**Rank**
GCB	0.1745	**1st**
CAL	0.1027	**3rd**
HFC	0.1006	**5th**
SGG	0.1026	**4th**
ECO BANK	0.1367	**2nd**

4. Concluding Remarks

This study aims at ranking listed banks on the Ghana Stock Exchange (GSE) based on their financials using the analytical hierarchy process proposed by Saaty in 1980.

5. Acknowledgement

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