

Structural Characteristics and Operational Patterns of Savings Cooperatives in Thailand: A Multivariate Analysis Approach

Phimphorn Sowawattanakul^{1*} and Burin Sukphisal²

¹ Faculty of Economics, Kasetsart University, Bangkok 10900, Thailand

² Faculty of Business Administration, King Mongkut's Institute of Technology Ladkrabang,
Bangkok 10520, Thailand

*Corresponding author: Phimphorn.so@ku.th

Abstract

Research into the analysis of factor classification and cluster characteristics of savings cooperatives aims to categorise the types of cooperatives and characteristic groups, thereby gaining insight into the structural features of savings cooperatives, including their typical attributes in Thailand. The analysis employed factor analysis and cluster analysis to examine secondary data from the Cooperative Auditing Department, which included performance, business characteristics, and financial data of savings cooperatives for the fiscal year 2022, encompassing comprehensive data for the research period. The study examined 57 variables, comprising cooperative characteristics, data from financial statements including both the balance sheet and profit and loss account, and variables associated with the calculation of financial ratios from 1,356 savings cooperatives. The results from the Exploratory Factor Analysis revealed that only 38 variables were suitable for the model. These variables were organised into seven components, which collectively explained 63.997% of the characteristics of savings cooperatives. The results of the Cluster Analysis, utilising the first component variable, divided the savings cooperatives in Thailand into three clusters. Cluster 1 is a small cluster comprising only three cooperatives that exhibit a maturity stage of operation. Cluster 2 consists of small cooperatives in the early stage, characterised by a high growth rate across various dimensions, along with significant investment and asset returns. Cluster 3 represents an expanding cooperative. The findings of the study align with certain classifications of cooperatives as stipulated by formal regulations. They reflect the similarities prevalent among most types of small cooperatives; however, notable differences remain within larger cooperatives. Hence, Regulatory oversight should emphasise debt sustainability monitoring for mature-stage cooperatives and balanced growth management with early warning indicators for expanding-stage cooperatives.

Keywords: Savings cooperatives, Factor analysis, Cluster analysis

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Introduction

Savings cooperatives form a vital part of Thailand's financial system, operating under the Cooperative Act of 2019 to promote financial inclusion and member welfare. These institutions serve two main functions: encouraging regular savings habits among members and providing accessible credit facilities to meet economic needs and improve the quality of life, in line with cooperative principles (Department of Cooperative Promotion, 2022). As of 31 December 2022, Thailand's cooperative sector consisted of 1,364 savings cooperatives and 11 federations, collectively serving 3,436,109 members and representing 22.96% of all cooperatives nationwide. More notably, these institutions control 3,139.09 billion baht in operating capital, accounting for 84.23% of the total cooperative sector's financial resources (Department of Cooperative Promotion, 2022). This significant market presence underlines the sector's importance in Thailand's financial landscape and its potential to influence economic growth.

Current classification systems for savings cooperatives utilise various criteria, including organisational affiliation, operational scale, internal control quality, and financial performance metrics. However, these approaches often focus on isolated features without fully examining the multi-dimensional nature of cooperative operations. The absence of integrated classification frameworks limits understanding of structural diversity and impedes the development of targeted policies that address operational differences within the sector.

This research addresses this gap by applying multivariate statistical techniques to uncover underlying structural patterns in Thai savings cooperatives. By integrating operational, financial, and organisational characteristics, we aim to develop a comprehensive understanding of cooperative types that can inform evidence-based policy-making and enhance sector governance. The study contributes to cooperative literature by: (1) being the first to conduct a comprehensive multivariate analysis of Thai savings cooperatives, (2) developing an empirically-based classification framework that goes beyond traditional size-based categories, and (3) identifying key operational factors that influence cooperative performance and stability.

Literature Review

Savings cooperatives are financial institutions that encourage members to save for lifetime security and can provide loans to members for their essential needs at low interest rates. They adhere to self-help and mutual cooperation to collectively address economic and social issues (Cooperatives Studies Institute, 2025). Cooperatives in Thailand have the status of a juristic person under the cooperatives law. The Ministry of Finance has announced that savings cooperatives can charge interest on loans in the same manner as financial institutions. Members of savings cooperatives are part of the same organisation and receive a regular salary. The main objectives of savings cooperatives are to promote savings, offer loans to members at lower interest rates than other financial institutions, and provide welfare tailored to members' needs to help them achieve a better life and greater stability. The cooperative's operating capital comes from share capital, deposits from members and other cooperatives, and loans from various sources within the country. In 2023, there were 1,356 savings cooperatives in Thailand with 3,450,728 members. Total capital was approximately 3.30 trillion baht, an increase of 5.20% from 2022 (Financial Data Analysis Unit, 2023). Overall, Thai savings cooperatives have steadily expanded over the past decade. In Thailand, there are various formal classifications of cooperatives, including:

Classification of savings cooperatives by the cooperative's affiliate organization

Due to regulations governing savings cooperatives, they are established under either public or private organisations, and their members are employees. As a result, the affiliated organisation of the cooperatives is one of the features used for classification. There are nine types of cooperatives based on their affiliated organisations: teacher savings cooperatives, which have the highest number of members and share capital; police savings cooperatives; military savings cooperatives; hospital savings cooperatives; university savings cooperatives; state enterprise savings cooperatives; other government agency savings cooperatives; public health savings cooperatives; and private and other savings cooperatives (Department of Cooperatives Promotion, 2022).

Classification of Savings Cooperatives by Cooperative Size

The classification of savings cooperatives and credit union cooperatives is divided by size and involves two methods. The first method is based on the Ministerial Regulation on the Operation and Supervision of Savings Cooperatives and Credit Union Cooperatives 2021, which categorises cooperatives into two sizes: (1) Large cooperatives, with assets of five billion baht or more, including savings cooperatives federations, and (2) Small cooperatives, with assets of less

than five billion baht. The second method classifies cooperative sizes according to various variables: operating capital at the end of the year, core business income during the year, and the number of members at the end of the year. These three criteria are used to calculate a weighted score based on their range of variables. (Department of Cooperative Promotion, 2023).

Classification of savings cooperatives by the cooperative internal quality control

The internal quality control of cooperatives is considered a vital factor that directly affects the efficiency of organisational management. The standard level of internal quality control in cooperatives is assessed based on four criteria: assessment of the control environment, assessment of risks and control activities, assessment of information and communication systems, and assessment of the monitoring and evaluation system (Department of Cooperative Promotion, 2022). The description of internal quality control is divided into five levels: excellent, good, fair, needs improvement, and no internal involvement control.

Classification of savings cooperatives by the level of cooperative strength and stability

The Department of Cooperative Promotion, along with the Department of Cooperative Auditing, has set criteria for evaluating the strength of cooperatives across four areas: the ability to serve members, operational efficiency, organisational management effectiveness, and administrative efficiency. Cooperatives are categorised into four levels: 1) Cooperatives with good to excellent internal quality control and no operational faults, or faults that have been fully corrected; 2) Cooperatives with fair internal quality control or those with faults that have been entirely addressed but need monitoring or are under correction; 3) Cooperatives with business efficiency requiring improvement; and 4) Cooperatives that have been instructed to cease operations by the Cooperative Registrar and are in liquidation. (Piyajun, 2022).

Classification of savings cooperatives by Business Performance Analysis

Business efficiency analysis mainly assesses the financial ratios linked to the operations and management of cooperatives, considering self-reliance, financial stability, debtor quality, financial liquidity, business effectiveness, and management efficiency. The scoring criteria used by the Cooperative Auditing Department classify savings cooperatives into five categories: 1) Cooperatives with excellent financial stability can effectively withstand the impact of business fluctuations; 2) Cooperatives with good financial stability can partly withstand the impact of business fluctuations; 3) Cooperatives that meet the specified financial stability standards but need to be cautious of risks that could affect their performance and financial position; 4) Cooperatives that do not yet meet the specified financial stability standards can withstand

business fluctuations to some extent but are somewhat fragile; and 5) Cooperatives with financial vulnerability are unable to withstand the impact of business fluctuations. (Cooperative Audit Department, 2023).

Classification of savings cooperatives by cooperative standards

The Cooperative Promotion Department has established criteria for assessing cooperative standards, which have been in effect since 2021. These standards are based on performance over the past two fiscal years, including the most recent fiscal year's results, the preparation of financial statements completed within 150 days after the end of the budgetary year, participation in business with cooperative members—covering at least 60% of all members—hiring cooperative staff who work regularly and are responsible for the operations and business of the cooperatives, the allocation of net profits, and the payment of member welfare funds or public benefit funds at least once. Additionally, cooperatives must comply with laws, regulations, and orders from the Cooperative Registrar. The classification results will be announced as either Passed or Failed. (Cooperative Audit Department, 2023).

Classification of savings cooperatives based on relevant studies

Apart from formal classifications of cooperatives, the variables used in the study of savings cooperatives include the financial management variable through CAMEL analysis. For example, in the research on the economic efficiency of savings cooperatives in Thailand conducted by Klinjun et al. (2023), financial ratios were used to represent cooperative efficiency, which is influenced by both internal and external factors. Internally, it was found that a distinctive organisational structure, effective operations, an active working committee, and lawful management have impacted cooperative efficiency. Externally, factors such as increasing investment opportunities, prospects for savings cooperatives, and support from government agencies have also affected efficiency. However, rising inflation and higher interest rates have impacted the ability to repay debts, resulting in an increase in non-performing loans of savings cooperatives and a low growth rate in profits. These findings align with the study by Mmari and Thinyane (2021), which indicated that the factors contributing to better financial performance of savings cooperatives and credit unions include both external factors—such as members' socio-economic characteristics—and internal factors, including operating capital, loans, deposit management, and asset growth.

Khuntong et al. (2019) found that financial stability is one of the factors used to classify cooperatives. Economic stability positively influences management accounting techniques and asset management. Furthermore, management accounting techniques also have a positive

effect on the asset management of savings cooperatives in Thailand. Meanwhile, the study by Tapaneeyaworawong (2017) illustrated three variables that could be incorporated into the equation to classify the financial stability of savings cooperatives. These included a variable in the dimension of capital adequacy, calculated as the asset growth rate, and two variables in the dimension of liquidity: the reserve growth rate and the growth rate of other accumulated capital. However, studies in different areas may yield varying results. According to the observation made by Junlaphet et al. (2021), differences between areas, such as savings, indicate that cooperative members in the Northern region have higher savings than those in the North-Eastern region. Savings mobilization is relatively concentrated in Bangkok. The savings amount of the savings cooperatives at the provincial level has a positive relationship with GPP, the proportion of production in the service sector, the real interest rate, and the number of members. Conversely, the amount of savings shows a negative relationship with the proportion of production in the industrial sector.

The classification of cooperatives by efficiency by Sripoon et al. (2016) found that cooperatives with technical inefficiency in their operations are caused by having deposits from members, share capital, and loan debtors lower than the appropriate production level. Savings cooperatives with inefficient technical operations will not be able to make a profit. The classification of cooperatives by financial variables by Pornpradub and Bosakoranut (2021) found that the capital management structure is a critical financial factor that influences the operational direction of savings cooperatives. The ratio of cooperative capital to total assets is positively related to the net profit rate. The ratio of cash and bank deposits to total assets has a positive correlation with the profit growth rate. The ratio of investment to total assets is positively related to profit per member. Conversely, the ratios of deposits to total assets and cooperative capital to total assets are negatively associated with profit per member.

Analyzing the consistency between the efficiency of cooperative operation functions and fifteen aspects of cooperative characteristics, which are 1) Cooperative philosophy, 2) Member deposit management, 3) Member lending business, 4) Cooperative financial management, 5) Application of sufficiency economy philosophy to cooperatives, 6) Cooperative operation policy setting, 7) Quality of life development, 8) Welfare organisation, 9) Cooperative internal audit and control, 10) Cooperative finance and accounting, 11) Cooperative management, 12) Member participation, 13) Development of cooperative business networks and communication, 14) Building trust, providing exemplary service to members and cooperative networks, and 15) Creating motivation for savings among cooperative personnel and members.

The study found that the level of lending to members was very high across these aspects, while the consistency of financial management was at a secondary high level. Regarding the development of quality of life and communication for developing the cooperative business network, both indicators are at a moderate level. (Kongthanacharuanan and Chueamuangphan, 2016).

The practical aspects of managing savings cooperatives also consider various factors from other groups, such as studies based on Buddhist principles. These studies found that two main factors influence the effectiveness of savings cooperative management in Thailand, as identified through qualitative research: general management theories and Buddhist principles. The development models for effective management of savings cooperatives are categorised into seven models: 1) Effective planning model based on Buddhist principles, 2) Effective organisation model based on Buddhist principles, 3) Effective human resource management model based on Buddhist principles, 4) Effective diagnosis, command or guidance model based on Buddhist principles, 5) Effective coordination model based on Buddhist principles, 6) Effective reporting model based on Buddhist principles, and 7) Effective budget management model based on Buddhist principles. (Wongsan et al. 2018)

Besides considering efficiency, the study on the excellence of savings cooperatives in Thailand by Massamur et al. (2018) identified several factors that are likely to influence the efficiency, effectiveness, and success of these cooperatives. The study found six significant factors that affect the opportunity for excellence: cooperative size, attendance at member meetings, leadership of the cooperative chairman, education level of managers, experience of managers, and the proportion of member training. Additionally, three factors that tend to impact the opportunity for excellence are the debt-to-equity ratio, employee-to-equity ratio, and average income per household within the cooperative area.

Based on the review of related research, the study of cooperative grouping, efficiency analysis, and characteristics of cooperatives has been diverse, with the number of variables used in the research interpretable in different ways. In this study, it is vital to investigate the situation based on data derived from real-world problems, enabling an analysis of both the grouping of cooperatives and their various features using factual operational data. This approach aims to improve understanding of the group's structure of cooperatives from actual facts and to provide initial data for analysis, ultimately leading to a deeper understanding of the savings cooperative context. This can be summarised as the research framework for the study as follows:

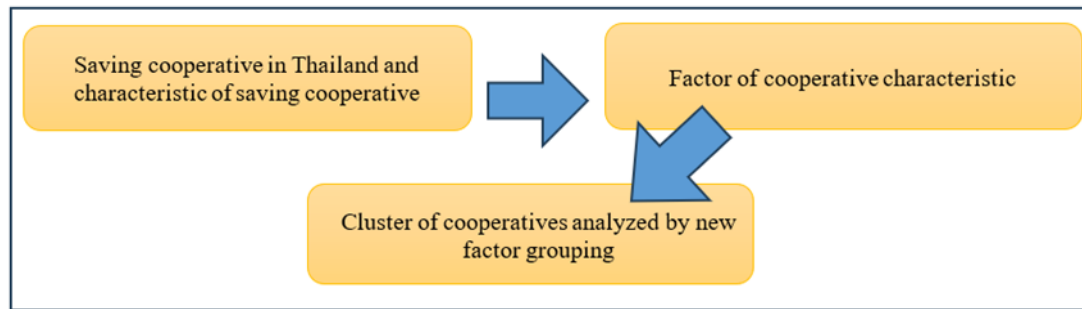


Figure 1 Research Framework

Methodology

This research was conducted to study and analyse the group structure of savings cooperatives and their characteristics in Thailand. The data from savings cooperatives in Thailand, which were registered and reported to the Cooperative Auditing Department during the fiscal year 2022, were utilised. The dataset included 1,356 cooperatives, covering cooperative characteristics, business operations, and financial status, as disclosed by the Cooperative Auditing Department. The data were subsequently analysed for key financial ratios to serve as covariates in examining the relationships between data groups, as well as for factor analysis and cluster analysis to understand the structure of savings cooperatives in Thailand. The resulting components were then analysed according to group savings cooperatives.

Data on 57 variables for various savings cooperatives in Thailand was collected. These variables, recorded by relevant organisations, relate to savings cooperatives in Thailand. The study begins with all variables and then eliminates unsuitable ones to explore the significant structural model. The data set consists of three parts: 1) Variables of cooperative characteristics, 2) Variables from financial statements including both the balance sheet and profit and loss statement, and 3) Variables derived from financial ratio calculations. Nearly all variables are ratio scales, except for three nominal scale variables: province, region, and cooperative size. These three variables will not be used in the factor analysis and cluster analysis but will be utilised later to analyse the cluster groups.

Data analyses examined the components of savings cooperative operations in Thailand using two main methods: 1) Exploratory Factor Analysis (EFA), which is a technique for analysing the components and naming them. The statistics used in this test include the appropriateness of the sample group (Kaiser-Meyer-Olkin: KMO), checking the population correlation matrix (Bartlett's test), correlation analysis, grouping components, and rotating the axes using the Varimax method. 2) Clustering analysis is a technique for analysing similar data sets within the same data set. The statistics involved include checking and adjusting variable values to ensure they are appropriate

as normally distributed variables, determining quantitative sub-variables to divide groups, and selecting the method for measuring distance. The distance analysis, which measures similarity based on the sum of squares within the cluster, aims to include the cluster that results in the smallest increase in the sum of squares within the cluster distance value, eventually allowing the division of cluster means. The study employs hierarchical techniques to select the number of groups and conducts partitioning using K-means. Then, the Z score values, the number of data sets in each group, and the different distances of each group are determined (Vanichbuncha, 2009). However, K-means clustering has its limitations. It can be sensitive to initial guesses, outliers can influence the results, it assumes spherical clusters, and it may face challenges with large datasets. (Khan et al, 2024).

Result

The study found that, based on data from 2022, there were 1,356 savings cooperatives, with the highest number in Bangkok and its vicinity at 496 cooperatives, or 36.59%, and the lowest in the upper central region, with 56 cooperatives, or 4.13%. From the data used in the calculation, total assets amounted to 3,437.52 billion baht, liabilities to 1,845.33 billion baht, member shares to 1,347.89 billion baht, and total shareholders' equity to 1,604.67 billion baht. Total revenue was 170.09 billion baht, resulting in a profit of 102.53 billion baht. The overall business operation value, which generally combines the value of credit, savings, and other related businesses operated by savings cooperatives, in 2022 was 3,817.76 billion baht.

Factor Analysis

The analysis in this section begins by assessing the suitability of all 57 variables through correlation statistics, as well as the Kaiser-Meyer-Olkin (KMO) measure and Bartlett's Test of Sphericity. The process involved removing variables with a correlation coefficient greater than 0.8 and excluding variables that hindered the calculation of the KMO value, resulting in 39 variables. These remaining variables have a KMO of 0.565 and Bartlett's Test significance of 0.000. Consequently, it can be concluded that the data set is appropriate for factor analysis.

Then, the communalities were analysed. The initial communalities value for all variables from the Principal Component Analysis (PCA) was 1. In contrast, the extraction communalities for the lowest variable, the cash flow ratio, was 0.172, which is less than 0.3. Therefore, the calculation was repeated after removing this variable. The remaining 38 variables were then recalculated. The Kaiser-Meyer-Olkin (KMO) measure for all 38 variables was greater than 0.5, with a mediocre Bartlett's test value (between 0.5 and 0.7) (Hadi et al, 2016). The initial

communalities for all variables were 1, and after extracting the components, the communalities for all variables were greater than 0.3. These 38 variables were thus suitable for further grouping of the components.

The eigenvalue of these variables was greater than 1 and indicated eleven factors. This can be interpreted as the traits of the savings cooperatives, which can be grouped into eleven categories. The cumulative percentage of variance of all eleven components is 76.755, demonstrating that these components can explain the characteristics of the savings cooperatives' operations by 76.755%.

Table 1 Total variance explained by the component analysis

Components	Rotation Sums of Squared Loadings		
	Eigenvalues	% of Variance	Cumulative%
1	11.295	26.569	26.569
2	3.041	8.225	34.794
3	2.919	7.663	42.457
4	2.480	7.259	49.716
5	2.093	5.644	55.360
6	1.630	4.892	60.252
7	1.337	3.745	63.997
8	1.169	3.563	67.560
9	1.143	3.325	70.884
10	1.062	3.197	74.081
11	1.000	2.674	76.755

Source: Calculated by researchers

The researcher selected orthogonal rotation of the components using the Varimax method to make each component independent, which would facilitate the interpretation of the components. According to the data, eleven components could be grouped, with only six components comprising more than three variables and another five comprising only two or one variable. As Angsuchot et al. (2009) suggested, this method's component grouping should show a cumulative variance of more than 60%. Therefore, this study focused only on components 1 to 7, which could explain 63.997% of the data characteristics of the savings cooperatives. Of these seven components, six had more than three variables, and only one consisted of just two variables.

The analysis was performed using Cronbach's alpha reliability test. All 38 variables had a coefficient of 0.831, which is greater than 0.5, indicating that all 38 variables can comprehensively

explain the characteristics of the savings cooperatives. In the component analysis, variables with similar importance scores are grouped into the same component and ranked from highest to lowest importance. The variables in each component are shown in Table 2.

Table 2 Internal variables and weights

Variables	1	2	3	4	5	6	7
Investment	0.953						
Shareholder	0.944						
Business operation value	0.935						
Income	0.933						
profit-loss	0.918						
member deposits	0.914						
short-term loans	0.852						
Cash	0.803						
long-term investments	0.772						
long-term loans	0.770						
number of members	0.744						
accumulated capital	0.654						
other non-current liabilities	0.503						
land, buildings, and equipment	0.437						
savings per member		0.974					
debt per member		0.968					
other current assets		0.692					
profit per member		0.658					
capital growth rate			0.996				
asset growth rate			0.987				
business growth rate			0.970				
payable expenses not exceeding 1-year				0.914			
long-term debt				0.911			
other cooperative deposits				0.656			
return on investment ratio					0.917		
profit to business operation value ratio					0.848		
return on equity ratio						0.803	
return on assets ratio						0.727	
current asset ratio						-0.719	

Table 2 (Continued)

Variables	1	2	3	4	5	6	7
deposits from other cooperatives							0.747
debt-equity ratio							0.642
current debt ratio							0.340

Source: Calculated by researchers

The above factor analysis, considering the results of operations and financial figures, divides 38 savings cooperative variables into seven components as follows:

- **Component 1:** Business capital management accounts for 24.736% of the characteristics of the data group, comprising fourteen variables: investment, shareholder, business operating value, income, profit and loss, member deposits, short-term loans, cash, long-term investments, long-term loans, number of members, accumulated capital, other non-current liabilities, and land, buildings, and equipment.
- **Component 2:** Business transactions with members can clarify the characteristics of the savings cooperative's operational data by 32.345%, consisting of four variables: savings per member, debt per member, other current assets, and profit per member.
- **Component 3:** Growth from the capital foundation can elucidate the characteristics of the savings cooperatives' operating data, which increased by 39.449%. It includes three variables: capital growth rate, asset growth rate, and business growth rate.
- **Component 4:** Debt turnover relative to business operation value can explain the characteristics of the operating data, increasing by a total of 46.149%. It includes three variables: payable expenses not exceeding one year, long-term debt, and other cooperative deposits.
- **Component 5:** Generating income through the cooperative business can explain the characteristics of the operating data, increasing by 51.574% overall. It comprises two variables: the return on investment ratio and the profit to business operation value ratio.
- **Component 6:** Asset management can account for 56.803% of the savings cooperatives' operating data characteristics, which include three variables: return on equity ratio, return on assets ratio, and current asset ratio.

- **Component 7:** Debt management, comprising three variables—deposits from other cooperatives, debt-equity ratio, and current debt ratio—can account for 61.527% of the operating data's characteristics.

All components are summarised from the analysis presented in the table below.

Table 3 Summary of components classified by Factor analysis

Components	% of Variance	Cumulative%
1. Business capital management	26.569	26.569
2. Business transactions with members	8.225	34.794
3. Growth from the capital foundation	7.663	42.457
4. Debt turnover to business operation value	7.259	49.716
5. Generating income through the cooperative business	5.644	55.360
6. Asset management	4.892	60.252
7. Debt management	3.745	63.997

Source: Calculated by researchers

The results indicated that managing business capital is the most crucial aspect of managing savings cooperatives, followed by conducting business with members, which must be considered alongside growth from the initial capital or the overall development of the cooperative as essential factors. It was also observed that debt circulation to generate income is a set of variables shared by many cooperatives. This set of elements more effectively explains the financial characteristics of savings cooperatives than debt management related to deposits from other cooperatives.

Cluster Analysis

The correlation was analysed, and nine variables were removed because they had correlation values higher than 0.8. These nine variables included total current assets, non-current assets, total assets, total current liabilities, total liabilities, reserve capital, total equity, average annual equity, and average annual assets. The process began with data enhancement by transforming the non-normally distributed variables into logarithmic values to make them normally distributed. The first component from factor analysis, which was the main component, was used for the cluster analysis. This analysis selected the non-hierarchical or K-Means clustering method, which is suitable for classifying groups with over 200 cases. (Angsuchot et al., 2009).

Initially, three groups were defined. The grouping and factor characteristics resulted in the initial cluster centre values for the savings cooperative dataset as follows: Cluster 1 had a centre point of 16.175, cluster 2 a centre point of -2.535, and cluster 3 a centre point of 5.390. These

values showed a significant distance between the centres of the three groups. Table 4 displays the iteration history of the cooperative savings dataset. The average or centre value of each cluster changes with each calculation round. The maximum number of rounds was set to 20. However, the calculations were stopped at the 8th round because it was observed that there was no change in the centre value of each group, and the centre value was 0.

Table 4 Iteration history of cooperative saving data set

Iteration	Iteration History		
	Change in Cluster Centers		
	1	2	3
1	1.975	2.370	2.673
2	0.000	0.015	0.229
3	0.000	0.006	0.083
4	0.000	0.005	0.078
5	0.000	0.002	0.029
6	0.000	0.002	0.029
7	0.000	0.001	0.014
8	0.000	0.000	0.000

Source: Calculated by researchers

The between-cluster mean-square and cluster mean square displayed a Significance value < 0.05 . In testing the difference between the averages of each cluster, the mean values of the factors are different at the F-statistic value of 3383.133. The final cluster calculation of the new factor grouping shows the averages of each variable. In all three groups, the results of the grouping and the characteristics of the factors with the center point distance are more clearly separated. Cluster 1 shows a center point value of 14.199, cluster 2 shows a center point value of -0.196, and cluster 3 has a center point value of 2.255. Table 5 illustrates the number of cooperatives in each cluster. It was found that most cooperatives (1,216 cooperatives) were in Cluster 2, followed by Cluster 3 (87 cooperatives) and Cluster 1, which consists of only three cooperatives.

Table 5 Number of cases (saving cooperatives) in each cluster

Number of Cases in each Cluster	
Cluster 1	3.00
Cluster 2	1,216.00
Cluster 3	87.00
Valid	1,306.00

Table 5 (Continued)

Number of Cases in each Cluster	
Unable to justify	50.00

Source: Calculated by researchers

The study presents interesting features, outlined as follows. In cluster 1, which comprises only three cooperatives, it was found that they are savings cooperatives affiliated with a well-known university, the Savings Cooperatives Association of Thailand, and the savings cooperatives of the Electricity Generating Authority of Thailand Limited, which holds the largest capital amount in Thailand. Additionally, the basic information for each cluster demonstrated distinct characteristics of the cooperatives within them. Cluster 1, a small group of just three cooperatives, all belong to the category of large savings cooperatives based on the size classification established by the Department of Cooperative Promotion. The other large cooperatives are distributed between cluster 2 and cluster 3, accounting for 41.10% and 56.85% respectively. Regarding small-sized cooperatives, it was observed that over 99% of savings cooperatives are grouped into cluster 2. Only a tiny fraction, four cooperatives—or 0.34%—are classified within cluster 3, as shown in Table 6.

Table 6 Number of cases (saving cooperatives) in each cluster compared to regularity size criteria

Cooperative classified by size	Cluster	Number of saving cooperative	Percentage	Number of Members
Large savings cooperatives	1	3	2.05	30,099.00
	2	60	41.10	7,178.35
	3	83	56.85	16,245.70
	Total	146	100.00	12,804.05
Small savings cooperatives	2	1,156	99.66	1,204.47
	3	4	0.34	37,079.00
	Total	1,160	100.00	1,279.82
Unable to justify		50		158.04
Grand total		1,356		2,520.63

Source: Calculated by researchers

When savings cooperatives are classified by region, it was found that in cluster 1, a small group with only three cooperatives, all are cooperatives in Bangkok and its surrounding areas.

Over 80% of savings cooperatives across all regions are grouped into cluster 2. The upper central region has the highest proportion of savings cooperatives in cluster 3.

The values vary in terms of the number of members, members' shares, business operation value, income, and average net profit for each cluster. Cluster 1 is a large cooperative group with an average of 30,099 members, an average member's share of 36,346.41 million baht, a business operation value exceeding 100 billion baht, and average income and profit of over 5,000 million baht and 2,500 million baht, respectively. The next largest cooperative is in cluster 3, with an average of 17,203.55 members, an average member's share of approximately 7,300 million baht, a business operation value of more than 22,000 million baht, and an average income and profit of 939.05 million baht and 557.97 million baht, respectively. Meanwhile, Cluster 2 is a smaller cooperative group, with an average of around 1,500 members. These cooperatives have an average member share of about 500 million baht, a business operation value exceeding 1,250 million baht, and average income and profit of only 59.17 million baht and 37.60 million baht, respectively, as shown in Table 7.

According to component 1 obtained from the factor analysis, which comprises fourteen variables, the highest and lowest values of the main variables in each cluster reveal significant characteristics of the cooperatives. The average values of share value, business operation value, income, and profit varied across all three groups, although the highest and lowest values in clusters 2 and 3 show some overlap in all items.

Table 7 Number of members, members' shares, business operation value, income, and average net profit of each cluster.

	Cluster			
	1	2	3	Average
Number of Members (persons)	30,099.00	1,499.24	17,203.55	2,520.63
Average members' shares (Million Thai baht)	36,346.41	495.93	7,299.65	994.02
Average business operation value (Million Thai baht)	114,259.98	1,252.09	22,436.04	2,815.46
Average income (Million Thai baht)	5,408.35	59.17	939.05	125.44
Average net profit (Million Thai baht)	2,745.60	37.60	557.97	75.61

Source: Calculated by researchers

Considering the critical financial ratios of all three clusters, the values obtained are related to the business size of each cluster, which has been previously shown. Particularly in terms of

growth rates, larger cooperatives (clusters 1 and 3) typically have lower growth rates than smaller cooperatives, except for asset growth. Conversely, cluster 3 exhibits a very high growth rate. Additionally, it was observed that in cluster 2, there are differences in financial ratios between clusters 1 and 3, with profit margins, investment returns, and returns on assets being higher than those of cluster 2, except for returns on equity. Overall, it is possible to assign names based on the characteristics of the clusters, which are divided as follows:

Cluster 1 – Mature stage cooperative

This cluster comprised large cooperatives with an average of 30,999 members, average member shares worth 36,346.61 million baht, a business operation value exceeding 100,000 million baht, and an average income and profit of over 5,000 million baht and 2,500 million baht respectively. Additionally, it features a noteworthy characteristic: a very high debt-to-equity ratio. Growth is more complex in large cooperatives with extensive customer bases. Securing capital to meet members' needs and generate income is a crucial guideline for ongoing operations.

Cluster 2 – Initial stage cooperative

This cluster comprised small cooperatives with an average membership of approximately 1,500 individuals. The average share per member is about 500 million baht, with a business operation value exceeding 1,250 million baht, and average income and profit figures of just 59.17 million baht and 37.60 million baht, respectively. These cooperatives exhibit key characteristics, such as high growth rates in both business and assets. Furthermore, as small cooperatives with strong operational results, they achieve high returns on investment, assets, and profits. They are also capable of expanding their businesses and increasing income by leveraging their capital.

Cluster 3 – Expanding stage cooperative

This cluster was the largest cooperative group, with an average of 17,203.55 members, approximately 7,300 million baht in member shares, a business operation value of over 22,000 million baht, and an average income and profit of 939.05 million baht and 557.97 million baht respectively. Its most notable characteristic is having many members; however, it has already reached a certain level of growth, and the business growth rate is not very high. These cooperatives can still operate with their capital, as indicated by a debt-to-equity ratio of 1.33, and they can utilise their capital to generate high income level.

Discussion

From the component analysis, the elements of the variables related to the operation of Thai savings cooperatives can be grouped into seven main categories. Based on the analysis of each element, the characteristics of each can be described as follows:

Component 1, which consists of fourteen variables, explains 24.736% of the characteristics of savings cooperatives. These variables include investment, shareholder, business operation value, income, profit-loss, member deposits, short-term loans, cash, long-term investments, long-term loans, number of members, accumulated capital, other non-current liabilities, and land, buildings, and equipment. They relate to capital management for business operations that generate income and profit for savings cooperatives. Sripoon et al. (2016) conducted a study on cooperative efficiency. They found that factors affecting efficiency include member deposits, share capital, and loan receivables. Similarly, the study by Mmari and Thinyane (2021) revealed that internal factors such as operating capital, loans, and deposit management influence better financial performance in SACCOS. Therefore, this component is crucial for the efficiency and capital management of savings cooperatives.

The second component was identified as being linked to business operations. Four variables—savings per member, debt per member, other current assets, and profit per member—were primarily considered for the average transaction per member. This set of variables aligned with the savings cooperative assessment variables in terms of clarity, transparency, and operational aspects. These factors are consistent with cooperative philosophy and pertain to managing the cooperative members' deposits and lending activities per member.

The third component comprises three variables: capital growth rate, asset growth rate, and business growth rate. It is defined as the growth aspect of the capital foundation. The elements in this group align with the study of Khuntong et al. (2019), who examined the financial stability of savings cooperatives. Variables used to develop an equation for classifying the economic stability of savings cooperatives include the variable related to capital adequacy and the variable related to liquidity, which are the growth rates of reserves and other accumulated capital. Therefore, it can be concluded that the growth component of the capital foundation in this group is a significant variable influencing the financial stability of savings cooperatives.

Another interesting component is component 4, which generates income through the cooperative business, consisting of two variables: investment return and business operation profit ratios. The ratios in this group relate to the study by Pornpradub and Bosakoranut (2021), which

found that a set of variables has a positive relationship with the profit rate of savings cooperatives. These variables also guide the development of appropriate cooperative management.

When examining the critical financial ratios used to classify savings cooperatives, which can be divided into three groups, it becomes clear that the values obtained are related to the business size of each cluster previously shown, particularly concerning growth rates. In the case of small cooperatives or initial-stage cooperatives, it was found that in the classification of cluster 2—where more than 99% of the cooperatives are grouped—most savings cooperatives are in cluster 2, with only a tiny fraction, or just 0.34%, falling into cluster 3 or expanded cooperatives. Therefore, the classification of cooperatives, based on the specified size of 5 billion baht into large and small categories by the Department of Cooperative Promotion, can reflect the group characteristics of cooperatives and be appropriate for small savings cooperatives. However, for large cooperatives (operating capital exceeding 5 billion baht), these can be subdivided into subgroups with similar features.

Furthermore, there is a notable issue with certain financial behaviours in Cluster 1, mature cooperatives, which exhibit high levels of debt. This can be attributed to the fact that the sources of funds for savings cooperatives include member share value, member deposits, other cooperative deposits, and loans from other sources. The latter three sources are considered cooperative debt. Savings cooperatives operate like financial institutions, earning income from the difference between the interest they pay on their sources of funds and the interest they collect when they invest or lend out money. A high debt-to-equity ratio is not always harmful to a company's profits. If the company can show that it has sufficient cash flow to meet its debt obligations and that leverage is increasing equity returns, this may signal financial strength in institutions in Poland, Lithuania, and the United States. (Novickyte and Petraityte, 2014; Lysiak et al, 2022, Macrotrend; 2024). As a result, this type of cooperative often generates profit through debts, which are usually cheaper than member share value.

Additionally, a study of cooperatives affected by area by Junlaphet et al. (2021) stated that the mobilisation of cooperative savings is entirely concentrated in the Bangkok area. It was found that, in the case of the classification of cooperatives in cluster 1 or the maturity stage, cooperatives are in Bangkok and its vicinity. However, in other regions, clusters 2 and 3 similarly distribute the number of cooperatives. Therefore, it is still not possible to conclude about the area effect. Similar to the findings of Tapaneeyaworrawong (2017), the study showed that different regions may have varying results when studying the characteristics of cooperatives because of

other elements, such as being cooperatives in urban, suburban, or rural areas, including the parent organisation of the savings cooperative.

Suggestion

Results from the study can be recommended as follows:

- Although the KMO value exceeds 0.5, it remains suboptimal, which may impact the reliability of the factor analysis. This constitutes a limitation of the study. Nevertheless, this study reveals the structural model of saving cooperatives in Thailand through different aspects that have not been explored in prior research.
- The classification of cooperatives by size, based on operating capital of more than 5 billion baht as a large cooperative and less than 5 billion baht as a small cooperative, primarily reflects the similarities among small cooperatives. However, many characteristics differ in large cooperatives with capital exceeding 5 billion baht. Therefore, policies intended for large cooperatives should be considered carefully, as each cooperative may face different operational challenges. In cluster 1, some cooperatives rely heavily on external debt, whereas in cluster 3, expanding-stage cooperatives must consider growth financed by debt within their capacity to manage capital, in order to generate substantial returns.
- Analysis of the cooperative's components revealed that the first group includes investment, shareholder value, business operation value, income, profit and loss, member deposits, short-term loans, cash, long-term investments, long-term loans, the number of members, accumulated capital, other non-current liabilities, and land, buildings, and equipment. These fourteen variables are essential and should be considered as they primarily influence the efficiency of the cooperative's operations.
- For cooperative stability, cooperatives need to consistently examine the growth rates of capital, assets, and businesses. These indicators are significantly related to the stability of the cooperative.
- Due to the diversity and large number of cooperatives, classifying all of them may overlook certain characteristics. Therefore, conducting classification analysis by dividing them into subgroups, such as large, small, or savings cooperatives within specific areas, may produce some distinct results.
- This cooperative cluster analysis was based on component 1 from factor analysis. Therefore, a study should also consider each key variable or component, such as component 2, cooperative operations, or component 4, cooperative stability. Additionally, the grouping in cluster 2 contains a large number of cooperatives, up to 1,216, accounting for approximately 90%

of the data set. Further subdividing the cooperatives in this cluster by specific characteristics could provide a clearer understanding of the cooperatives in Thailand.

- Saving cooperatives may expand their business value through liability management. Results indicate that debt turnover influences income-generation capability. However, this depends on the difference between the cost of funds and the returns from investments or member loans.

- The cluster analysis relies solely on the first-factor component, which may risk oversimplifying multidimensional data. Future research should examine other components, including factors such as regional variables, to better understand geographical influences.

Conclusion

The study identifies seven components that collectively explain 63.997% of the characteristics of savings cooperatives. The most significant component is "Business capital management," which comprises fourteen variables: investment, shareholder, business operating value, income, profit and loss, member deposits, short-term loans, cash, long-term investments, long-term loans, number of members, accumulated capital, other non-current liabilities, and land, buildings, and equipment. The results of the Cluster Analysis, using the first component variable, divided the savings cooperatives in Thailand into three clusters. Cluster 1 is a small group comprising only three cooperatives that demonstrate a mature stage of operation. Cluster 2 includes small cooperatives in the early stage, characterised by a high growth rate across various dimensions, as well as significant investment and asset returns. Cluster 3 represents expanding cooperatives. The findings align with certain classifications of cooperatives as outlined by formal regulations. They reflect the similarities common among most types of small cooperatives; however, notable differences remain within larger cooperatives. Therefore, policy formulation for larger cooperatives may require unique operational considerations. Mature-stage cooperatives that exhibit high debt-to-equity ratios should be supported through debt management monitoring standards, including liquidity coverage requirements, and periodic assessment of the cost-of-funds-to-return to ensure sustainable leverage practices. Whereas expanding-stage cooperatives should be supported through growth management guidelines that balance capital expansion with prudent debt levels, incorporating early warning indicators based on the growth rates of capital, assets, and business operations.

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