

PORTFOLIO SELECTION ON BANK CORPORATIONS IN THE PHILIPPINES USING FUZZY-ANALYTIC NETWORK PROCESS

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ABSTRACT

Majority of the investors found financial corporations as option on investing stocks, given its strengths particularly in being involve on banking regulation policies, and being diverse in functions such as commercial banking, investment banking and insurance. However, the volatility of banks in external factors because of their being a cyclical type of business and sensitive to economic recessions made investing in banking stocks risky. These risks are mostly experienced during the COVID-19 pandemic period where economies had been closed due to lockdowns, and as we are on our way to the post-pandemic stage, there should be a shift in choosing right portfolio investment to gain higher returns. The objective of this study is to analyze the financial performance before and during the quarantine period of 16 banking corporations listed on Philippine Stock Exchange (PSEi) and choose one with best returns. This paper uses the Fuzzy Analytic Network Process approach to rank banking portfolios. Profitability, growth, and market are used as criteria in ranking portfolios in FANP approach. For the criteria and its corresponding importance ranking, we will use the data results from the FANP portfolio selection study conducted.

KEYWORDS

Banking system, portfolio evaluation, COVID- 19, FANP, portfolio selection ranking

1. INTRODUCTION

Banking systems dominate the financial industry of the Philippines, and their performance greatly affects the growth on the economy. According to the data published by IMF (International Monetary Fund), its total assets cover 126% of the gross domestic product of the country [1]. This results in the interest of the investors in choosing banks as options for value investing.

According to an article published by The Motley Fool Foundation, investing in bank stocks has strengths such as regulation policies, and capability to do two types of businesses, namely commercial banking, and investment banking [2]. The banking sector also provides dividends, which demonstrates a great history of monetary performance, and gives investors a share of profits [3].

There are also risks being considered in investing stocks in bank corporations. Banks depend on how public consumers spend and borrow money to gain profit, meaning they are cyclical type of business and sensitive to economic recessions. Banks are risky to loan loss or default, when recession hit, loan losses among consumers could increase and could give difficulty for the businesses on paying debts. Lastly, decreasing interest rates might hurt bank profits [2].

The risks on investing in bank stocks were greatly experienced during the Coronavirus-19 pandemic. According to an article from the Businessworld, the Philippine Stock Exchange (PSEi) declined by 31.9% on the 1st Quarter of 2020 [4]. One out of five branches of Manila's biggest banks were shut down during the virus outbreak [5]. According to the data from PricewaterhouseCoopers Philippines, gross non-performing loans ratio increased by 2.21% last March 2020 [6]. A one-standard-deviation increase in liquidity risk lowered stock returns by 5% during

the pandemic period or 7.4% of the unconditional mean return [7]. Mandarin Securities Corp. research analyst Zoren Philip A. Musngi said the sell-off in financial markets during the pandemic losses many trading desks and portfolios, that also led for bank corporations to double their loan loss provisions and affects negatively on some banks' non-interest income side [8]. It is important to test the performance of banks during the recovery after the pandemic.

Banking systems are complex options in stocks investments and scenarios such as COVID-19 pandemic make it more complicated; therefore, it is necessary for the investors to consider factors, aspects, and scientific strategies to maximize their profits especially during unforeseen circumstances.

This study focused on the assessment on 16 bank/financial corporations which were listed on the Philippine Stock Exchange (PSEi) market, and selection of the best option to be included in the investment portfolio from 2020 to 2021 will be done. Annual data from PSEi Edge, Investagrams, and Morningstar were utilized in the establishment of criteria and selection of proper investment portfolio.

1.1 Company Growth

Patel defined company growth as a stage where a banking business exposes to unprecedented and sustained maximization in market reach and profit avenues [9]. According to the study from Galankashi, Rafiei, and Ghezelbash, parameters such as revenue growth rate, earnings per share growth rate, and company profit growth rate are needed to consider.

Revenue growth rate is equivalent to the change of revenue divided by the initial revenue. By computing the company growth rate, a company gains into change in sales volume, as well as business expansion trends [10]. Earnings per share growth rate is computed as the ratio of increase on company's profit over outstanding shares of its stocks [11]. Company profit growth rate is the difference of the previous period's revenue from the current period's revenue and then divide that number by the previous period's number.

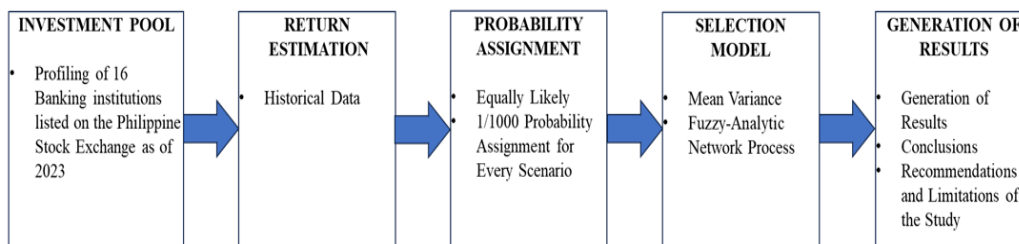


Figure 1. Conceptual Framework of the Study (Adapted from Galankashi, Helmi, Hashemzahi, 2016)

1.2 Stock Market Performance

Butler identified stock market performance as the gauge of banking stocks' capability to increase or decrease the wealth of its stakeholders [12]. The common ratios used in measuring stock market performance are price to book ratio, price to earnings ratio, and return on equity.

Price to book ratio is defined by Investopedia as tool for the investors to measure banks' capitalization to its book value and locate firms which are undervalued [13]. It is equivalent to the market price per share over book value per share. Meanwhile, the price to earnings ratio is also known as price multiple or earnings ratio [14]. It is the ratio that assesses its market share price over earnings per share. Lastly, return on equity presents how a bank effectively and efficiently manages the money contribution of each shareholder [15]. It is equivalent on the net income of the company over average income quality.

1.3 Company Profit

Company profit is one of the necessary parameters used to determine the financial health of banking institutions. It is defined as the money left after all operational costs had been paid.

Parameters related to the measurement of company profit are net earnings per share, profit margin, and return on assets [16]. Net earnings per share indicates the price a firm can produce for each share of its stock and is equivalent to net income of the company over weighted average shares outstanding [17]. Profit margin is a degree of company's profit expressed as the revenue percentage that the bank keeps as profit [18]. Return of assets is a banking ratio that calculates company's profit with the relationship on corporation assets.

2. METHODOLOGY

To achieve the objective of this study, the conceptual framework consists of five stages namely investment pool, return estimation, probability assignment, selection model, and performance evaluation. Figure 1 presents the overall framework of this study.

2.1 Investment Pool

The first stage of the study is the investment pool. This stage includes profiling of 16 banks listed in the Philippine Stock Exchange (PSEi). PSE Edge, bank corporation's websites and other bank articles were used as the source of relevant information on banks.

The following are the banking institutions listed in the Philippine Stock Exchange as of 2023. These companies were used as subjects in the investment pool of this empirical study.

- 2.1.1. Asia United Bank Corporation
- 2.1.2. BDO Unibank Inc.
- 2.1.3. Bank of Commerce
- 2.1.4. Bank of the Philippine Islands
- 2.1.5. China Banking Corporation
- 2.1.6. Citystate Savings Bank
- 2.1.7. Eastwest Banking Corporation
- 2.1.8. Metropolitan Bank & Trust Company
- 2.1.9. Philippine Business Bank
- 2.1.10. Philippine Bank of Communications
- 2.1.11. Philippine National Bank
- 2.1.12. Philippine Savings Bank
- 2.1.13. Philippine Trust Company
- 2.1.14. Rizal Commercial Banking Corporation
- 2.1.15. Security Bank Corporation
- 2.1.16. Union Bank Corporation

Asia United Bank is a commercial bank registered with the Securities and Exchange Commission since October 3, 1997, and it has 99% ownership in the Rural Bank of Angeles, 100% in Cavite United Rural Bank, and 39% in Asia United Leasing and Finance Corporation (AULFC) [19]. AUB is the 12th largest bank in the Philippines with assets of 336,454.99 million in Philippine peso as of December 31, 2022 [20]. BDO Unibank is a member of country's largest conglomerate, SM Group, with services in deposit-taking, foreign exchange, credit cards, etc., and has the largest distribution network with over 1600 physical bank branches and more than 4000 automated-teller machines. It has the biggest asset among other banks in the country worth 3,924,462.61 million in Philippine peso [21]. Bank of Commerce is already operating since 1963 and became an affiliate of San Miguel Corporation last 2008 [22]. Bank of the Philippine Islands was established as a domestic commercial bank on 1943 and transformed into public banking on 1971 with subsidiaries such as BPI Family Savings Bank, BPI Capital Corp., BPI Direct BanKo Inc., and BPI Asset Management [23]. BPI had managed its mobile app on the third spot as the most-used banking app in the country after Globe's G-Cash and Pay Maya [24]. China Banking Corporation was founded by Dee C. Huan in 1920, listed on the local stock exchange in 1927, and acquired its universal banking license in 1991. China Banking Corporation joined the SM Group and was recognized as the second strongest bank in the Philippines. It also ranked among the top 20% of the Asia-Pacific region's strongest banks, according to the Asian Banker's 2021 ranking of the 500 strongest banks. [25]. Citystate Savings Bank's registration in Securities and Exchange Commission granted last 1997 and was listed on the Philippine Stock Exchange on January 3, 2002 [26]. EastWest Banking Corporation was established in 1994 and became the first to receive a commercial banking license following the central monetary authority's banking liberalization in the mid-1990s. It serves middle-market businesses, and the mass consumers. [27]. Metropolitan Bank and Trust Company or Metrobank was established in 1962 and as of September 2022, 48.1% of the family is publicly owned, where 37.2% belongs to GT capital holdings inc, and 14.7% to the Ty family [28]. Metrobank is the 4th largest bank in the country in terms of assets with 2,581,746.19 million in Philippine peso [21]. Philippine Business Bank was incorporated as a Philippine corporation and registered with the SEC on January 28, 1997, originally as 'Total Savings Bank.' That same year, it commenced operations as a thrift bank under MB Resolution No. 29. [28]. Philippine Bank of Communications was originally a Philippine branch of Taiwan's Bank of Communications in 1939 but became under Filipino ownership when Ralph Nubla purchased majority of capital stocks last 1974. In 2000, stock shareholders committed to making PBCOM the biggest capitalized commercial bank by pouring Php 2.6 billion of net equity [29].

Philippine National Bank (PNB) was previously established as a government-owned corporation in 1916 and became privatized last 2007. This bank can attract in full banking services in People's Republic of China, Hong

Kong, and United Kingdom, and engages in diverse financial businesses such as remittances, investment banking, insurances, stock brokerage, and leasing services [30]. Philippine Savings Bank or PSBank was primarily operated as a savings and mortgage banking since 1959 and in 1983, Metrobank became its subsidiary. As of December 31, 2021, PSBank has 250 branches and 547 ATMs nationwide, and is considered the 2nd largest savings bank after BPI Savings Bank [31].

Philippine Trust Company, more commonly known as PhilTrust Bank, was incorporated on October 21, 1916, and provides domestic and trust operations such as savings and pension plan administration, investment management, and insurance trust [32].

Rizal Commercial Banking Corporation (RCBC) is part of Yuchengco Group of Companies and has over 462 physical bank branches and 2911 ATMs as of December 2022. RCBC merged with its conglomerate affiliates such as SunLife GREPA Financials and Malayan Insurance Company Inc. for its insurance products [33].

Security Bank Corporation was established in 1951 and has subsidiaries like SB Rental Corporation, SB Equities Inc., SB Cards Corporation, and SB Capital Investment Corporation [34]. Union Bank of the Philippines has bank consolidations, one with International Corporate Bank in 1994 and International Exchange Bank in 2006. As of December 2021, it has 385 physical bank branches and 497 ATM, has products such as corporate and middle market lending, consumer financial loans and bancassurance [35]. Its mobile banking app ranks 5th on the top used financial applications in Philippine Google Play Store as of April 2023 [36]. The researchers gathered annual historical data to be used for the back-testing methodological approach during quarantine period (2020-2021).

The source of data in this study would be from Philippine Stock Exchange (PSE) Edge portal, Morningstar, and Investagrams.

2.2 Return Estimation and Probability Assignment

The second stage is the return estimation and assignment of weights with the goal of foreseeing the performance of the investment pool. In this stage, a set of criteria to be used for the model was proposed, and past historical results were utilized as return estimates which are assumed.

Banking corporations are screened with three (3) criteria: company growth, company profit, and stock market performance. Under the company growth, sub-criteria are revenue growth rate, earnings per share growth rate, and company profit growth rate. Under the stock market performance, the ratio necessary to consider are price to book ratio, price-to-earnings ratio, and return on equity. Under company profit, sub-criteria such as net earnings per share, profit margin, and return on assets were measured. In summary, the criteria are as follows:

- If the average revenue growth rate is greater than or equal to 5% (which is an ideal minimum revenue growth rate according to Investopedia), the banking institution passed the criterion [38].
- If the average price to book ratio is less than or equal to 1, the bank passed the criteria. According to an article from GoCardless, a price to book lower than 1 ratio could mean the stock has lower value and worth buying [39].
- If the average price to earnings ratio is less than or equal to 20, the bank passes the sub-criterion [40].
- If the average return on equity is above 5% value, the bank passed the sub-criterion [41].
- The banking institution passes the criteria if its profit margin is the same or surpasses 10%, which is considered average profit margin [42].
- If the return of assets is above 5% value, the bank passed the criterion [43].

All sub-criteria data of each banking institution were back-testing and would be in an annual period. Past historical returns were collected as return estimates which are assumed as equally likely.

2.3 Selection Model

2.3.1 Fuzzy Analytic Network Process

Fuzzy-analytic network process method is used as a multi-criteria process to handle interaction among variables that are linguistic [43]. Khotima used FANP, together with the SWOT analysis, to identify the most appropriate development strategy to be applied in small and medium enterprises [10]. Siaw et. al adopted this method to determine the most important core banking solution selection criteria [11].

It was defined by Xiang et. al as a process of solving complicated non-linear objective functions with many local minima and can be used in financial problems [10]. Qodsi et. al had utilized simulated annealing algorithm with cardinality constraints using 50 companies listed in Tehran's stock exchange from April 2010 to April 2012 [11]. Som et. al used this approach in determining the volatility of cryptocurrencies in different countries [12].

Figure 2 shows the FANP decision tree where growth, stock market and company profit are the criteria, and the bottommost layer consists of their respective sub-criteria.

Furthermore, figure 3 shows the sequence of activities to achieve the goal of this study.

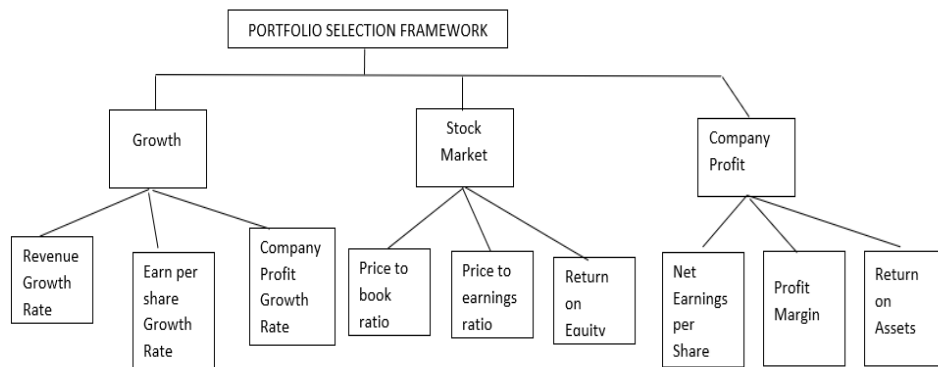


Figure 2. Portfolio Selection Framework (Adapted from Galankashi, Helmi, Hashemzahi, 2016)

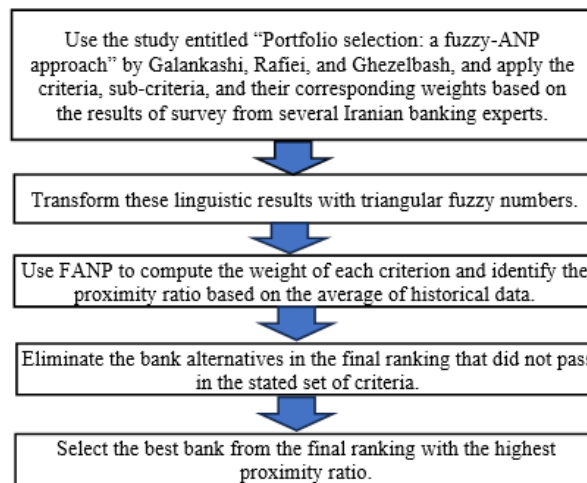


Figure 3. FANP Procedure Framework (Adapted from Galankashi, Helmi, Hashemzahi, 2016)

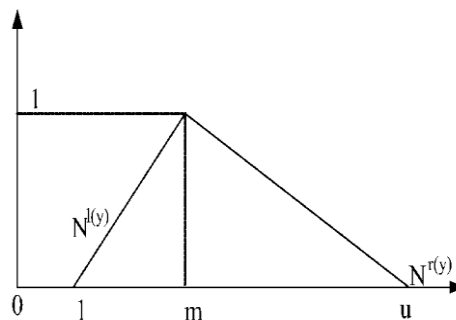


Figure 4. Triangular Fuzzy Number (Gani, 2012)

Figure 4 explains the constraints in this study. Constraint no. (1) says that fuzzy number I_{ij} is equivalent to the minimum value of score (k) that describes the significance of criteria and sub-criteria. Constraint no. (2) explains the relationship between m_{ij} and B_{ijk} with its respective score (k) and period (n). Constraint no. (3) says that fuzzy number u_{ij} is equivalent to the maximum value of score (k) that describes the significance of criteria and sub-criteria.

Constraints no. (4), (5), (6), (7) and (8) are algebraic expressions that are related to fuzzy numbers $N1$ and $N2$.

- (1) $I_{ij} = \min(B_{ijk})$
- (2) $m_{ij} = \sqrt[n]{\pi_{k=1}^n B_{ijk}}$
- (3) $u_{ij} = \max(B_{ijk})$
- (4) $N2 + N1 = m2 + m1$

- (5) $N2 + N1 = u2 + u1$
- (6) $N2 + N1 = l2 + l1$
- (7) $N_1^{-1} = (\frac{1}{u_1}, \frac{1}{m_1}, \frac{1}{l_1})$
- (8) $N_2^{-1} = (\frac{1}{u_2}, \frac{1}{m_2}, \frac{1}{l_2})$

Constraint no. (9) addressed weights of criteria in relation with fuzzy-valued. Constraints no. (10), (11), (12) and (13) relate to the likelihood degrees of triangular-fuzzy numbers N1 and N2.

- (9) $S_k = \sum_{k=1}^n N_{kj} [\sum_{j=1}^n N_{ij}]^{-1}$
- (10) $V(N1 \geq N2) = 1$ if $N1 \geq N2$
- (11) $V(N1 \geq N2) = 1$ if $L1 \geq U2$
- (12) $V(N1 \geq N2) = hgt(N1 \cap N2)$ otherwise
- (13) $hgt(N1 \cap N2) = \frac{u_1 - l_2}{(m_2 - m_1) + (u_1 - l_2)}$

Constraint no. (14) computed the weight of indices in pairwise comparison. The advantages of using pairwise comparison as a methodology in ranking portfolio are as follows: it has the capability to rank long options of portfolios by sub-grouping based on weights of criteria and sub-criteria, it forces the respondents to do selections based on their requirements and preferences, and it converts qualitative data such as experts' own opinions and perspectives into numerical data [36]. Constraint no. (15) ensures that score (k) is not equivalent to period (n). Constraint no. (16) decides the weight factors. Constraint no. (17) gives the values indicated on constraints no. (14), (15) and (16). Constraints no. (17) and (18) compute the connections of criteria and sub-criteria.

- (14) $W(X_i) = Min(V(S_i \geq S_k))$
- (15) $k \neq i$ $k= 1,2,3,4,5,.....n$
- (16) $W'(X_i) = [W'(C1), W'(C2), W'(Cn)]^T$
- (17) $Wi = \frac{Wi'}{\sum Wi'}$
- (18) $W_c = W \times B$

2.3.2 Mean Variance Portfolio Model

The other model to be used in this study is the mean-variance portfolio model. It emphasizes increasing stock returns and eliminating variance risks. By using this model, we can measure the intensity of risks that are acceptable to exchange on level of stock rewards.

2.4 Generation of Results

The final ranking of bank alternatives through FANP, and the result for the best bank selection from the mean-variance portfolio method were generated through computing and programming software such as Microsoft Excel and Spyder Python. This data was determined if considering banking criteria could reflect and helpful in getting high returns from banking portfolio.

Conclusions were created based on the results, and recommendations and limitations of the study were indicated for the improvement on future studies regarding on banking portfolio selection in the Philippines.

3. RESULTS AND ANALYSIS

Table 1: Pairwise Comparison Matrix of Criteria by Geometric Distribution

CRITERIA	GROWTH			STOCK MARKET			COMPANY PROFIT		
GROWTH	0.3610	0.3247	0.2899	0.2832	0.2915	0.3068	0.3320	0.3584	0.3730
STOCK MARKET	0.3357	0.3506	0.3652	0.3584	0.3135	0.2841	0.2727	0.2832	0.3135
COMPANY PROFIT	0.3032	0.3247	0.3449	0.3584	0.3950	0.4091	0.3953	0.3584	0.3135
SUM OF WEIGHTS	2.77	3.08	3.45	2.79	3.19	3.52	2.53	2.79	3.19

Table 1 presents the computation of relative priorities of criteria which will serve as the integral components in decision-making on portfolio selection by geometric distribution method.

Table 2: Normalized Weights of Criteria (Adapted from Galankashi, Helmi, Hashemzahi, 2016)

CRITERIA	NORMALIZED WEIGHTS
Company Growth	0.324503
Stock Market	0.319662
Company Profit	0.355834

Table 2 presents a comprehensive summary of the results derived from the previous two pairwise comparison tables. It provides a clear, consolidated view of how the various criteria were ranked based on the expert responses. According to the assessments given by Iranian banking experts, the most significant factor among all the criteria is company growth, which has emerged as the top priority. This is followed closely by stock market performance, indicating its substantial influence on decision-making. Additionally, company profit ranks third, highlighting its importance, though it is considered slightly less critical compared to the other two factors. The table encapsulates these priorities, offering a clear understanding of the experts' collective perspectives.

Table 3: Weights of Sub-Criteria (Adapted from Galankashi, Helmi, Hashemzahi, 2016)

RANK NO.	SUB-CRITERIA	RANKING WEIGHTS
1	Price to book ratio	0.06187
2	Price to earnings ratio	0.05907
3	Profit Margin	0.05634
4	Net Earnings per Share	0.05358
5	Revenue Growth Rate	0.05358
6	Company Profit Growth Rate	0.53523
7	Return on Assets	0.05226
8	Earnings per share growth rate	0.04402
9	Return on Equity	0.03309

Table 3 presents a detailed summary of the ranking outcomes for each sub-criterion, derived from the questionnaire responses collected in this study, following the methodology established by Galankashi et al. This ranking reflects the prioritization of each sub-criterion as perceived by the participants, offering insight into the relative importance of each factor within the broader context of the study's objectives. [37]

Table 4: Price to Book Ratio (Adapted from Morning Star, 2021; Investagrams, 2021)

BANK	2020	2021	AVE.	JUDGMENT Criteria (≤1)
AUB	0.61	0.57	0.59	PASSED
BDO	1.26	1.27	1.27	FAILED
BNCOM	N/A	N/A	N/A	N/A
BPI	1.3	1.43	1.37	FAILED
CHIB	0.66	0.61	0.64	PASSED
CSB	1.31	1.09	1.20	FAILED
EW	0.44	0.88	0.66	PASSED
MBT	0.69	0.79	0.74	PASSED
PBB	0.61	0.47	0.54	PASSED
PBCOM	0.79	0.64	0.72	PASSED
PNB	0.29	0.2	0.25	PASSED
PSB	0.67	0.7	0.69	PASSED
PTC	4.48	4.59	4.54	FAILED
RCBC	0.37	0.37	0.37	PASSED
SECB	0.81	0.72	0.77	PASSED
UBP	1.38	1.27	1.33	FAILED

Table 4 shows that firms such as BDO, BPI, CSB, PTC, and UBP had price to book ratio more than 1, which lead on the failure on criteria. There is no available price-to-book ratio data provided by the Bank of Commerce.

Table 5: Price to Earnings Ratio (Adapted from Morning Star, 2021; Investagrams, 2021)

BANK	2020	2021	AVE.	JUDGMENT Criteria (≤ 20)
AUB	4.93	9.52	7.23	PASSED
BDO	16.51	12.09	14.3	PASSED
BNCOM	N/A	N/A	N/A	N/A
BPI	15.35	18.96	17.16	PASSED
CHIB	4.67	4.67	4.67	PASSED
CSB	94.22	94.22	94.22	FAILED
EW	3.79	3.79	3.79	PASSED
MBT	12.58	13.23	12.91	PASSED
PBB	14.29	14.29	14.29	PASSED
PBCOM	5.29	10.97	8.13	PASSED
PNB	0.97	0.77	0.87	PASSED
PSB	10.56	23.66	17.11	PASSED
PTC	105.26	226.92	166.09	FAILED
RCBC	7.5	7.37	7.44	PASSED
SECB	11.14	16.02	13.58	PASSED
UBP	6.29	11.25	8.77	PASSED

Table 5 presents the limitation in obtaining relevant data for the Bank of Commerce. As a result, no specific findings or comparisons could be made for that particular bank within the context of the P/E ratio analysis. On the other hand, the majority of the other banks under review met the established criteria, which required an average P/E ratio below 20. This indicates that these banks, in general, are valued at a level considered reasonable by this standard. However, there were two exceptions to this trend: CityState Bank (CSB) and the Philippine Trust Company (PTC). Both institutions exceeded the threshold, showing higher P/E ratios compared to the other banks in the study. These findings suggest that, while most banks aligned with the criterion of having a P/E ratio under 20, CSB and PTC may be perceived as relatively more expensive investments or may have been valued higher in the market for other potential reasons.

Table 6: Profit Margin (Adapted from Morning Star, 2021; Investagrams, 2021)

BANK	2020	2021	AVE	JUDG Criteria (≥ 10)
AUB	20.15	31.31	25.73	PASSED
BDO	19.175	23.3	21.24	PASSED
BNCOM	11.73	19.17	15.45	PASSED
BPI	21.01	24.52	22.77	PASSED
CHIB	27.73	31.39	29.56	PASSED
CSB	1.95	0.95	1.45	FAILED
EW	18.64	18.6	18.62	PASSED
MBT	11.41	21.97	16.69	PASSED
PBB	13.88	20.24	17.06	PASSED
PBCOM	19.97	31.15	25.56	PASSED
PNB	5.78	72.6	39.19	PASSED
PSB	6.54	10.17	8.36	FAILED
PTC	21.88	22.25	22.07	PASSED
RCBC	12.99	17.9	15.45	PASSED
SECB	15.07	18.9	16.99	PASSED
UBP	27.67	28.19	27.93	PASSED

Table 6 reveals that Asia United Bank (AUB) achieved the highest profit margin among all banks evaluated from the second quarter of 2022 through the first quarter of 2023. In contrast, other institutions, including CityState Bank (CSB), EastWest Bank (EW), and Philippine National Bank (PNB), did not meet the targeted average profit margin of 20% or higher during this period. This indicates a performance gap among these banks in terms of profitability, with AUB outperforming its peers by consistently surpassing the profit margin threshold, while CSB, EW, and PNB fell short of this benchmark.

Table 7: Return of Assets (Adapted from Morning Star, 2021; Investagrams, 2021)

BANK	TOTAL INCOME (2020-2021)	TOTAL ASSETS	RETURN OF ASSETS	JUDG Criteria (≥5%)
AUB	7500000000	84161480000	8.91%	PASSED
BDO	71110000000	6.86717E+11	10.36%	PASSED
BNCOM	186970000000	72574840000	258%	PASSED
BPI	45970000000	4.04435E+11	11.37%	PASSED
CHIB	27150000000	2.11921E+11	12.81%	PASSED
CSB	247410000000	1237660000	19990%	PASSED
EW	11030000000	1.19705E+11	9.21%	PASSED
MBT	35990000000	4.74612E+11	7.58%	PASSED
PBB	2107051000	28506840000	7.39%	PASSED
PBCOM	2740000000	17427240000	15.72%	PASSED
PNB	34410000000	3.03717E+11	11.33%	PASSED
PSB	2650000000.00	69021510000	3.84%	FAILED
PTC	1982921941	58968400000	3.36%	FAILED
RCBC	12100000000	1.22512E+11	9.88%	PASSED
SECB	14350000000	1.35995E+11	10.55%	PASSED
UBP	24080000000	2.42414E+11	9.93%	PASSED

According to Table 7, only two institutions, the Philippine Savings Bank (PSB) and the Philippine Trust Company (PTC), did not meet the specified return on assets (ROA) criteria. This shortfall indicates that these banks failed to achieve the minimum performance threshold set for financial efficiency and profitability, which led to their classification as not meeting the criteria in this evaluation.

Table 8: Return of Equity and Net Earnings Per Share (Adapted from Morning Star, 2021; Investagrams, 2021)

BANKS	RETURN ON EQUITY				NET EARNINGS PER SHARE			
	2020	2021	AVE.	JUDG. (≥5%)	2020	2021	GROWTH RATE	JUDG. (≥0%)
AUB	8.59	10.70	9.65	PASS	12.91	12.91	0%	PASS
BDO	7.189	10.094	8.64	PASS	10.84	12.82	18.25%	PASS
BNCOM		5.166	5.17	PASS	1.28	1.03	-20.0%	FAIL
BPI	7.679	8.169	7.92	PASS	8.78	8.78	0%	PASS
CHIB	11.498	12.681	12.09	PASS	7.1	7.1	0%	PASS
CSB	0.827	0.145	0.486	FAIL	-0.12	-0.12	0%	PASS
EW	11.73	7.608	9.669	PASS	2.06	2.53	23.15%	PASS
MBT	4.194	6.824	5.509	PASS	7.28	7.84	7.62%	PASS
PBB	6.766	8.076	7.421	PASS	1.6	2	26.42%	PASS
PBCOM	9.329	11.097	10.213	PASS	3.4	3.7	7.75%	PASS
PNB	1.683	19.656	10.67	PASS	7.55	8.87	17.40%	PASS
PSB	3.211	4.412	3.8115	FAIL	8.62	2.29	-73.44%	FAIL
PTC	3.525	3.171	3.348	FAIL	0.75	0.36	-52.08%	FAIL
RCBC	4.95	6.376	5.663	PASS	5.93	5.93	0%	PASS
SECB	6.027	5.531	5.779	PASS	14.01	13.52	-3.46%	FAIL
UBP	10.995	8.555	9.775	PASS	5.85	5.85	0%	PASS

Table 8 provides a detailed analysis of the return on equity (ROE) and net earnings per share (EPS) growth rate among the banks under review. The data highlights that CSB, PSB, and PTC each recorded an ROE below 5%, indicating a shortfall in meeting the established ROE benchmark, which signals underperformance in generating

returns relative to shareholder equity. Additionally, several banks, including BNCOM, PSB, PTC, and SECB, reported a negative growth rate in net earnings per share, reflecting declining profitability over the period. These results collectively indicate challenges in both profitability and shareholder value growth for these institutions.

Table 9: Company Profit and Revenue (Adapted from Morning Star, 2021; Investagrams, 2021)

Banks	COMPANY PROFIT			REVENUE			JUDG Criteria (≥5%)
	2020	2021	Growth Rate	2020	2021	Growth Rate	
AUB	1500000000	1295000000	-13.67%	4450000000	3050000000	-31.46%	FAILED
BDO	17275000000	17429000000	0.89%	28250000000	42860000000	51.72%	PASSED
BNCOM	6690000000	5990000000	-10.46%	86070000000	100900000000	17.23%	PASSED
BPI	101920000000	97410000000	-4.43%	218600000000	241100000000	10.29%	PASSED
CHIB	43500000000	48070000000	10.51%	120600000000	150900000000	-18.66%	FAILED
CSB	5317845000	272175000	-18.54%	272710000000	286500000000	5.06%	PASSED
EW	34910000000	24280000000	-30.45%	6510000000	4520000000	-30.57%	FAILED
MBT	125903292000	103384004000	-17.89%	138300000000	221600000000	60.23%	PASSED
PBB	119767000	132032000	10.24%	938883000	1168168000	24.42%	PASSED
PBCOM	5850000000	5050000000	-13.68%	11700000000	15700000000	34.19%	PASSED
PNB	45250000000	43570000000	-3.71%	20400000000	323700000000	1486.76%	PASSED
PSB	16930000000	15140000000	-10.57%	11100000000	15400000000	38.74%	PASSED
PTC	43300000000	37100000000	-14.32%	1156583226.37	826338715.08	-28.55%	FAILED
RCBC	36190000000	34170000000	-5.58%	50200000000	70800000000	41.04%	PASSED
SECB	49270000000	36580000000	-25.76%	74300000000	69200000000	-6.86%	FAILED
UBP	41750000000	44440000000	6.44%	115500000000	125300000000	8.48%	PASSED

As presented on Table 9, banks such as AUB, CHIB, EW, and PTC had negative growth rate in terms of company profit and revenue.

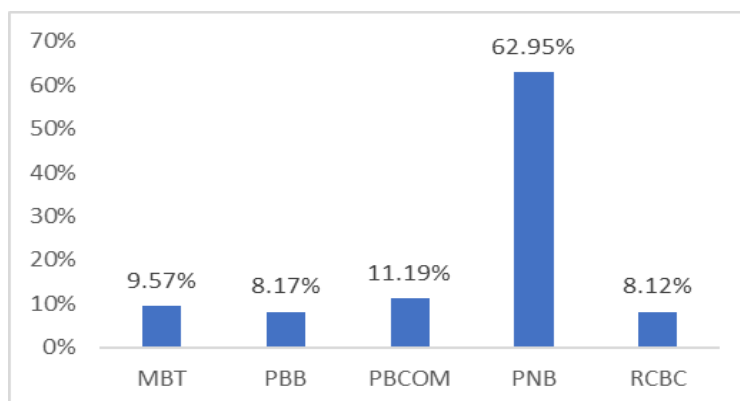


Figure 5. Final Ranking of Alternatives

Only five (5) banks had passed all the criteria and sub-criteria: Metrobank (MBT), Philippine Business Bank. PBCOM (Philippine Bank of Communications. Figure 5 is a bar graph which shows the final computed weights of the four remained banks.

Two investment pools were analyzed: one with all 16 banks and another with 5 banks that passed the fuzzy-analytic network process (FANP). Both used an equally weighted strategy to determine the most optimized portfolio, and their performance over 260 trading days was compared based on metrics like mean return, standard deviation, and cumulative returns (Tables 9 and 10).

Table 10: Portfolio Comparison on Mean-Variance Model

	MEAN VARIANCE						Market Return
	All Banks			Banks Passed on FANP			
Risk-Free Rate	0.5	0.75	1	0.5	0.75	1	
Mean Return	-0.000756	-0.004132	0.000250	0	-0.002207	-0.001794	-0.000232
Std. Deviation	0.0139985	0.028258	0.020592	0	0.016918	0.031910	0.012701
Cumulative Return	-0.199424	-0.696141	0.009034	0	-0.459811	-0.451637	-0.078095

Table 10 shows that the highest profit came from the all-bank portfolio at a 1 risk-free rate (RRF). The FANP-passed bank portfolio had lower investment loss and standard deviation, except at 1 RRF. In terms of cumulative returns, only the all-bank portfolio with 1 RRF and the FANP-passed bank portfolio with 0.5 RRF avoided negative total returns over 260 trading days.

Table 11: Portfolio Comparison on Safety-First Model

SAFETY-FIRST					Market Return
	All Banks		Banks Passed on FANP		
<u>Min. Threshold</u>	3%		3%		
Probability	3%	5%	3%	5%	
Mean Return	-0.000830	-0.000122	-0.001263	-0.001664	-0.000232
Std. Deviation	0.029456	0.020724	0.016472	0.023833	0.012701
Cumulative Return	-0.280026	-0.083837	-0.305013	-0.397973	-0.078095

In the safety-first model, the all-bank portfolio demonstrated superior mean returns compared to the FANP-passed portfolio, as presented in Table 11. However, this higher average return came with an increased level of risk, as indicated by a higher standard deviation. This suggests that while the all-bank portfolio had better overall returns, it also experienced greater variability in performance. Additionally, both portfolios were evaluated using a minimum threshold return of 3%, with a probability set at 3%. This threshold indicates that the model aimed to minimize the likelihood of returns falling below 3%, underscoring a conservative risk management approach within the safety-first framework.

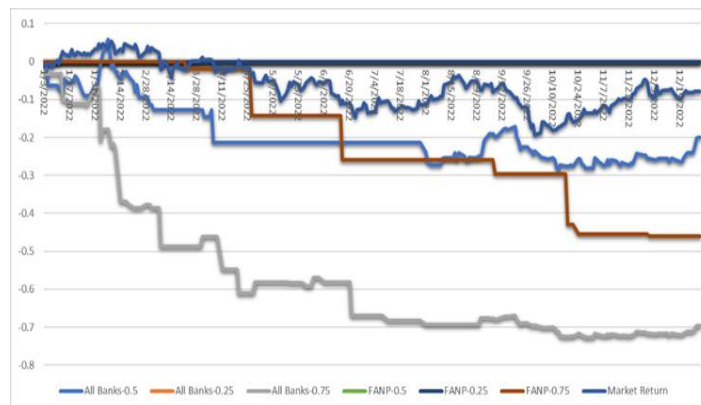


Figure 6. Portfolio Cumulative Returns over 260-Trading Days Using Mean Variance

Figure 6 is a line graph which shows the trend of portfolio cumulative returns over 260-Trading Days using Mean Variance.

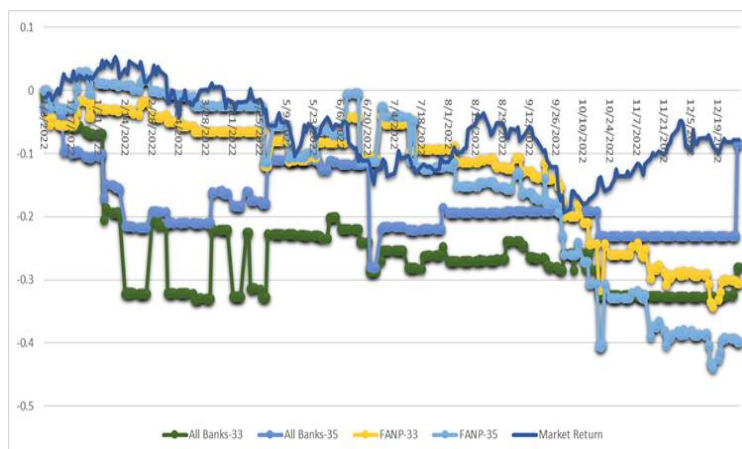


Figure 7. Portfolio Cumulative Returns over 260-Trading Days Using Safety-First

Figure 7 is a graph which shows the trend of portfolio cumulative returns over 260-Trading Days using Safety-First.

4. CONCLUSION

On the results presented here in the study, it can be suggested to invest in the four banking alternatives in this post-pandemic economic recovery in the country if criteria other than historical stock prices are considered. Applying FANP (Fuzzy-Analytic Network Process) in banking portfolio selection allows important elements in the banking industry to be part of jurisdiction, and to be controlled by different levels of attributes. FANP framework enables to present that there are banking stocks which perform better in many banking aspects other than banks included in the blue-chip companies such as BDO, BPI and Security Bank. This study has limit on the weights used in the criteria and sub-criteria prioritization since we used survey data from Iranian banking expert respondents. It is advisable to also conduct Likert-type questionnaire survey to Filipino banking experts for more accurate results of this study. Also, it is recommended to present FANP on bank performances during scenarios that greatly affect in the banking industry such as COVID-19 pandemic, Russia and Ukraine war conflict and economic crisis.

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