Portfolio Size on Profit Optimization: The Case of Large-Cap Companies in the Philippine Stock Market

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Abstract- This paper, employing a rigorous research methodology, randomly used the data of 35 large-cap companies in the Philippine stock market. It constructed seven model portfolios whose performance in 2021, after the COVID-19 pandemic, was empirically tested using the metrics Portfolio Alpha, Beta, Sharpe, Treynor, and Information Ratio. The initial results revealed that the 5-stock model portfolio was among the worst performers and had the highest level of volatility during the observed period. On the other hand, the 20-stock portfolio outperformed all the model portfolios tested in terms of return and volatility metrics. Moreover, the backtesting results determined that all portfolios with less than 20 stocks had lower 3-year average returns than those with at least 20 stocks. The study also showed that holding at least 20 large-cap stocks in 2019 (before), 2020 (during), and 2021 (after the pandemic) outperformed the PSEI.

Index Terms- *Modern Portfolio Theory, Alpha, Beta, Sharpe Ratio, Treynor Ratio, Information Ratio, Philippines*

I. INTRODUCTION

Stock market investing is among the key topics not just in financial markets but in wealth management discussions as well. Relative to this asset class is the concept of diversification that concerns many investors as to how many assets will deliver the highest potential return with the least risk. The concept of risk and diversification has been thoroughly discussed by known researchers and academicians such as Markowitz (1952), Evans and Archer (1968), Statman (1987), and Campbell et al. (2001). Unlike fixed-income securities or bonds, the value of stocks fluctuates more easily and is more sensitive to external economic factors (Li et al., 2000; Tehrani & Fariba, 2010). In theory, stock market volatility or risks can be classified into systematic and unsystematic risks. The former pertains to the risk that is inherent to the entire market, such as sudden changes in monetary policies and macro-economic backdrop, while the latter is sector or company-specific, which may be reduced through diversification (Lubatkin & Chatterjee, 1994; Miralles-Marcelo et al., 2012). However, too much diversification may dilute potential returns, leading to inefficiencies in portfolio management.

As of April 2024, the Philippine Stock Exchange has 284 constituents, with the top 30 largest companies composing the PSE Index, which serves as the benchmark for measuring the stock market's overall performance. The domestic stock market has six sector indices: financials, industrial, holding firms, property, services, mining, and oil. Unlike the Western markets, primarily driven by tech companies, the PSEI is overweighted in industrial conglomerates and utility companies. With this composition, the PSEI took a severe downturn in 2020 during the economic lockdown when traditional brick-and-mortar stores were forced to temporarily cease operations, thereby ending the year with a loss of 8%, while other markets like the US already posted gains of at least 15%. Due to the lack of growth companies and portfolio sizing limitations, institutional fund managers and retail investors face a constant challenge to outperform the broader market significantly.

This paper is mainly anchored to the Modern Portfolio Theory developed by Markowitz in 1952. The theory narrates the empirical method of asset selection to maximize the portfolio's overall performance relative to market risk. It also assumes that investors are generally risk-averse, which translates to the preference for a lower-risk asset or portfolio given a certain level of return. Nevertheless, supporting theories and principles were also utilized in this paper to adequately assess the performance of the model portfolios, to wit: the Portfolio Alpha was used to determine the outperformance of the portfolio compared to the stock market index; the Portfolio Beta was utilized to measure the volatility of the portfolio versus the benchmark; the Treynor and Sharpe Ratios were applied to know the risk-adjusted return of the portfolios based on systematic risks; and lastly, the Information Ratio was computed to evaluate the risk-adjusted excess returns.

The author explored several studies of the same interest, yet none of the portfolios covered were tested and backtested relative to the impact of the COVID-19 pandemic. This paper also used additional metrics to bolster the model portfolio selection process. Thus, the study contributes to the early literature on portfolio sizing and profit optimization before, during, and after the pandemic using publicly traded large-cap companies in the Philippine stock market.

II. Literature Review

The Modern Portfolio Theory (MPT) introduced a mean-variance mathematical framework that enables investors to construct a portfolio to optimize the risk-reward ratio. The theory states that an investor can achieve the best result of diversification by mixing securities of varying risk levels. This may improve the returns without necessarily increasing the volatility of the portfolio. The MPT also assumes that most investors are risk-averse and will choose a less risky portfolio given a certain level of risk. Abalkhail (2017) referenced the theory in his study on optimizing risky asset portfolios using the US stock market's consumer discretionary, energy, financials, and utility sectors. The result showed that sector-index and sector-based funds are not optimum portfolios. Likewise, Li (2022) provided that the portfolio risk decreases when the number of stocks increases, and when the number of stocks is at least 12, the diversifiable risk reaches 88.45%. Jayeola et al. (2017) ascertained that diversifying in gold minimizes risk and achieves more advantages than other asset classes. Statman (1987) also stated that a well-diversified portfolio needs between 30 stocks for borrowing and 40 stocks for a lending investor. Moreover, Adamiec, Cernauskas, and Rhoads (2019), using the constituents of the S&P500 Index, determined that the most optimal portfolio had 25 stock positions.

Various studies also utilized the basic rubrics of the theory to evaluate the performance of a portfolio at any given time. Brands and Gallagher (2005) used Sharpe Ratio in their analysis of Australian Fund-of-Funds and found that adding funds to structure leads to the deterioration in portfolio skewness and kurtosis. Using correlation, Sharpe Ratio, and Portfolio Beta in studying the effect of the number of holdings in a portfolio, Chong and Phillips (2013) concluded that massive portfolios are not necessary to obtain diversification. Similar results were obtained by Murthy (2008) using 2012-2016 data from the Indian stock market and uncovered that only two stocks are included in the optimal portfolio. The paper of Hübner (2005) utilized a derivative of Treynor Ratio and established that portfolio rankings with this metric are more reliable than Jensen's Alpha and Information Ratio. Nevertheless, the paper of Blatt (2004) highlighted the advantages and drawbacks of Information Ratio in evaluating the performance of portfolio managers, thus the necessity to cross-reference using other statistical measures.

III. METHODOLOGY

The study was primarily designed to identify the ideal size of a portfolio that will deliver the highest potential return at the least level of risk after the COVID-19 pandemic. A total of 35 companies with the largest market capitalization were randomly selected to compose seven model portfolios with varying sizes. Alternative portfolio management metrics such as Portfolio Alpha, Beta, Treynor, Sharpe, and Information Ratio were used to evaluate the performance of the model portfolios. The secondary objective of the study was to test and retest the model portfolios before and during the pandemic. To measure the periodic performance of the stocks and the portfolios, the year 2019, when the pandemic was discovered, was the 'before' period, and the year 2020, when the world underwent economic lockdown, was the 'during' period. The year 2021, when the vaccine started to roll out worldwide, was the 'after' period. All stocks were given equal weights in the portfolio construction process.

The initial computation was done by calculating the expected return of the portfolio $E(R_p)$ using the 5-year average performance of the individual stocks from 2017 to 2021. Where W_i is the weight and R_i is the performance of the observed stock. The formula is stated as:

$$E(R_p) = \sum_{i=1}^{n} W_i R_i$$

The Alpha α_P was used to determine the portfolio's outperformance against the broader market. Where R is the portfolio return in 2021, R_f is the risk-free rate equivalent to a 1-year gross yield of a treasury bill, β is the Portfolio beta, and lastly, R_m which represents the return of the benchmark, PSEI. The formula is stated as:

$$\alpha_P = (R - R_f) - \beta(R_m - R_f)$$

To measure the volatility of the portfolio relative to the benchmark, the Beta β_p was included as a proxy for standard deviation. Where W_i is the weight and β_i is the beta of the observed stock. The formula is stated as:

$$\beta_p = \sum_{i=1}^{n} W_i \beta_i$$

To know the risk-adjusted return based on systematic risk, the Treynor Ratio T_i was computed. The average return of the portfolio in 2021 is denoted by $\bar{R}_\iota$ while the average return of the risk-free investment is denoted by $\overline{R_f}$. The slope of the portfolio's characteristic line or beta is expressed as β_i. The formula is stated as:

$$T_i = \frac{\bar{R}_\iota - \overline{R_f}}{\beta_i}$$

The Sharpe Ratio S_i was used to determine the portfolio's risk-adjusted return based on the standard deviation of returns. Similar to Treynor Ratio, the average return of the portfolio in 2021 is denoted by $\bar{R}_\iota$ while the average return of the risk-free investment is denoted by $\overline{R_f}$. The standard deviation of the rate of returns is expressed as σ_i. The formula is stated as:

$$S_i = \frac{\bar{R}_\iota - \overline{R_f}}{\sigma_i}$$

Lastly, to measure the portfolio's returns above the benchmark, the Information Ratio IR_i is utilized. Where $\bar{R}_\iota$ is the average return of the portfolio and $\overline{R_b}$ is the average return of the benchmark, PSEI. The σ_{ER} is the standard deviation of excess return or the amount of unsystematic risk the portfolio incurred in generating incremental returns. The formula is stated as:

$$IR_i = \frac{\bar{R}_\iota - \overline{R_b}}{\sigma_{ER}}$$

After computing the 2021 results, the strategy was backtested to see if the model portfolios would show similar performance in 2019 and 2020, given the COVID-19 pandemic as the catalyst.

IV. Empirical Results

Table 1 displays the statistics of the model portfolios. All performance metrics should be interpreted as better if they have higher values, except for Beta, a volatility metric.

The 10-stock portfolio performed the least, with an expected return of 2.01% and an actual return of 0.14% in 2021. The portfolio underperformed against the benchmark with -0.17% Alpha and was the second most volatile portfolio with 0.70 Beta. Regarding the risk-adjusted returns, the portfolio consistently scored the lowest, with -0.21 Treynor, -0.607 Sharpe, and 0.155 Information Ratio. This also indicates that the portfolio had performed worse than a treasury bill.

Portfolio Size	Expected Return	Actual Return	Stock Market Return	Alpha	Beta	Treynor	Sharpe	Information
5	4.96%	4.12%	-0.24%	3.85%	0.72	0.035	0.280	0.639
10	2.01%	0.14%	-0.24%	-0.17%	0.70	-0.021	-0.607	0.155
15	4.42%	4.96%	-0.24%	4.59%	0.67	0.050	0.656	2.935
20	7.65%	12.71%	-0.24%	12.31%	0.65	0.170	0.889	8.664
25	7.35%	12.22%	-0.24%	11.84%	0.67	0.159	0.882	10.373
30	5.81%	10.22%	-0.24%	9.84%	0.66	0.130	0.853	11.156
35	6.37%	10.21%	-0.24%	9.89%	0.69	0.124	0.852	12.885

Table 1. Portfolio Statistics, after COVID-19 (2021)

The 20-stock portfolio outperformed the rest of the model portfolios, with an expected return of 7.65% and an actual return of 12.71% in 2021. The portfolio totally outperformed the benchmark with a 12.31% Alpha and a Beta of 0.65, which means that it's the least volatile among the model portfolios. Regarding risk-adjusted returns, the portfolio top-scored Treynor and Sharpe with 0.170 and 0.889, respectively.

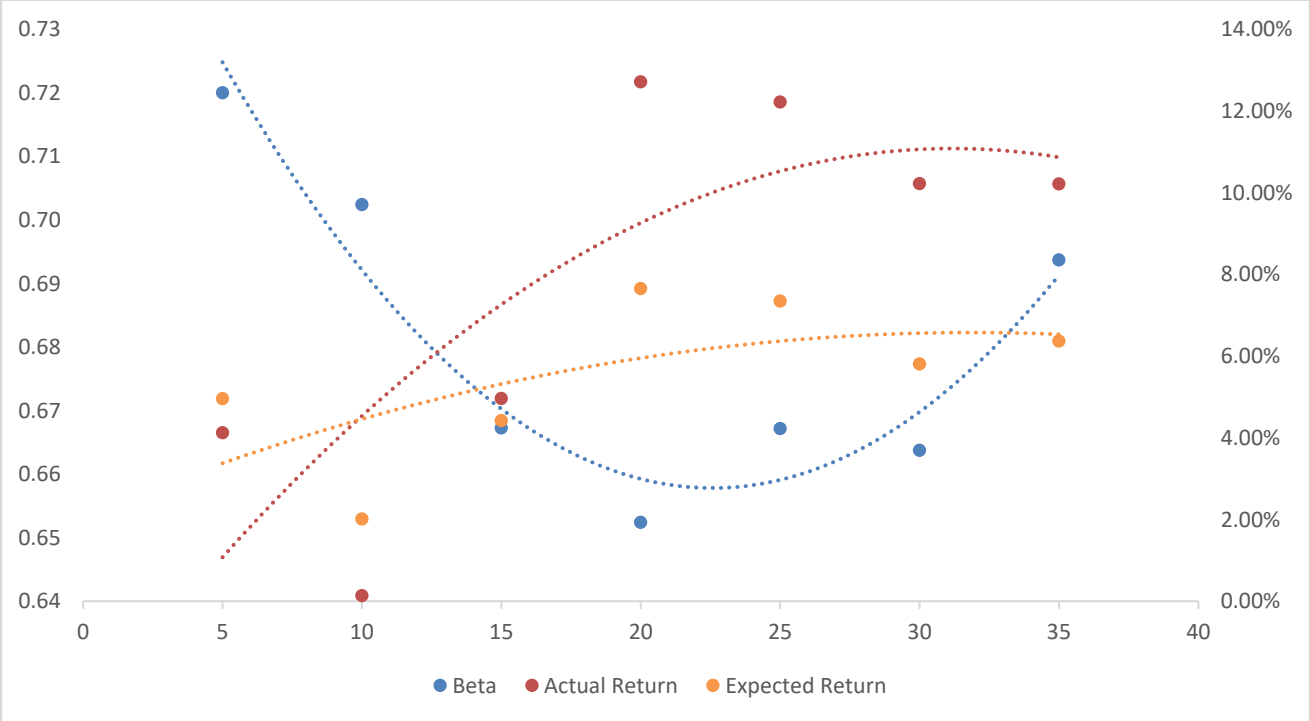

Figure 1. Beta vs Actual and Expected Return after COVID-19 (2021)

The correlation between the polynomial trendlines of beta, actual return, and expected return is shown in Figure 1. The illustration suggests that the level of portfolio volatility (blue line) in relation to the overall market is reduced until the 20-stock portfolio, after which the sensitivity to fluctuations gradually increases. Also noted is the widening variance between the portfolio's expected return (orange line) and the actual return (red line) starting on the 10-stock portfolio size and seemingly plateauing after the 30-stock portfolio.

Moreover, the findings are not consistent with the risk-reward tradeoff which states that the level of potential return increases as the level of risk increases. The most volatile 5-stock portfolio with Beta of 0.72 only delivered a return differential, that is actual minus expected return, of -0.84% while the least risky 20-stock portfolio with Beta of 0.65 posted 5.06% abnormal return. This is in contrast with the study of Li (2022) in China which yielded that risk decreases as portfolio size increases.

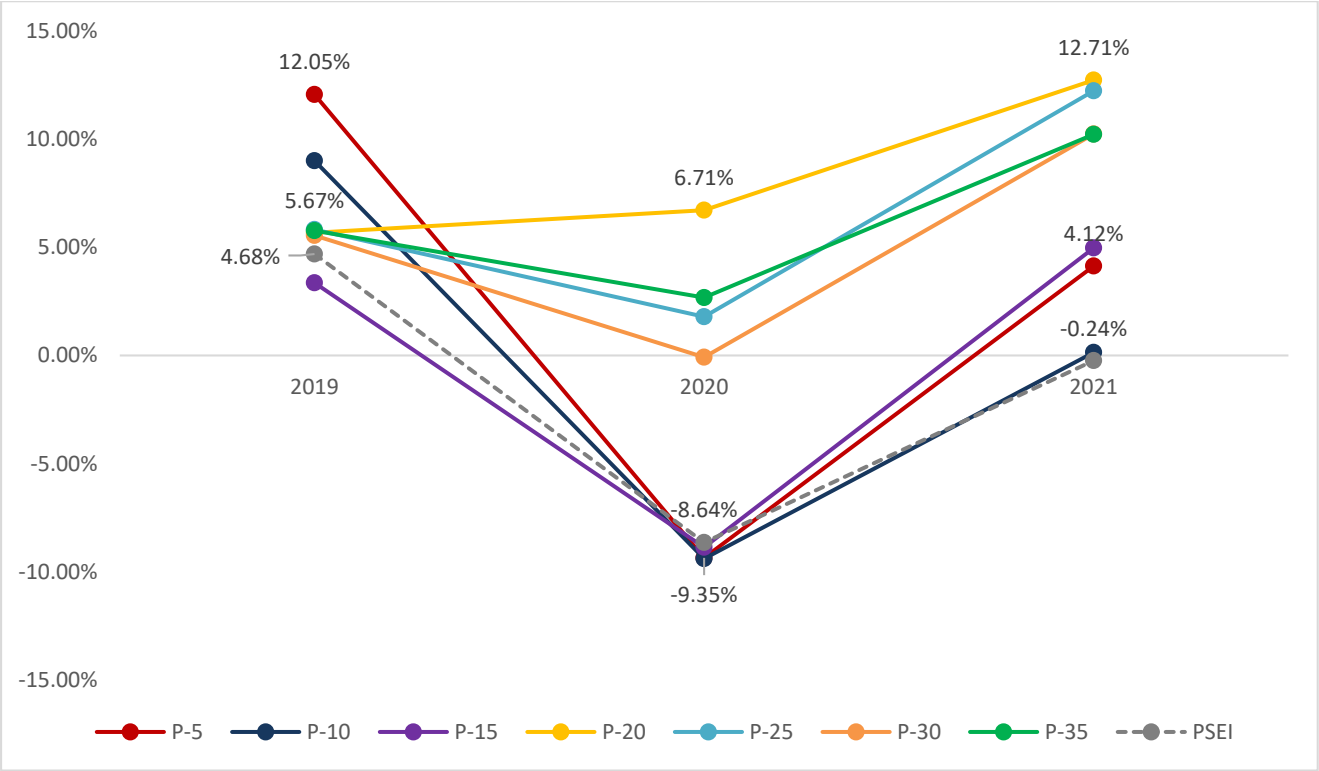

Figure 2. Backtesting Results before and during COVID-19 (2019 & 2020)

The result of backtesting revealed that the most volatile 5-stock portfolio outperformed the benchmark only before and after the pandemic by 157% and 1,800%, respectively. However, the portfolio underperformed during the pandemic with a -9.35% loss compared to the benchmark with only -8.64%. It is also noted that model portfolios with less than 20 stocks performed negatively, if not worse than the benchmark in 2020.

On the other hand, the least risky 20-stock portfolio consistently outperformed the benchmark by 21% in 2019, 170% in 2020, and 5,300% in 2021. The portfolio also posted the highest 3-year average performance of 8.36% compared to the rest of the model portfolios tested, with the benchmark at -1.40% per annum.

V. Conclusion and Recommendation

The results of this study revealed that the ideal portfolio size that may deliver the most optimized return with the least level of risk is a portfolio consisting of at least 20 large-cap stocks. It was also noted that when the number of holdings crossed 25 to 30 stocks, the portfolio's returns gradually declined while the volatility increased. The backtesting results showed that the average return of the portfolios with less than 20 stocks was lower than those with at least 20 stock holdings.

Alternative portfolio metrics also indicated favorable results for the 20-stock portfolio compared to the rest of the model portfolios tested.

Furthermore, this paper is recommended to retail investors, institutional buyers and fund managers as a reference for asset selection and portfolio construction strategy. The results may also guide equity market participants on how to lessen the impact of volatility caused by unforeseen market disruptors such as economic lockdown and pandemic. Given the limitation and scope of the study, the author endorses this work to the community of scholars for further review and analysis such as integration of machine learning methods and inclusion of small and medium-cap stocks in the selection process.

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