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A Note from the Editor's Board

In order to align with international standards, YMC Management Review will only publish research articles written in English starting in 2025. The articles can be found freely from our website and also the Airiti Library.

This number of the YMC Management Review contains three papers. The first article proposes three dynamic Dollar Cost Averaging investment approaches comparing to conventional method. In an era where financial freedom is widely pursued and ETFs are increasingly popular, the findings offer better investment options for periodic fixed-sum investors in Taiwan. Furthermore, ESG has emerged as both a prominent and significant issue in recent years. The second article examines the relationship between a firm's ESG performance and both its corporate value and overseas dependency from the perspective of sustainable supply chain management. The authors argue that ESG measurements may not be fully recognized by the market, or that companies may make efforts only in selected areas to meet external requirements rather than engaging comprehensively. Their results underscore the considerations that should be taken into account when employing ESG indicators in research. Finally, the third study centers on popular fitness business, exploring the interaction dynamics between aerobic instructors and group fitness participants, and examining the dimensions of three efficacy beliefs.

The YMC Management Review welcome all articles ready for submission, regarding the practical management discussion or management cases study.

Editor-in-Chief

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Modified Dollar Cost Averaging Investment Strategy: Evidence from Taiwan Stock Market

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Abstract

This study aims to propose approaches for improving long-term annualized rate of return in investment. In response to the widely used Dollar-Cost Averaging (DCA) strategy, we use three modified Dollar-Cost Averaging approaches as the Return-based Dollar-Cost Averaging, the Z-score Dollar-Cost Averaging, and the LOHAS Staff Notation as comparisons. Taking the Yuanta Taiwan 50 ETF (ticker symbol: 0050) as target, covering the period from July 2008 to July 2023, we find that all three modified DCA strategies contribute higher annualized returns than the conventional DCA. The optimal parameter combination is the Return-Based Cost Averaging method without a double-investment limit. The LOHAS Staff Notation approach achieves the highest annualized return under a 4-year calculation period.

To verify the long-term robustness of these strategies, the study conducted a rolling 10-year return analysis. The empirical results show that these modified investment amount strategies have more than an 87.13% probability of outperforming conventional DCA in terms of annualized returns. This demonstrates the significant long-term profitability and strong robustness of the proposed models across different market conditions.

Keywords: *Modified Dollar-Cost Averaging, LOHAS Staff Notation Investment Method, Exchange-Traded Fund (ETF)*

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Introduction

Since the 1980s, the advancement of globalization and information technology has fueled rapid growth in emerging market economies. Stock markets then play an increasingly significant role in global capital allocation. Owing to their potential for higher returns and diversification benefits, emerging markets have attracted considerable international capital inflows. Harvey (1995) demonstrates that returns in emerging stock markets are predictable and that their long-term average returns exceed those of developed markets significantly, consequently offering investors greater profit. As one of the leading emerging economies, Taiwan stock market has experienced substantial expansion over the past two decades. Data from the Taiwan Stock Exchange show that the market capitalization of Taiwan has grown dramatically, underscoring Taiwan's rise as a major stock market in the Asia-Pacific region.

With the continued growth of Taiwan capital market in recent years, participation in stock investments has also steadily increased. The rising number of individual investors energize the financial market. However, this trend also underscores the urgent need to provide appropriate asset allocation guidance and risk management education for those individual investors. Therefore, the Dollar-Cost Averaging (DCA) strategy has become highly popular among retail investors due to its simplicity and ability to mitigate short-term market fluctuations. Nevertheless, Thorley (1995) points out that DCA strategy can reduce investment risk compared to lump-sum investing. However, the DCA may result in lower long-term returns.

In contrast to prior studies that mainly focus on developed markets, this study intends to develop a modified investment model that is specifically tailored to Taiwan stock market. The model is designed to offer practical and actionable strategies suitable for a broad range of investors. In pursuit of this objective, this study employs the following approaches. First, we conduct extensive long-term back-testing to empirically validate the model effectiveness. Second, we compare the proposed modified models with the conventional DCA approach, analyzing differences on both annualized returns and average holding costs bases. Finally, we assess performance robustness through rolling return analysis. Such robustness evaluation enables the examination of long-term investment outcomes across different long and short timing points, thereby reducing potential bias arising from extreme market timing conditions.

The primary objective of this study is to develop and validate a modified DCA model designed to help individual investors achieve higher long-term annualized returns while mitigating investment risk. The study aims to provide an accessible and practical investment decision-making framework that enables a broader range of investors to effectively apply investment strategies for sustained wealth accumulation. With the continuous inflow of capital into the financial market, the stock exchange is anticipated to realize higher liquidity, greater market efficiency, and a strengthened capacity for corporate financing, thereby fostering sustainable real economic

development. This research not only supports wealth enhancement of individuals but also fosters the overall development, maturity, and international competitiveness of capital market.

This study proposes three modified DCA approaches to make comparison with conventional DCA. The Yuanta Taiwan 50 ETF (#0050), which is compiled by the Taiwan Stock Exchange Company and FTSE that comprise 50 of the most highly capitalized blue-chip stocks and representing nearly 70% of the Taiwanese market, are used as sample in the time frame of July 2008 to July 2023. We find the three modified DCA approaches performing better than the conventional DCA strategy. The advantage stands still when 10-year rolling return robustness check is applied, telling the result holds regardless of market conditions.

2. Literature review

2.1 ETF

The Exchange-Traded Fund (ETF) is an innovative investment tool designed to replicate the performance of a specific securities index. Its unique structure lies in the fact that the issuing company entrusts a basket of stocks to a custodian for management and divides the ownership into ETF units for public trading. Investors can freely buy and sell ETFs in the secondary market or convert ETF units back into the underlying index components. In recent years, the emergence of both thematic and strategic ETFs satisfies the needs of portfolio diversification.

The key advantage of ETFs is the trading flexibility. Investors can adjust positions in real time based on market conditions. Statman (1987) examines the relationship between the number of holdings and portfolio diversification, supporting the advantage of ETFs as a tool for achieving effective diversification. Since ETFs typically track specific indices, they can reduce the impact of individual stock volatility on the overall portfolio. Consequently, ETFs generally carry lower overall risk compared to single-stock investments.

As ETFs have become increasingly popular worldwide, both academia and practitioners have conducted extensive research on ETF investment strategies. Regarding the time-cost effect of ETFs, Atra and Mann (2001) and Leggio and Lien (2003) find that investing in ETFs through periodic fixed investment DCA method can effectively reduce investment costs compared with lump-sum investing. This is mainly because ETF prices exhibit certain seasonal fluctuations, and periodic investing helps smooth out cost variations.

In optimizing periodic ETF investment strategies, Dunham and Friesen (2012) and Lin and Xu (2016) propose modified adjusting investment amounts based on market indicators. Their findings demonstrate that such flexible, modified DCA strategies can significantly enhance returns while reducing costs, providing the motivation for this study. Furthermore, Bessembinder (2018) finds that in the U.S. stock market, only about 4% of listed firms account for the entire net wealth creation, a pattern observed across global markets. In the long run, only a small fraction

of companies outperforms the risk-free rate. Consequently, many scholars recommend that non-professional investors use market-cap-weighted ETFs to achieve diversification. These instruments are particularly suitable for individual investors with limited capital and investment expertise.

2.2 Dollar-Cost Averaging and Modified Dollar-Cost Averaging

Maintaining rationality and self-discipline enables investors to achieve profits in both bull and bear markets. Further, caution, logical decision-making, and emotional restraint are likewise essential for attaining stable long-term investment returns. To help investors stay engaged through market fluctuations and ease worries about buying at peaks, they can invest in ETFs and apply either a DCA or modified DCA strategy over the long term.

2.2.1 Dollar-Cost Averaging

The DCA refers to an investment strategy in which investors purchase a target asset at fixed intervals with a predetermined amount of capital. The primary advantage of this approach lies in its ability to smooth investment costs over time and mitigate the risk associated with making a lump-sum investment at market peaks. Israelsen (1999) demonstrates that DCA can outperform lump-sum investing under conditions of low price volatility. Statman (1995) also argues that DCA reduces investors' anxiety regarding market fluctuations and helps prevent suboptimal investment decisions. Nevertheless, the effectiveness of DCA remains a subject of debate. Constantinides (1979) contends that DCA is most appropriate for investors who is unable to commit their entire capital at once. Although the DCA lowers the average cost of investment, it is not, in theory, an optimal strategy.

2.2.2 Modified Dollar-Cost Averaging

An obvious drawback of DCA is it ignores the market timing problem. A fixed dollar amount is invested at regular intervals, regardless the market is up or down. Some researchers proposed modified investment strategies that adjust contribution amounts based on market conditions, known as Modified DCA. The theoretical foundation of such modified approaches originates from the work of Poterba and Summers (1988) and Fama and French (1988), who identified a significant "mean reversion" effect in stock prices. Mean reversion refers to the tendency of asset prices, returns, or volatility to move back toward their long-term average after deviating from it. Specifically, prices that rise above their long-term mean typically experience a downward adjustment, whereas prices that fall below the mean tend to move upward. This behavior does not imply an immediate correction; rather, it reflects the statistical property that extreme values are generally temporary and do not persist over time. The predictability associated with such mean-reverting movements provides a theoretical basis for modified investment strategies that adjust contributions according to market conditions. By leveraging this characteristic, investors can systematically modify their investment amounts and potentially enhance long-term returns.

Richardson and Bagamery (2011) proposed a modified DCA model that adjusts the investment amount in each period according to past price movements. When the market declines, the contribution increases; when it

rises, the contribution decreases. Their results showed that the modified DCA approach significantly improves investment performance compared with the conventional DCA method.

Similarly, Lin and Xu (2016) introduced a modified DCA strategy that adjusts investment amounts based on the standard deviation of past price fluctuations. Their empirical findings across U.S., Japanese, and European markets revealed that this modified adjustment approach consistently outperforms conventional DCA.

2.2.3 LOHAS Staff Notation Method

Dimitrios and Priestley (1999) observe mean reversion in Southeast Asian stock indices, suggesting that stock prices do not perfectly follow the random walk. Alexander and Peterson (2020) further discover that since ETFs often trade at persistent premiums or discounts relative to their net asset values (NAVs), they are subject to ongoing arbitrage forces, creating a self-correcting mean reversion process in ETF prices.

Based on mean reversion, Tseng (2007) proposed the Tseng's Tunnels (TCL). The TCL converts a stock index into its logarithmic form so that its long-term trend appears linear, as expressed in the following equation:

$$\boldsymbol{Log(Index) = a \cdot T + C} \quad (1)$$

Here, log(Index) denotes the logarithm of the index, T represents time measured in trading days, and both a and C are regression coefficients. According to this regression trend line, Tseng further designs five reference bands: Extremely Bullish Line (upper 95% confidence interval), Overly Bullish Line (upper 75%), Median Line (long-term trend), Overly Bearish Line (lower 75%), and Extremely Bearish Line (lower 95%).

Base on the TCL approach, Shiue and Tivo168 (2016, 2018) propose the LOHAS Staff Notation investment method. This method retains the idea of five reference bands from TCL but replaces the logarithmic transformation with actual price data. It constructs trend lines using moving averages over a selected time window. In addition, it introduces upper and lower bounds at one and two standard deviations above and below the trend line, respectively, to form five reference lines. The resulting pattern resembles a musical staff, hence the name Staff Notation. The LOHAS Staff Notation method suggests that when the stock price rises above the Overly Bullish Line, it indicates excessive optimism, suggesting that investors should gradually reduce their holdings. Conversely, when the price falls below the Overly Bearish Line, it signals a good buying opportunity and calls for increasing investment. Through this framework, investors can better utilize the mean-reversion behavior of prices and align with long-term market trends.

Shiue et al. (2017) applies the LOHAS Staff Notation model to ETFs across multiple markets, including the Vanguard Total Stock Market ETF (VTI), iShares MSCI ACWI (ACWI), iShares MSCI Russia ETF (ERUS), iShares MSCI Brazil ETF (EWZ), and Yuanta Taiwan 50 ETF (#0050), covering the period from January to July

2016. The study finds an average return of 26.75%, outperforming the S&P 500 Index by 4.46% during the same period. Wu (2018) employees the LOHAS Staff Notation model strategy to 58 Apple-related concept stocks and achieved an average return of 84%, significantly outperforming the broader market. Yang (2020) further examines the strategy using mutual funds and finds that the LOHAS Staff Notation model strategy generates higher returns than the conventional DCA approach.

Regarding the optimal observation period, Fama and French (1988) estimated that the half-life of mean reversion in stock prices is approximately three to five years. Similarly, Balvers et al. (2000) examine data from 18 major global markets and find a comparable mean reversion half-life. Shiue and Tivo168 (2016, 2018) also observed cyclical fluctuations in global equity markets, typically spanning three to four years for short cycles and seven to eight years for longer ones. They therefore recommended using half of a long cycle, approximately 3.5 years, as the ideal analysis period for the LOHAS Staff Notation model.

3. Methodology and Research Design

3.1 Research Framework

This study aims to evaluate whether the proposed modified Dollar-Cost Averaging investment strategy can deliver superior long-term performance compared with the conventional dollar-cost averaging (DCA) strategy. Following Shen (2022), we adopt the two modified DCA approaches: Return-based DCA method (RDCA) and the Z-score DCA method (ZDCA), as well as the LOHAS Staff Notation approach (LSN) of Shiue and Tivo168 (2016, 2018). This study evaluates three modified DCA approaches to assess whether they deliver better performance on Yuanta Taiwan 50 ETF compared to the conventional DCA strategy.

To assess the long-term applicability of each strategy, this study employs a ten-year rolling return analysis to examine whether their long-term performance consistently outperforms the conventional DCA method across different initial investment dates, thereby evaluating their robustness. Through a multi-dimensional comparison, including annualized returns, average cost, and robustness, we conduct an in-depth analysis of the differences between modified DCA strategies and the conventional DCA approach, with the aim of providing valuable insights for investors' decision-making.

3.2 Samples

This study selects ETFs rather than individual stocks as the research sample because ETFs offer higher pricing transparency, allowing their prices to accurately reflect the performance of the underlying index. This characteristic also facilitates a more realistic assessment of investment strategy performance. For the target ETF, we choose the Yuanta Taiwan Top 50 ETF, listed on the Taiwan Stock Exchange. As one of the most liquid and

representative indices in Taiwan's capital market, #0050 appropriately reflects the overall movement of the Taiwanese stock market.

The sample data are obtained from the Taiwan Economic Journal (TEJ) database, using ETF data retrieved through TEJ. We collect daily adjusted closing prices from July 7, 2008, to July 5, 2023, covering a total of 15 years. Although #0050 was launched in June 2003, the LSN method requires five years of historical prices to construct the five-line chart used in its analysis. Therefore, to enable a realistic performance comparison, the study period begins in July 2008.

3.3 Research design

The scheduled investment date is the 5th day of each month. If the date falls on a non-trading day, the contribution is postponed to the next trading day. On each contribution date, it purchases the corresponding number of shares based on the adjusted closing price of that day. To more closely approximate the theoretical fair value, odd-lot purchases are allowed. During the investment period, it is assumed that the investor does not sell any holdings and instead retains all positions until fully liquidating them on July 5, 2023.

For performance measurement, this study assumes that all buy and sell transactions are executed successfully at the adjusted closing price, and no additional transaction costs are considered. This setup allows the inherent characteristics of each strategy to be more clearly reflected, providing a solid foundation for subsequent performance evaluation and comparative analysis.

In the investment strategy model of this study, M_t is a function that adjusts the investment amount for each period based on current market information. When M_t =1, indicating that no adjustment is made to the investment amount and the originally fixed contribution is maintained. That is equivalent to the DCA strategy. Throughout the entire research period, the fixed monthly investment amount for the DCA baseline is set at 10,000 TWD.

3.3.1 Return-Based Average Cost Method

The RDCA adjusts the investment amount each period according to the historical price movements of the underlying asset. In this study, we examine the performance of this method under different parameter settings in the empirical analysis. The calculation formula is defined as follows:

$$\boldsymbol{M_t = 1 - a \cdot r_t(k)} \quad (2)$$

In this method, r_t (k) represents the cumulative return of the underlying asset over the past k trading days prior to period t. The parameter a is a positive constant that determines the sensitivity of the investment adjustment to past price changes. When r_t (k) is positive, indicating that the asset price has recently increased, M_t becomes less than 1. In this case, compared with the DCA amount, the RDCA reduces the investment amount for that period.

Conversely, when r_t (k) is negative, indicating a recent price decline, M_t becomes greater than 1, leading to an increase in the investment amount. Reducing the purchase amount after price increases helps avoid buying at excessively high costs, whereas increasing the amount after price declines allows for more favorable accumulation.

In this strategy, the parameters k and a can be optimized as independent variables. A larger k reflects a longer price trend reference period, while a larger value a implies higher sensitivity to price movements. Different parameter combinations may produce optimal outcomes under different market conditions. For this modified DCA method, we consider historical returns over approximately one month, one quarter, half a year, and one year of trading days specifically. That is k = 20, 60, 120, or 250. For the constant multiplier, we consider a = 1, 5, 10, 15, or 20, resulting in 4×5=204 combinations.

3.3.2 Z-score Dollar Cost Averaging

The ZDCA adjusts the investment amount each period based on the deviation of the asset's current price from its historical mean, measured by the Z-score. Let P_t denote the adjusted closing price of the asset in period, μ_t (k) the arithmetic mean of the adjusted closing prices over the previous k trading days, and σ_t (k) the corresponding standard deviation. The parameter a is a positive constant that determines the sensitivity of investment adjustments to the degree of price deviation. The Z-score is computed as:

$$\boldsymbol{Z-score} = \frac{\boldsymbol{P_t - \mu_t(k)}}{\boldsymbol{\sigma_t(k)}} \tag{3}$$

The Z-score measures the standardized deviation of the current price relative to the recent historical price sample. A positive Z-score indicates that the current price is above the recent average and M_t becomes less than 1, leading to a reduction in the investment amount for that period. Conversely, a negative Z-score indicates that the price is below the recent mean, M_t becomes greater than 1, thus increasing the investment amount. By relying on a standardized measure of price deviation, the ZDCA Method can automatically determine whether the current price is relatively high or low and adjust the investment amount accordingly.

Similar to the RDCA, the parameters k and a in the ZDCA can also be optimized as independent variables to identify the best parameter combinations under different market conditions. Equation (4) shows the M_t of ZDCA model.

$$\boldsymbol{M_t = 1 - a \cdot \frac{P_t(k) - \mu_t(k)}{\sigma_t(k)}} \tag{4}$$

3.3.3 Short-sell Prohibition and Limitation on Maximum Investment Amount

In order to make the indicator more aligned with the actual conditions faced by investors, the key parameter Mt in the indicator is restricted to vary within a certain range, thereby enhancing its practicality. In this study, we

adopt the method proposed by Shen (2022) to better capture the real market conditions. Our modified parameter, M'_t, is defined as:

$$\boldsymbol{M'_t = \max(0, \min(2 \cdot M_t, M_t))} \quad (5)$$

We set two constraints on the indicator values. First, short selling is not allowed, so the minimum value of the indicator is set to 0. Second, the maximum value of the indicator is capped at twice the original investment amount. This approach makes the indicator calculations more reflective of actual market conditions.

3.3.4 Short-sell Prohibition with no Limitation on Investment Amount

The previously mentioned limit of twice the maximum investment amount was intended to reflect the common capital constraints faced by retail investors, while prohibiting short selling was meant to preserve the original purpose of DCA. In this section, we still set the minimum indicator value to 0 to prohibit short selling, but no upper limit is imposed on the maximum investment amount. Both calculation methods for the indicators are designed to represent reasonable adjustments based on actual market conditions, thereby enhancing the reliability and practicality of the study. Accordingly, the new indicator, M''_t, can be expressed as follows:

$$\boldsymbol{M''_t = max(0, M_t)} \quad (6)$$

Based on the principles of avoiding short selling in periodic asset investment and the spirit of increasing or decreasing positions under mean-reversion modified investment, we apply both setting on M_t (M'_t and M''_t) in the case of RDCA and ZDCA.

3.3.5 LOHAS Staff Notation

This study also applies the LSN of Shiue and Tivo168 (2016), aiming to explore the optimal evaluation period and investment amount. Obviously, we need to use historical data to construct the staff notation, the five lines channel that helps investors to make increase or decrease investment amount decision. To examine whether different choices of the evaluation period affect returns, we follow the findings of Fama & French (1988) and Balvers & Gilliland (2000) to have 3-, 3.5-, 4-, 4.5-, and 5-year evaluation period. Finally, five different types of LSN model are constructed.

n the LSN approach, the trend line serves as the central line among the five lines, and the standard deviation defines the spacing between them. When the asset price rises above the central line, the investment amount should be gradually reduced; when the price falls below it, the investment amount should be increased. In other words, the investment amount is determined by the asset price's position relative to the LSN intervals on the deduction date. The deduction amounts we use are presented in Table 1.

This study designs three plans, all of which follow the LSN investment rules. The difference among them lies in the magnitude of the increases and decreases in investment amounts. In Plan 1, the adjustment is 1,000 (10% of the scheduled investment amount), while in Plans 2 and 3, the adjustments are amplified as 2,000 (20%) and 3,000 (30%), respectively.

Table 1

The investment amount in LSN approach

This table reports the investment amount of the LSN approach respecting to the position that the asset price is located in the Staff Notation. The investment amount will be increased (decreased) when the current value is lower (higher).

Position within LSN Interval	Investment Amount		
	Plan 1	Plan 2	Plan 3
Above +2 SD	7,000	4,000	1,000
+1 SD to +2 SD	8,000	6,000	4,000
+1 SD to trend line	9,000	8,000	7,000
Trend line to -1 SD	11,000	12,000	13,000
-1 SD to -2 SD	12,000	14,000	16,000
Below -2 SD	13,000	16,000	19,000

Note: SD=Standard Deviation

3.4 Performance measurement

This study evaluates the performance of the four investment strategies using two metrics: annualized return and average cost.

3.4.1 Annualized Return

The annualized return was calculated as follows. The 5th day of each month was designated as the purchase date, and the 5th day of the maturity month as the settlement date. Investments were made periodically and held until maturity. The final annualized return for each investment was computed based on the purchase price and the price at maturity. Let the investment amounts each month be m_1, $m_2 \ldots m_t$, with a total of t investment periods. Then, the total invested amount, or total investment cost, is given by:

$$\boldsymbol{m_1 + m_2 + \cdots + m_t = \sum_{i=1}^{t} m_i} \tag{7}$$

Let v_i denotes the closing price on the purchase day, and mi the investment amount for that period. The number of shares held for that month, u_i, is then calculated as:

$$\boldsymbol{u_i = \frac{m_i}{v_i}} \tag{8}$$

After a total of t investment periods, the total number of shares held is:

$$\boldsymbol{u_1 + u_2 + \cdots + u_t = \sum_{i=1}^{t} \frac{m_i}{v_i}} \quad (9)$$

The total amount received upon maturity, M_t, is equal to the adjusted closing price at maturity, v_t, multiplied by the total number of shares held:

$$\boldsymbol{M_t = v_t \cdot \sum_{i=1}^{t} \frac{m_i}{v_i}} \quad (10)$$

Accordingly, the annualized return, R, satisfies the following equation.

$$\boldsymbol{\frac{M_t}{(1+R)^t} + \sum_{i=0}^{t-1} \frac{-m_i}{(1+R)^i} = 0} \quad (11)$$

3.4.2 Average Cost

The average cost (AC) equals the total amount received from selling at maturity M_t divided by the total number of units (shares) held.

$$\boldsymbol{AC = \frac{M_t}{\sum_{i=1}^{t} \frac{m_i}{v_i}}} \quad (12)$$

4. Empirical Result and Analysis

4.1 RDCA and ZDCA with Maximum Double-Investment Limit

Following the framework of Shen (2022), the increase in the investment amount for each period is restricted to no more than twice the originally planned amount (10,000 TWD), and short selling is not allowed. The results show that, compared with the conventional DCA, all parameter combinations in Tables 2 and 3 using the RDCA method and the ZDCA method yield annualized returns higher than those of the conventional DCA. This indicates that applying the RDCA method and the ZDCA to the ETF #0050 can outperform the conventional DCA strategy.

According to Table 2, the annualized returns generated by the RDCA strategy outperform the conventional DCA approach across all parameter combinations, providing preliminary evidence that modified approach can enhance long-term investment performance. In particular, when the weight parameter a=20 and the reference period k=250 days, the annualized return of our target asset (#0050) reaches 12.45%, which is 0.68% higher than the conventional strategy.

The analysis of variations in k reveals that the RDCA method exhibits differing levels of sensitivity to the length of the reference period. For #0050, the annualized returns computed using this method show a positive

correlation with k. Regarding the relationship between the annualized return and a when k is fixed, we find that the annualized return of #0050 increases steadily as a rises.

Table 2

The performance of applying conventional DCA and RDCA methods

This table reports the results applying conventional DCA and RDCA methods on the investment of Yuanta Taiwan Top 50 ETF (#0050) in the time frame of July 7, 2008, to July 5, 2023. When using the RDCA, we included a setting with and without the double investment limit to increase its flexibility. Also, we use different parameter settings on both *k* and *a*. The *k* is the time length of observations, given from 20 to 250 days. Whereas the *a* is the degree of sensitivity of price movement given from 1 to 20.

Method and Parameters	Total cost	Total value	Annualized Return	Average Cost	Method and Parameters	Total cost	Total value	Annualized Return	Average Cost
Conventional DCA	1,800,000	4,668,234	11.77%	49.71	Conventional DCA	1,800,000	4,668,234	11.77%	49.71
RDCA	**With** double investment amount restriction				RDCA	**Without** double investment amount restriction			
k=20, a=1	1,786,937	4,643,512	11.78%	49.61	k=20, a=1	1,786,937	4,643,512	11.78%	49.61
k=60, a=1	1,753,620	4,595,587	11.82%	49.19	k=60, a=1	1,753,620	4,595,587	11.82%	49.19
k=120, a=1	1,703,830	4,509,574	11.91%	48.71	k=120, a=1	1,703,830	4,509,574	11.91%	48.71
k=250, a=1	1,619,669	4,390,456	11.97%	47.56	k=250, a=1	1,619,669	4,390,456	11.97%	47.56
k=20, a=5	1,734,683	4,544,621	11.80%	49.21	k=20, a=5	1,734,683	4,544,621	11.80%	49.21
k=60, a=5	1,580,010	4,312,666	11.97%	47.23	k=60, a=5	1,593,221	4,396,079	12.01%	46.72
k=120, a=5	1,392,787	3,922,064	12.26%	45.78	k=120, a=5	1,443,006	4,223,967	12.35%	44.04
k=250, a=5	1,200,246	3,610,676	12.31%	42.85	k=250, a=5	1,280,183	4,071,544	12.42%	40.53
k=20, a=10	1,672,768	4,436,910	11.82%	48.60	k=20, a=10	1,689,002	4,488,166	11.82%	48.51
k=60, a=10	1,414,443	3,929,737	12.09%	46.40	k=60, a=10	1,524,388	4,432,342	12.17%	44.34
k=120, a=10	1,225,079	3,535,239	12.35%	44.67	k=120, a=10	1,449,839	4,640,560	12.57%	40.28
k=250, a=10	1,120,068	3,374,062	12.42%	42.80	k=250, a=10	1,469,281	5,046,532	12.55%	37.53
k=20, a=15	1,609,698	4,285,257	11.85%	48.43	k=20, a=15	1,675,003	4,516,623	11.86%	47.81
k=60, a=15	1,331,770	3,730,363	12.11%	46.02	k=60, a=15	1,595,978	4,840,442	12.23%	42.51
k=120, a=15	1,145,271	3,338,394	12.40%	44.23	k=120, a=15	1,601,247	5,408,710	12.68%	38.17
k=250, a=15	1,111,029	3,356,984	12.43%	42.67	k=250, a=15	1,809,464	6,454,832	12.57%	36.14
k=20, a=20	1,559,346	4,169,822	11.88%	48.21	k=20, a=20	1,692,584	4,625,607	11.89%	47.17
k=60, a=20	1,279,229	3,614,624	12.11%	45.62	k=60, a=20	1,723,271	5,401,222	12.27%	41.13
k=120, a=20	1,108,526	3,250,497	12.43%	43.97	k=120, a=20	1,814,642	6,337,447	12.74%	36.91
k=250, a=20	1,107,422	3,350,222	12.45%	42.61	k=250, a=20	2,175,897	7,924,724	12.58%	35.40

In Table 3, the ZDCA method likewise delivers annualized returns that outperform the conventional DCA strategy across all parameter combinations, further confirming the effectiveness of dynamic adjusting investment amounts. In particular, when the parameters are set to a=10 and the reference period k=250 days, the annualized return of #0050 reaches 12.5%, which is 0.73% higher than the conventional strategy, highlighting the profit potential of the ZDCA method. We find that the ZDCA strategy is not highly sensitive to changes in the parameter a; the annualized return is almost unaffected by variations in a, indicating that the reference period k plays the

dominant role. As a result, changes in a contribute little to the final return, a characteristic that distinguishes this method from the RDCA approach. Moreover, by examining changes in k, we observe that the annualized return of #0050 shows a clear upward trend as k increases, with this positive relationship becoming particularly evident once k exceeds 60 days.

Table 3

The performance of applying conventional DCA and ZDCA methods

This table reports the results applying conventional DCA and ZDCA methods on the investment of Yuanta Taiwan Top 50 ETF (#0050) in the time frame of July 7, 2008, to July 5, 2023. When using the RDCA method, we included a setting with and without the double investment limit to increase its flexibility. Also, we use different parameter settings on both k and a. The k is the time length of observations, given from 20 to 250 days. Whereas the a is the degree of sensitivity of price movement given from 1 to 20.

Method and Parameters	Total cost	Total value	Annualized Return	Average Cost	Method and Parameters	Total cost	Total value	Annualized Return	Average Cost
Conventional DCA	1,800,000	4,668,234	11.77%	49.71	Conventional DCA	1,800,000	4,668,234	11.77%	49.71
ZDCA	With double investment amount restriction				ZDCA	Without double investment amount restriction			
k=20, a=1	1,363,798	3,661,855	11.95%	48.01	k=20, a=1	1,810,649	4,905,179	11.90%	47.59
k=60, a=1	1,249,604	3,441,430	12.08%	46.81	k=60, a=1	1,507,375	4,230,242	11.97%	45.94
k=120, a=1	1,124,564	3,268,219	12.25%	44.36	k=120, a=1	1,351,807	3,995,166	12.15%	43.62
k=250, a=1	1,065,361	3,208,460	12.42%	42.81	k=250, a=1	1,304,085	4,020,447	12.36%	41.82
k=20, a=5	1,322,209	3,498,668	12.08%	48.72	k=20, a=5	5,405,363	14,788,181	11.91%	47.12
k=60, a=5	1,206,618	3,345,931	12.09%	46.49	k=60, a=5	4,227,087	12,231,502	11.91%	44.55
k=120, a=5	1,091,651	3,278,986	12.23%	42.92	k=120, a=5	3,782,616	11,604,852	12.06%	42.02
k=250, a=5	1,029,964	3,128,650	12.49%	42.44	k=250, a=5	3,722,621	11,967,053	12.36%	40.10
k=20, a=10	1,315,542	3,468,016	12.09%	48.90	k=20, a=10	10,082,390	27,632,628	11.90%	47.04
k=60, a=10	1,204,006	3,330,042	12.09%	46.61	k=60, a=10	7,801,030	22,660,073	11.90%	44.38
k=120, a=10	1,093,044	3,287,574	12.23%	42.86	k=120, a=10	6,986,612	21,498,643	12.04%	41.90
k=250, a=10	1,025,439	3,114,460	12.50%	42.45	k=250, a=10	6,895,124	22,283,636	12.35%	39.89
k=20, a=15	1,311,983	3,456,265	12.09%	48.94	k=20, a=15	14,770,711	40,513,804	11.90%	47.00
k=60, a=15	1,197,403	3,307,238	12.09%	46.68	k=60, a=15	11,377,940	33,097,940	11.89%	44.32
k=120, a=15	1,095,536	3,294,076	12.23%	42.87	k=120, a=15	10,195,887	31,402,428	12.04%	41.86
k=250, a=15	1,028,159	3,125,524	12.49%	42.41	k=250, a=15	10,077,687	32,632,138	12.34%	39.81
k=20, a=20	1,307,742	3,444,381	12.09%	48.95	k=20, a=20	19,461,484	53,402,834	11.90%	46.98
k=60, a=20	1,192,047	3,289,494	12.09%	46.72	k=60, a=20	14,958,696	43,547,786	11.89%	44.28
k=120, a=20	1,100,714	3,305,802	12.23%	42.92	k=120, a=20	13,407,849	41,311,437	12.03%	41.84
k=250, a=20	1,028,101	3,126,944	12.49%	42.39	k=250, a=20	13,260,249	42,980,640	12.34%	39.77

We evaluate the performance of two modified investment adjustment strategies—the RDCA method and the ZDCA method—when applied to the ETF #0050. The results indicate that regardless of whether the RDCA or ZDCA method is used, the annualized returns for all parameter combinations outperform those of the conventional DCA approach. We also observe that for both strategies, increases in the reference period k and the weight

parameter a lead to reductions in the average holding cost, reflecting that dynamic adjusting investment amounts helps lower the portfolio's cost basis.

4.2 RDCA and ZDCA without Maximum Double-Investment Limit

To further uncover the potential benefits of the RDCA and the ZDCA methods, this section removes the constraint on the maximum investment amount. When the computed value of Mt exceeds 2, the investment amount for that period is adjusted in accordance with its actual magnitude, thereby allowing allocations to surpass twice the originally planned amount. The primary motivation for lifting this upper bound is to enable the strategies to more fully exploit investment opportunities that arise during periods of extreme market conditions. When the price of the underlying asset experiences a substantial decline, the value of Mt may increase sharply, indicating that a significant increase in investment during that period is warranted. Imposing a twofold cap would hinder the strategy from fully realizing this objective. Although removing the investment ceiling may increase the capital deployed in certain periods, it allows investors to accumulate a larger number of shares at relatively depressed price levels. From a long-term perspective, this facilitates a reduction in the average cost of holdings and ultimately enhances the annualized return of the strategy.

For making comparison, we report the results on the right hand sigh of Table 2. When there is no upper limit on the investment amount, all parameter combinations of the average-cost strategy yield annualized returns that outperform the conventional DCA strategy, and surpass the results observed under scenarios with an investment cap. We find that, under the average-cost strategy without an upper investment limit, the optimal parameter combination for #0050 occurs at a=20 and k=120, delivering an annualized return of 12.74%, which is 0.31% higher than the scenario with a cap. Levy (1967) and Poterba & Summers (1988) suggest that tracking stock price trends over a 120–150-day horizon is more appropriate. Our findings likewise confirm that moderately referencing medium- to long-term price trends and assigning them appropriate weights can help enhance the annualized return of a variable-amount investment strategy.

Regarding average cost, the findings of this study show that removing the upper limit of twice the investment amount can indeed further reduce the portfolio's average holding cost. However, this reduction in average cost does not translate into a significant improvement in annualized returns. The potential reasons behind this phenomenon merit continued attention and deeper investigation by future researchers. After all, the ultimate goal of an investment strategy is not merely to lower the average cost, but more importantly, to generate greater long-term returns for investors.

In summary, the findings of this section reveal that under the RDCA method and the ZDCA method without an upper investment limit, different parameter combinations exert varying effects on annualized returns. This

insight helps us further refine parameter settings to maximize the potential of modifiedally adjusting investment amounts, thereby achieving more desirable investment outcomes.

4.3 LSN

We adopt the LSN strategy proposed by Shiue and Tivo168 (2016). According to the empirical results presented in Table 4, the annualized returns achieved by applying the strategy to the ETF #0050 are consistently higher than those of the conventional DCA method. This finding provides preliminary evidence supporting the superiority of the strategy compared with conventional DCA.

Regarding the optimal investment period of the LSN strategy, this study finds that setting the investment period to four years yields the highest annualized return. We can see the LSN Plan 3 attains an annualized return of 12.21%, outperforming conventional DCA by 0.44%. With respect to the adjustment range of investment amounts, we observe that moderately increasing the investment amount in the lower-bound trend zone while

Table 4

The performance of LSN

This table reports the results applying conventional DCA and LSN methods on the investment of Yuanta Taiwan Top 50 ETF (#0050) in the time frame of July 7, 2008, to July 5, 2023.

Method	Estimation period (year)	Total Cost	Total Value	Annualized Return	Average Cost
Conventional DCA		1,800,000	4,668,234	11.77%	49.71
LSN	3	1,787,000	4,693,917	11.89%	49.08
Plan 1	3.5	1,785,000	4,713,522	11.91%	48.82
	4	1,778,000	4,711,280	11.92%	48.65
	4.5	1,780,000	4,718,559	11.91%	48.63
	5	1,762,000	4,688,860	11.90%	48.45
	3	1,774,000	4,719,600	12.02%	48.46
Plan 2	3.5	1,770,000	4,758,809	12.04%	47.95
	4	1,756,000	4,754,325	12.07%	47.62
	4.5	1,760,000	4,768,884	12.05%	47.58
	5	1,724,000	4,709,486	12.03%	47.19
	3	1,761,000	4,745,282	12.14%	47.84
Plan 3	3.5	1,755,000	4,804,097	12.18%	47.10
	4	1,734,000	4,797,371	12.21%	46.60
	4.5	1,740,000	4,819,209	12.18%	46.55
	5	1,686,000	4,730,112	12.15%	45.95

reducing it in the upper-bound zone significantly enhances annualized returns. Furthermore, when the gap between the investment amounts allocated to the upper and lower trend zones is widened even more, the annualized return improves again. This result validates the fundamental principle of the LSN strategy: 'increase investment at lower price levels and reduce investment at higher price levels.

In examining the average investment cost, the results show an inverse relationship between average cost and the investment period. Similar to the investment-adjustment rule, increasing investment in the lower-bound trend zone while decreasing it in the upper-bound zone effectively lowers the overall average investment cost. Moreover, further widening the investment gap between the two zones leads to an additional reduction in average cost.

4.4 Comparison of three modified DCA strategies

Across the three variable-amount investment strategies examined in this study, all applications to the ETF #0050 produce annualized returns that outperform the conventional DCA method. Table 5 summarizes the maximum annualized returns achieved by each of the three strategies. We recommend that investors adopt the RDCA strategy without the two-times investment cap, and set the parameters to k=250 and a=20. Under this configuration, the strategy yields an annualized return of 12.74%, which is 0.97% higher than that of the conventional DCA approach.

Table 5

The best performance of each method

This table presents the best performance and the relative settings of the four approaches obtained from this study.

Method	Conventional DCA	RDCA	ZDCA	LSN
Max Return	11.77%	12.74%	12.50%	12.21%
Parameters		k=250, a=20	k=250, a=10	
Setting		Without two-times investment amount restriction	With two-times investment amount restriction	Plan 3 with 4-year estimation

4.5 Robustness Analysis

To verify the robustness of the various variable-amount investment strategies proposed in this study under different market conditions, we further employ a rolling 10-year return analysis to assess whether each strategy can consistently outperform the conventional DCA method over the long term. Specifically, the sample period is divided into multiple consecutive 10-year sub-periods, and the annualized return of each strategy is calculated within each sub-period. The results of all sub-periods are then aggregated and averaged. In total, the full sample can be divided into 61 rolling 10-year windows.

Table 6

Robustness check of RDCA and ZDCA performance comparing to conventional DCA

This table reports the odds and excess return of RDCA and ZDCA comparing to conventional DCA in the robustness check under different parameter setting.

RDCA			ZDCA		
Parameters	Odds	Excess return	Parameters	Odds	Excess return
(k=20,a=1)	93.44%	0.01%	(k=20,a=1)	88.52%	0.29%
(k=60,a=1)	90.16%	0.04%	(k=60,a=1)	90.16%	0.51%
(k=120,a=1)	88.52%	0.08%	(k=120,a=1)	91.80%	0.82%
(k=250,a=1)	93.44%	0.17%	(k=250,a=1)	93.44%	1.19%
(k=20,a=5)	93.44%	0.05%	(k=20,a=5)	85.25%	0.35%
(k=60,a=5)	91.80%	0.22%	(k=60,a=5)	90.16%	0.59%
(k=120,a=5)	90.16%	0.47%	(k=120,a=5)	88.52%	0.93%
(k=250,a=5)	90.16%	0.86%	(k=250,a=5)	91.80%	1.41%
(k=20,a=10)	78.69%	0.04%	(k=20,a=10)	81.97%	0.34%
(k=60,a=10)	98.36%	0.47%	(k=60,a=10)	88.52%	0.59%
(k=120,a=10)	93.44%	0.80%	(k=120,a=10)	88.52%	0.95%
(k=250,a=10)	91.80%	1.27%	(k=250,a=10)	90.16%	1.43%
(k=20,a=15)	98.36%	0.18%	(k=20,a=15)	80.33%	0.33%
(k=60,a=15)	98.36%	0.62%	(k=60,a=15)	88.52%	0.59%
(k=120,a=15)	96.72%	1.04%	(k=120,a=15)	88.52%	0.95%
(k=250,a=15)	86.89%	1.34%	(k=250,a=15)	90.16%	1.44%
(k=20,a=20)	100.00%	0.27%	(k=20,a=20)	88.52%	0.29%
(k=60,a=20)	98.36%	0.73%	(k=60,a=20)	88.52%	0.59%
(k=120,a=20)	98.36%	1.18%	(k=120,a=20)	86.89%	0.82%
(k=250,a=20)	86.89%	1.36%	(k=250,a=20)	90.16%	1.44%
Average	92.87%	0.56%	Average	88.52%	0.79%

We compare the performance of the RDCA strategy, the ZDCA strategy, and the LSN strategy without the two-times investment cap against the conventional DCA method across these 61 rolling periods. The results are summarized in Tables 6 and 7.

As shown in Tables 6 and 7, the RDCA, ZDCA, and LSN methods outperform the conventional DCA method in 92.87%, 88.52%, and 100% of the 61 rolling periods, respectively. The corresponding average excess annualized returns are 0.56%, 0.79%, and 0.37%. Moreover, as the parameter values of k and a increase, the advantages of

Table 7

Robustness check on the performance of LSN comparing to conventional DCA

This table reports the odds and excess return of LSN comparing to conventional DCA in the robustness check by three different plan setting.

Method	Estimation period	Odds	Excess return
LSN	3	100%	0.14%
Plan 1	3.5	100%	0.17%
	4	100%	0.19%
	4.5	100%	0.19%
	5	100%	0.18%
	3	100%	0.29%
Plan 2	3.5	100%	0.36%
	4	100%	0.40%
	4.5	100%	0.40%
	5	100%	0.38%
	3	100%	0.46%
Plan 3	3.5	100%	0.56%
	4	100%	0.62%
	4.5	100%	0.61%
	5	100%	0.58%
Average		100%	0.37%

both the RDCA strategy and the ZDCA strategy over the conventional DCA method become even more pronounced.

5. Conclusion and Suggestion

This study examines the performance differences between three modified investment-amount adjustment strategies—the return-based average-cost method, the Z-score average-cost method, and the LOHAS Staff Notation Strategy—and the conventional dollar-cost averaging method in the Taiwan stock market. The results confirm that these modified strategies are capable of achieving higher annualized returns than the conventional DCA approach in most cases, demonstrating the significant advantages of adjusting investment amounts modifiedally.

Taking the ETF #0050, which represents the top 50 companies in the Taiwan stock market by market capitalization, as sample, we find the highest annualized return is achieved under the return-based average-cost strategy without the two-times investment cap, using the parameter setting of k=250 (longer evaluation period) and α=20 (greater sensitivity to price movements). The findings indicate that moderately referencing medium- to

long-term price trends and assigning them a higher weight can further enhance the performance advantage of variable-amount investment strategies relative to fixed-amount approaches.

On the other hand, this study finds that the LOHAS Staff Notation Strategy also performs exceptionally well. When a four-year investment period is adopted, and the investment amount is moderately increased in the lower-bound trend zone while decreased in the upper-bound zone, not only is the annualized return significantly improved, but the overall average investment cost is also effectively reduced. This finding provides clear guidance on parameter adjustments for the practical implementation of the LOHAS Staff Notation Strategy.

Finally, this study provides Taiwanese investors with three modified investment-amount adjustment strategies that can help achieve long-term asset growth. It is expected that through further research and practical application, the use of these strategies offers investors substantial improvements in returns.

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ESG, Firm Value and Overseas Dependency

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Abstract

This study investigates the relationship between a firm's ESG (Environmental, Social, and Governance) rating and its firm value. Using data from Taiwanese companies over the period 2016 to 2024, the analysis finds no significant association between ESG ratings and firm value, as measured by Tobin's Q. Furthermore, the study explores whether the pursuit of overseas income incentivizes firms to engage in ESG activities, within the framework of sustainable supply chain management (SSCM). The empirical results indicate that governance ratings are positively related to overseas dependency, while environmental ratings show a negative association. These findings suggest that ESG ratings may not be widely recognized by the market, possibly due to limited access to relevant information or the inability of ESG ratings to accurately reflect a firm's actual ESG strategies. It is also plausible that firms prioritize specific goals, such as carbon footprint reduction or net-zero commitments, rather than broader environmental performance, in alignment with SSCM objectives. We find firm's governance quality and foreign directors on board matter to its international development.

Keywords: *ESG, firm value, overseas income, sustainable supply chain management.*

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1. Introduction

Against the pressing societal concerns about environmental and social issues and the poor response of policymakers, firms informally entrust with the duty of addressing these challenges and integrate environmental, social and governance (ESG) into their business practices (Fiorillo et al., 2025). Institutively, such integration increases firm's cost since those practices deviates from operation. The common sense suggests that the benefits of embracing ESG outweigh its burdens. From the income side, ESG increases consumer demand for "ethical" goods, strengthens the reputation of more socially responsible firms and, in turn, improves their financial performance (Servaes & Tamayo, 2013). From the cost side, as sustainability plays a greater role in investment decisions (Avramov, Cheng, Lioui, & Tarelli, 2022), financial markets may eventually reward these firms with tangible benefits. Numerous studies have examined the relationship between ESG ratings and firm market value, as well as the implications for investment returns. However, the findings remain largely mixed and inconclusive (Chau et al., 2025).

Eccles et al. (2014) demonstrate that high sustainability companies outperform low sustainability companies on both the market and accounting performance. Whereas, Pástor et al. (2021) show that brown stocks, which firms involve in industries with significant environmental harm, outperform green stocks, which represent shares of companies operating in environmentally friendly industries. Above empirical studies show no solid and consistent results. Moreover, Giglio et al. (2025) find investors' return expectations vary considerably across geographical regions due to different investors belief in ethic motives. Since Taiwan authority has promoted ESG for few years, it is about time to examine how the market reacts to ESG rating. The rationale behind is not only to see the impact from ESG performance but also to the accelerated push toward the ESG engagement.

Coming with the ESG, the concept of Sustainable Supply Chain Management (SSCM) also has emerged in response to growing public concern over environmental degradation and social challenges (Lien and Wang, 2025). SSCM integrates environmental, social, and economic considerations into traditional supply chain practices, aiming to minimize negative impacts while creating long-term value for all stakeholders. As sustainability becomes a fundamental expectation in global markets, SSCM is increasingly recognized not only as an ethical responsibility but also as a strategic asset that enhances organizational resilience, innovation, and competitiveness. In this context, firms are increasingly collaborating to reconfigure their supply chains and drive collective ESG initiatives. By leveraging the combined resources, capabilities, and influence of supply chain partners, such collaborations seek to foster sustainable development and enable systemic improvements across environmental, social, and governance dimensions (Correia et al., 2024).

Taiwan's economy is highly export-oriented, with exports accounting for over 60% of its GDP. Within the framework of SSCM, it is anticipated that firms will actively invest in ESG initiatives to enhance their market competitiveness and capture emerging business opportunities. This trend is especially pronounced among

companies with a strong reliance on international markets. Empirical studies by Tan et al. (2025) and Cai and Hao (2025) indicate that strong ESG performance is positively associated with increased overseas business income. Based on these findings, it is reasonable to expect that firms with higher ESG ratings will derive a greater proportion of their total revenue from overseas markets.

ESG is a conceptual indicator that combines Environment, Social, and Governance with different dimensions of assessment. Firms are unlikely to maintain balanced investment across the three ESG dimensions, and the impact of each dimension on firm tends to vary. For example, Fiorillo et al. (2025) examine how ESG performance affects the cost of debt in the primary corporate bond market and find lower yields (approximately 10 bps) for high-ESG firms, with results mainly attributed to the environmental and social pillars. Also, Darendeli et al. (2022) show that corporate social responsibility (CSR) supports firms in securing customer orders, particularly when corporate clients aim to maintain environmentally sustainable supply chains. That is, the three pillars of ESG have differing effects on firm value and overseas income. Therefore, assessing the impact of each ESG dimension individually is valuable, as it enables firms to prioritize one or two areas instead of all three, especially when addressing specific strategic concerns.

The purpose of this study is threefold. First, it examines how the market reacts to ESG ratings using data from the emerging Taiwanese market. Second, it investigates the relationship between ESG ratings and firms' foreign income in the context of an export-driven economy. Third, it decomposes the overall ESG rating into its three constituent dimensions—environmental, social, and governance—to identify their individual effects. Utilizing data from Taiwanese firms spanning 2016 to 2024, this study aims to provide insights into the distinct roles of each ESG dimension in shaping firm performance and the opportunity in global market.

2. Literature review and hypotheses development

2.1 ESG

ESG practices were initially introduced through a 2004 United Nations initiative and gained global recognition with the launch of the Principles for Responsible Investment (PRI) in 2006, has become a key corporate strategy focused on sustainability (Hou et al., 2025; Yi et al., 2024; Chen et al., 2025). Adeneye, et al. (2023) document that ESG has been a surge of interest in non-financial performance, particularly corporate sustainability and the integration of ESG factors after the Paris Agreement on climate change in 2015. Numerous national policies have driven widespread adoption of ESG practices (Zhou et al., 2020).

In emerging markets, environmental, social and governance factors are a critical input for managing risks, attracting capital, being competitive, and complying with evolving regulations (Rahat and Nguyen, 2024). The

increasing significance of ESG factors marks a crucial transformation in how businesses are valued by investors, stakeholders, and the wider public. Rahat and Nguyen (2024) document that a growing recognition of the intricate relationship between corporate behavior, societal impact, and long-term financial performance has prompted an increased emphasis on ESG considerations. As this recognition gradually matures, companies have no choice but to invest in ESG activities. Literature also shows that firms with robust ESG practices are perceived as better equipped to navigate a dynamic business environment, encompassing regulatory shifts (Mirza, et al., 2023), climate-related challenges (Shan, et al., 2023), and social disruptions (Becchetti, et al., 2023). Investing in ESG activities seems to be another non-core operating activity of enterprises and has become a popular trend in contemporary times.

In this social cognitive atmosphere, engaging in ESG generates competitive advantage (Wang et al., 2023). As consumers become more environmentally and socially conscious, companies with stronger ESG profiles gain a competitive edge (Xiao, et al., 2024). This can result in an increased market share and revenue growth, further positively influencing the company's valuation. Further, ESG compliance is indicative of a company's long-term focus. Investors seeking stable and resilient investments view ESG-compliant companies favorably (Lian, Ye, Zhang, & Zhang, 2023). The commitment to sustainable practices contributes to long-term financial performance, supporting a positive valuation outlook (Rahat and Nguyen, 2024). The above benefits make companies more willing to invest in ESG activities and also give management a reason to increase spending on non-business related programs under the premise of maximizing shareholder wealth.

When incorporating ESG factors into firm's investment decisions, it is essential for firms to evaluate the benefits. Companies with strong ESG performance are often benefited from improved access to financing (Su et al., 2024) or broaden funding resource (Lin and Li, 2025). Chen et al. (2025) document that ESG practices contribute to lowering financing costs, increasing access to external financing, and greater transparency in their governance structures. Lian et al. (2025) also find ESG performance has a positive effect on companies' trade credit financing. The advantage on financing enhances firms' ability to invest in growth and strategic initiatives, thereby positively influencing their valuation (Ferriani, 2023; Rojo-Suárez & Alonso-Conde, 2023). Moreover, a solid ESG profile strengthens a company's reputation and brand image (Lee et al., 2022) and reduces relationship-based transactions by improving accounting information quality (Zhang et al., 2025). Firms perceived as socially responsible and environmentally conscious tend to attract more customers, business partners, and investors. This favorable perception can translate into a higher market valuation, as stakeholders increasingly associate ethical and sustainable practices with long-term value creation (Rahat & Nguyen, 2024). Existing literature also suggests that ESG practices can enhance financial performance (Fatemi et al., 2015; Albuquerque et al., 2019), improve operational stability and market resilience (Lins et al., 2017), affect the supply chain financing (Xin et al., 2025),

and associate with lower bankruptcy risk (Lin et al., 2025). The above results make companies willing to continue investing in ESG.

Benefit from ESG investment also yields to the others. Existing literature suggests that ESG practices contribute to lowering financing costs, increasing access to external financing, and greater transparency in their governance structures (Chen et al., 2025). Strong ESG performance can reduce risk perceptions among investors and creditors, thereby lowering external financing costs (Chen et al., 2023; Dhaliwal et al., 2011). Furthermore, ESG is also linked to green innovation (Lin et al., 2021; Wang et al., 2023), better risk management and governance, lowering the risk perceptions of investors and creditors (Lian et al., 2023), boosts corporate reputation and market recognition, mitigating the adverse effects of information asymmetry (Eccles et al., 2014). In sum, strong ESG performance enables firms to secure external financial support more easily (Cheng et al., 2014).

2.2 ESG and firm market value

Existing literature suggests that ESG practices can enhance financial performance and improve operational stability and market resilience (e.g., Chen et al., 2025). This is also true in emerging market (Rahat and Nguyen, 2024). However, Duque-Grisales & Aguilera-Caracuel (2019) find a negative correlation between ESG and corporate performance in emerging markets. Cai and Hao (2025) present two contrasting perspectives on the relationship between ESG and corporate performance. One view suggests that ESG practices enhance a company's competitiveness, innovation capacity, and commitment to social responsibility, thereby fostering stakeholder trust and brand reputation—factors that become critical drivers of business success, especially in challenging times. In contrast, the opposing view argues that ESG efforts can lead to inefficient resource allocation, information asymmetry, and greater exposure to risks, ultimately reducing a firm's overall value. Among them, a positive relationship is more expected in Taiwan market. The Financial Supervisory Commission (FSC) proposed Sustainable Development Roadmap in 2022, promoting net-zero policy, sustainable governance culture, transparent information disclosure, strengthen stakeholders' communication, and ESG performance assessment. The FSC also released the Green and Transformative Finance Action Plan in 2024 to provide financial support for net-zero transition, collect and build corporate carbon emissions data, strengthen climate resilience, encourage financial industry to disclose carbon reduction targets and nature-related financial information, promote sustainable finance licenses, improve sustainable finance assessment and international influence. The plan aims to expand the scope and intensity of financial support. As a result, the ESG engagement in emerging Taiwan market is expected to earn the positive effects. We therefore develop our first hypothesis:

H1: There is a positive relation between ESG rating and firm market value in Taiwan.

2.3 ESG and overseas income

The positive relation between ESG performance and firm value stands base on the stakeholder theory where firms enhance legitimacy by aligning with stakeholder expectations. Contrarily, the negative relation is supported by the agency theory which argues a negative association due to potential conflicts of interest between managers and shareholders. Essentially, Taiwan is a small economic entity and depends heavily on international trade. It is more likely that Taiwanese firms engage in ESG due to stakeholder expectation since they are actively participating in international supply chain activities and facing significant pressure in their export strategies. Compliance with ESG protocols can bring more business opportunities as well as overseas income to Taiwan's foundry manufacturers.

The Association for Supply Chain Management defines the sustainable supply chain management is an overarching strategy that aims to incorporate sustainable practices throughout the entire supply chain . They also state that corporations are pledging to work only with first tier suppliers who are committed to supply chain sustainability, and who ask the same from their suppliers. Across the global, suppliers then are asked to follow the sustainability guideline. For Taiwan, which is heavily dependent on international trade, the argument that compliance with ESG agreements can bring more benefits is supported. Tan et al. (2025) find superior ESG performance significantly enhancing overseas business income using Chinese A-share listed samples. They suggest that strong ESG performance can convey non-financial information, reduce information barriers, and increase overseas business income, and that it fosters overseas business income by mitigating financing constraints, circumventing operational risks, and bolstering product competitiveness. Moreover, Cai and Hao (2025) find ESG performance has a substantial positive effect on export performance, with financing cost reduction and alleviation of financial constraints being key mechanisms, particularly through green technology innovation. Using ESG as a dialogue platform will help the development of international trade and stimulate manufacturers engaged in international trade to be more willing to invest in ESG. Using Taiwan semiconductor industry samples, Lien and Wang (2025) find the sustainable supply chains are vital for international enterprises, with ESG factors now essential in supplier assessments. Adhering to the spirit of green supply chain management is very important for Taiwanese manufacturers who value export performance. As a result, we develop our first hypothesis as:

H2: There is a positive relation between ESG rating and overseas income in Taiwan.

3. Data and methodology

To understand whether Taiwanese firms engaging in ESG activities relates to their foreign sales and market value due to the international code on ESG, this study collects Taiwan public firm data including all of the financial data and ESG rating from Taiwan Economic Journal (TEJ). About 2,449 firms are obtained in the time spin of 2016 to 2024 from either the Taiwan Stock Exchange Corporation or the Taipei Exchange.

The TESG Rating is the first ESG indicator in Taiwan authorized by Sustainability Accounting Standards Board. It is a quantitative assessment of the ESG performance of publicly listed and publicly issued companies. The assessment uses over 70 variables across 16 issues related to the three pillars of ESG (Environmental, Social, and Governance) following the Global Reporting Initiative (GRI). It provides comprehensive ESG ratings for Taiwan's publicly listed companies. Using over 70 quantitative variables and covering 16 sustainability topics, TESG ratings represent not only companies' achievements in ESG (Environmental, Social, and Governance) but also serve as a crucial reference for investors and financial institutions evaluating future potential. Therefore, this study collects the TESG and also the ratings of Environment, Social, and Governance (Escore, Sscore, and Gscore) from TEJ.

Rahat and Nguyen (2024) and Chau et al. (2025) investigate the impact of ESG scores on firm valuation, using Tobin's Q as valuation metrics. Rahat and Nguyen (2024) argue the Tobin's Q assesses the alignment between a company's market value and the replacement cost of its assets, valuable for evaluating operational efficiency and market pricing. This study uses equation (1) to test the relation between firm's ESG performance and its market value in our panel regression fixed effect model.

$$\boldsymbol{y_{i,t} = \alpha_0 + \beta_1 ESG_{i,t} + \beta_2 Control_{i,t} + YE + FE + \varepsilon_{i,t}} \quad (1)$$

The control variables include firm size (*Lnsize*), market-to-book ratio (*MB*), R&D expense (*RD*), leverage (*LEV*), Asset turnover (*Asset_T*), Turnover (*Turn*), Cash ratio (*Cash_R*), and earnings per share (*EPS*). The *Lnsize* is the natural logarithm of firm's total asset. *MB* is the market to book ratio. *RD* is the RD expenses divided by total asset. Following Chau et al. (2025), the *Asset_T* is the net income divided by total asset and *LEV* is the total asset divided by share capital. Turn is the annual trading volume divided by the number of shares outstanding. *Cash_R* is the cash flow ratio, measured whether the cash flow generated by business activities is sufficient to pay current liabilities under normal operation. All the variables are measured on annual basis.

To understand if the ESG performance is driven by firm's overseas business, this study developed the equation (2) as:

$$\boldsymbol{Osales_{i,t} = Osales_{i,t-1} + \beta_1 ESG_{i,t-1} + \beta_2 Control_{i,t-1} + YE + FE + \varepsilon_{i,t}} \quad (2)$$

The *Osales* is the ratio of firm's foreign sales to its sales. The Financial Supervisory Commission no longer asks firms to report the data since 2024, we access the *Osales* from 2016 to 2023. Again, we use four ESG indicators in equation (2). As to the control variables, we include the return-on-asset (*ROA*), the sales growth rate (*SG*) that measures the change in a company's sales compared to that in previous year. Due to the foreign directors

on board affects firm's internationalization (Barroso, et al. 2011), we include the *ODR* computed as the number of foreign directors to the board size in equation (2).

4. Empirical results

The descriptive statistics is showed in Table 1. All the variables are reported in prior chapter. About 2,449 firms are obtained in the time spin of 2016 to 2024 from either the Taiwan Stock Exchange Corporation or the Taipei Exchange and finally 14,990 firm-year data are collected.

Table 1

Descriptive statistics

This table reports the descriptive statistics of all variables used in this study. The data is collected from the TEJ in the time spin of 2016 to 2024 on annual basis. About 2,249 firms are obtained. The definition of the variables is reported in the text.

	Lnsize	*MB*	*ROA*	*RD*	*LEV*	*TURN*	*EPS*	*Cash_R*
Mean	15.4470	2.3207	4.1945	29.4266	5.7893	199.265	3.0675	1.2603
Median	15.2731	1.65	4.38	13.8739	4.0095	81.3818	1.61	0.59
Maximum	22.6242	203.68	89.31	707.524	162.231	5858.67	210.70	173.18
Minimum	9.7566	0.19	-127.50	0.0000	0.0145	0.5160	-35.39	0.00
Std. Dev.	1.4881	3.5789	9.1793	47.3897	7.7717	331.237	7.4019	4.333

	ASSET_T	*TBQ*	*TESG*	*Escore*	*Sscore*	*Gscore*	*ODR*	*Osales*
Mean	0.7334	1.4157	54.7033	55.0231	54.7319	54.5409	0.0161	0.6229
Median	0.6552	1.06	54	52.92	53.82	55.02	0	0.7425
Maximum	5.7049	56.18	83.73	92.16	91.00	84.41	0.9091	1
Minimum	0	0.02	29	23.32	26.58	19.65	0	-0.0480
Std. Dev.	0.5150	1.5327	8.3540	12.2089	10.9718	10.5096	0.0693	0.3418

Among those ESG indicators, TESG is the comprehensive, overall measurement indicator with a mean of 54.7 and median of 54. Also, the means for Escore, Sscore, and Gscore are 55.02, 54.73, and 55.02. All of the four indicators have similar value. Seems like most of the performance assessments to firms are valued at an ordinary level, rarely having outstanding performances. This phenomenon is normal for a newly established evaluation agency. Under the pressure of reducing negative reactions from the evaluated, many evaluations try to adopt neutral evaluations. At the same time, they also try not to give negative comments from the perspective of encouraging the evaluated. The correlations are reported in Table 2.

Table 2

Correlation Coefficient

This table reports the correlation coefficient of variables. The definitions of all variables are the same as in Table 1. Values in boldface are significant at the 10% or higher level.

	Lnsize	*MB*	*ROA*	*RD*	*LEV*	*TURN*	*EPS*	*Cash_R*	*ASSET_T*	*TBQ*	*TESG*	*Escore*	*Sscore*	*Gscore*	*ODR*
MB	-0.0628														
ROA	0.2112	0.1044													
RDTA	-0.1473	0.1736	-0.0177												
LEV	0.4613	0.0378	0.1741	-0.0269											
TURN	0.0333	0.1189	0.1919	0.1652	0.0279										
EPS	0.2865	0.1579	0.5235	0.0552	0.5876	0.1077									
CASH_R	-0.1354	0.0374	0.0048	0.0870	-0.0180	0.0003	0.0105								
ASSET_T	0.0691	0.0281	0.2192	0.0256	0.0411	0.0615	0.1154	-0.1689							
TBQ	-0.1061	0.6100	0.2066	0.2974	0.0123	0.1754	0.2367	0.1290	-0.0136						
TESG	0.4673	0.0236	0.1915	0.0664	0.1975	0.0223	0.1934	-0.0567	0.1280	0.0468					
Escore	0.4477	0.0135	0.1169	0.0082	0.1926	0.0248	0.1460	-0.0737	0.1124	-0.0002	0.7505				
Sscore	0.4885	0.0138	0.1397	0.0562	0.1561	0.0147	0.1379	-0.0564	0.0654	0.0327	0.7794	0.5214			
Gscore	0.1589	0.0259	0.1601	0.0671	0.1147	0.0127	0.1506	-0.0064	0.1174	0.0616	0.6972	0.2661	0.2296		
ODR	0.0415	0.0696	0.0004	0.0381	0.0266	-0.0002	0.0422	0.0125	0.0156	0.0258	0.0446	0.0233	0.0076	0.0693	
Osales	0.0665	-0.0005	0.0211	0.1890	0.0461	0.1139	0.0834	-0.0039	0.1030	0.0031	0.0104	0.0620	-0.0460	0.0148	0.0037

To test the hypothesis 1, this study uses the panel regression with fixed year effect and firm effect to identify if the ESG performance matters to firm value. The result is reported in Table 3. Four ESG indicators are applied as the dependent variable. Among them, the *TESG* associates insignificantly with firm value showing the ESG performance doesn't matter much to firm performance. When three pillars of ESG are tested separately, only *Escore* displays a significant relation with the Tobin's Q. The empirical results support the argument of Chau et al. (2025) that relation between ESG and firm value remains largely mixed and inconclusive.

Even literatures argue a positive relation between ESG performance and firm value, some issues need to be further clarified. First, is the ESG assessment mechanism correct and the measurement truly reflects the status quo of firm's performance? When it comes to evaluation, the fairness and authority of the evaluation unit are often examined. Even the TEJ is the only one institution that offers ESG performance of public firms in Taiwan, their measurement might not be accepted by all of the market participants. That is, when the market questions the accuracy of such information, it will not react to it. Second, the TEJ is a closed database. Users must pay to access the data. Therefore, when there are obstacles to obtaining information and the trust is not high, this might also be the reason why the research results are not solid. Finally, judging from the numerical distribution of the rating data, most of the rated companies are clustered at 54 points, indicating that the agency may have considered avoiding negative emotions from the rated or encouraging the rated companies to pursue improvement, which made the ESG rating scores overly concentrated, causing problems in data analysis.

The hypothesis 2 argues the overseas business drives the intention of ESG engagement in Taiwan. The *Osales* is used as the dependent variable that measures the degree of overseas sales to firm's overall sales in the year. The higher *Osales* represents the firm depending more on the business out of Taiwan market. This study mainly tests if the *TESG* and *EScore* relating positively to the *Osales*. Staying with the concept of SSCM, firms are expected to engage in ESG for obtaining business opportunity. Table 4 reports the results.

In Table 4, the TESG is found to have a statistical relation with *Osales*. However, such relation is absent in the case of *Escore* and *Osales*. The empirical results do not support our hypothesis 2. To know better about the influence from the ESG performance, the Table 4 shows the *Gscore* playing critically on affecting *Osales*. In sum, the results tell the ESG engagement doesn't affect firms' overseas business, suggesting the sustainable supply chain management might not sound in Taiwan or the ESG assessment by TEJ might be questionable. Further, the quality of corporate governance is the key that pushes firm to operate internationally. We also find the foreign directors (*ODR*) have positive impact, echoing support for influence of the international experiences on board to top management team.

Table 3

Regression analysis on the ESG to Tobin's Q

This table reports the panel regression analysis with year and firm fixed effect to test the relation between ESG performance and firm value. The Tobin's Q is the dependent variable that represents the firm value. All the variables are defined as same as those in Table 1.

	Tobin's Q			
TESG	0.0013			
	(0.4559)			
Escore		0.0025 **		
		(0.0157)		
Sscore			5.72E-06	
			(0.9967)	
Gscore				-4.87E-05
				(0.9630)
Lnsize	-0.1595 ***	-0.1627 ***	-0.1567 ***	-0.1566 ***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
MB	0.1487 ***	0.1487 ***	0.1487 ***	0.1487 ***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
RD	0.0039 ***	0.0039 ***	0.0039 ***	0.0039 ***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
LEV	-0.0326 ***	-0.0331 ***	-0.0325 ***	-0.0325 ***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Asset_T	0.1131 ***	0.1091 ***	0.1145 ***	0.1146 ***
	(0.0023)	(0.0033)	(0.0020)	(0.0020)
Turn	0.0005 ***	0.0005 ***	0.0005 ***	0.0005 ***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Cash_R	0.0050 **	0.0050 **	0.0050 **	0.0050 **
	(0.0171)	(0.0187)	(0.0172)	(0.0173)
EPS	0.0377 ***	0.0376 ***	0.0377 ***	0.0377 ***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Year Effect	YES	YES	YES	YES
Firm Effect	YES	YES	YES	YES
Obs.	14490	14490	14490	14490
Adj. R^2	0.7406	0.7407	0.7406	0.7406
F-statistic	23.8970 ***	23.9099 ***	23.8957 ***	23.8957 ***
P(F-statistic)	(0.0000)	(0.0000)	(0.0000)	(0.0000)

Table 4

Regression result on the ESG performance and firm's overseas sales

This table reports the panel regression analysis with year and firm fixed effect to test the relation between firm's overseas income proportion and its ESG performance. All the variables are defined as same as those in Table 1.

	Osales			
Osales $_{t-1}$	0.5124 ***	0.5127 ***	0.5127 ***	0.51189 ***
	(0.0000)	(0.0000)	(0.0000)	
TESG $_{t-1}$	0.0007 ***			
	(0.0041)			
Escore $_{t-1}$		4.4E-05		
		(0.7962)		
Sscore $_{t-1}$			0.0001	
			(0.7216)	
Gscore $_{t-1}$				0.0005 ***
				(0.0005)
Lnsize $_{t-1}$	0.0197 **	0.0222 **	0.0221 **	0.0210 **
	(0.0356)	(0.0180)	(0.0182)	(0.0245)
MB $_{t-1}$	-0.0013 ***	-0.0013 ***	-0.0013 ***	-0.0013 ***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
ROA $_{t-1}$	3.0E-04 *	3.0E-04 *	3.0E-04 *	3.0E-04 *
	(0.0528)	(0.0571)	(0.0570)	(0.0534)
LEV $_{t-1}$	3.6E-06	3.5E-06	3.5E-06	3.6E-06
	(0.5519)	(0.5573)	(0.5587)	(0.5484)
Turn $_{t-1}$	1.7E-06	1.7E-06	1.7E-06	1.7E-06
	(0.6051)	(0.5961)	(0.5999)	(0.6046)
ODR$_{t-1}$	0.0905 ***	0.0899 ***	0.0900 ***	0.0886 ***
	(0.0067)	(0.0071)	(0.0070)	(0.0079)
Year Effect	YES	YES	YES	YES
Firm Effect	YES	YES	YES	YES
Obs.	8637	8637	8637	8637
Adj. R^2	0.9550	0.9546	0.9550	0.9550
F-statistic	126.8374 ***	126.6877 ***	126.6888 ***	126.9064 ***
P(F-statistic)	(0.0000)	(0.0000)	(0.0000)	(0.0000)

5. Conclusion and Discussion

This study reexamines the relation between firm's market value and ESG performance in Taiwan in the absence of a solid conclusion on this issue. Empirical results show no clear relation between firm's value and its ESG performance even in the cases of separating the three pillars from the whole. This study consists with the argument of Chau et al. (2025) that findings remain largely mixed and inconclusive.

Based on the concept of sustainability supply chain management, this study argues the Taiwanese firms that depends heavily on exports should weight much on ESG performance for pursuing overseas income. The results show insignificant relation between ESG performance and firm's overseas business share, suggesting the principle of sustainability supply chain management may not stand in Taiwan. Instead, we find the governance quality, which is a relatively mature assessment among others, playing critical to firm's overseas sales in export-oriented Taiwan market.

This study essentially not only identifies whether the market reacts positively to the ESG performance as suggested by literatures or the stand of sustainability supply chain management, it also explores issues about TEJ's assessment of ESG performance. One obvious problem is that TEJ may have taken the position of encouraging enterprises when conducting the evaluation, and the scores evaluated have a clustering phenomenon and fail to have a differentiated comparison effect. Forcing the scores of the evaluation to show a near-normal distribution may distort the data. In short, the purpose of TEJ's ESG ratings is to encourage companies to pursue progress in the ESG field, but its data may not be suitable for academic research. Another possible issue is that the rating results are closed information that is not freely available to the public. When the market cannot easily obtain them, they fail to fully reflect the ESG performance of the companies.

In fact, some Taiwanese companies use other methods other than TEJ ratings to highlight their ESG, environmental, or sustainability performance. That probably explains why the ESG or environmental performance is incapable of describing firm's overseas business. In line with the SSCM, Buyers often require suppliers to provide carbon footprint information or to comply with their ESG strategies. Therefore, the ESG efforts made by Taiwanese companies may not necessarily reflect the questions asked by TEJ. In sum, this study provides considerations on the use of ESG rating data in ESG study.

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Understanding Instructor Impact from the Participant's Perspective: A Triadic Efficacy Approach in Group Fitness Programs

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Abstract

This study adopts the Triadic Efficacy Model as its theoretical foundation to explore the interaction dynamics between aerobic instructors and participants within group fitness classes, as well as to examine the dimensions of three efficacy beliefs. Employing a qualitative research design, the study conducted in-depth interviews with eight participants from a fitness club who regularly attended group classes. The objective was to uncover how interpersonal interactions shape efficacy beliefs in this setting. Findings revealed three primary efficacy dimensions:1. Self-efficacy: (1) Effort investment – Participants reported choosing class formats, closely observing the instructor's movements, maintaining enthusiasm, overcoming difficulties, and striving to complete routines. (2) Enjoyment – They described staying in optimal mental and physical states to actively engage in the sessions. (3) Exercise during leisure – Many continued to practice after class, progressing steadily toward personal goals. 2.Other-efficacy: (1) Effort investment – In addition to instructors' personalities and pedagogical traits, participants evaluated teaching approaches, motivational strategies, attentiveness, feedback mechanisms, and instructional diversity. (2) Enjoyment – Participants expressed emotional satisfaction when instructors maintained a positive atmosphere during teaching. (3) Exercise during leisure – Some pursued further learning or certifications to enhance their own competencies. 3.Relation-inferred efficacy: (1) Effort investment – Participants recognized tailored instruction and goal-oriented guidance as key drivers of effort. (2) Enjoyment – When instructors demonstrated genuine care and shared their passion for dance, participants reported higher engagement and satisfaction. (3) Exercise during leisure – Continued practice outside class was often aimed at improving

performance and sustaining progress. The analysis further indicates that both other-efficacy and relation-inferred efficacy serve as critical sources of self-efficacy, especially when embedded in meaningful interpersonal interactions. Participants noted that perceiving instructors as competent and socially attuned contributed significantly to strengthening their own efficacy beliefs.

Keywords: *Self-efficacy, Other-efficacy, Relation-inferred Efficacy.*

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1. Introduction

According to a foundational study published by the American College of Sports Medicine (ACSM) in 2000, regular participation in fitness activities significantly contributes to both physical and psychological well-being. The core objective of fitness programs is to enhance individuals' exercise behaviors. To achieve this goal, it is essential to implement well-structured exercise plans that optimize participation and engagement (Chiu, 2008). In recent years, the fitness industry has emerged as a focal point of academic research, encompassing a wide range of topics, including exercise management and psychological factors. This study focuses specifically on the psychological dimension, exploring the efficacy beliefs of participants within the fitness context. In the fitness industry, instructional formats are generally categorized into one-on-many group aerobic classes and one-on-one personal training sessions. This research concentrates on the former, with an emphasis on group-based settings. Previous studies (Jackson, Knapp, & Beauchamp, 2008) have noted the structural similarities between the dyadic relationship of coaches and athletes and the interactional dynamics between aerobic instructors and participants in group classes. While prior literature has primarily examined self-efficacy and proxy efficacy within such dyadic contexts, the present study draws on the tripartite model of efficacy beliefs proposed by Lent and Lopez (2002). This model expands beyond self-efficacy to include two additional constructs—other-efficacy (OE) and relational-inferred self-efficacy (RISE)—offering a more comprehensive framework for understanding efficacy beliefs within exercise settings.

Self-efficacy originates from Bandura's Social Cognitive Theory. Bandura (1977, 1986) defined self-efficacy as an individual's belief in their ability to execute specific behaviors under particular circumstances. In essence, self-efficacy refers to the confidence a person has in their capability to successfully integrate and perform actions toward a desired goal (Feltz, 1988). In this study, self-efficacy is defined as "the participant's confidence in evaluating their own abilities when engaging in an aerobic dance class." Building on this foundation, Lent and Lopez (2002) proposed that, in addition to self-efficacy, two other types of efficacy beliefs—other-efficacy and relational-inferred self-efficacy (RISE)—are also relevant, particularly in close or cooperative relationships. Other-efficacy refers to an individual's belief in their partner's ability to perform a given task. Accordingly, this study defines other-efficacy as "the participant's confidence in evaluating the aerobic instructor's ability during class participation." Lent and Lopez (2002) further argued that beyond acknowledging the partner's ability, individuals also form beliefs about how competent their significant others or partners perceive them to be. This belief is conceptualized as relational-inferred self-efficacy (RISE). In this study, RISE is defined as "the participant's belief about the aerobic instructor's confidence in their ability." In the context of group-based fitness programs, the interaction between aerobic instructors and participants is inherently reciprocal, resembling a collaborative partnership. According to the Triadic Efficacy Model, such dyadic relationships involve not only

self-directed efficacy beliefs but also efficacy beliefs directed toward and inferred from significant others. These multi-dimensional efficacy beliefs are especially relevant in cooperative contexts, as they contribute to predicting the quality and outcome of interpersonal interactions (Lent & Lopez, 2002).

Previous studies on efficacy beliefs have primarily focused on competitive sports contexts, particularly coach–athlete relationships (Jackson et al., 2008), and physical education settings involving teacher–student dynamics (Dunlop, Beatty, & Beauchamp, 2011). Beyond these domains, research has also extended into fields such as business and finance (Yang, 2014; Yim, Chan, & Lam, 2012) and healthcare provider–patient relationships (Chen, 2017; Jackson, Dimmock, Taylor, & Hagger, 2012). For instance, the works of Jackson et al. (2008) and Dunlop et al. (2011) provide insight into both the internal psychological processes and the interpersonal outcomes within coach–athlete interactions, integrating cognitive, emotional, and behavioral dimensions. In the domain of school-based physical education, research on triadic efficacy has demonstrated that, regardless of a student's level of self-efficacy, those who hold stronger confidence in their teacher's dance ability (i.e., high other-efficacy) tend to exhibit better individual performance outcomes than those with lower levels of such confidence.

While the existing literature has extensively examined self-efficacy, discussions surrounding dyadic efficacy beliefs remain relatively limited. In particular, the processes through which mutual trust is established within interpersonal relationships, and how such trust may serve as a foundation for enhancing one's sense of efficacy, warrant further investigation. To address this gap, the present study situates its inquiry within the fitness industry, focusing on participants in group exercise classes. It explores the formation of efficacy beliefs—specifically, the triadic structure of self-efficacy, other-efficacy, and relational-inferred self-efficacy (RISE)—as they emerge both during and beyond class sessions. Drawing on the relational efficacy framework proposed by Lent and Lopez (2002), this study seeks to provide a more comprehensive understanding of how efficacy beliefs are shaped through classroom interactions and instructor–participant dynamics. By identifying the underlying components and interrelationships of the triadic efficacy model, this research contributes to both theoretical development and practical advancement. The findings aim to offer actionable insights for fitness industry operations, including strategies for optimizing group instruction and designing effective training programs for aerobic instructors, with the broader goal of enhancing participant engagement and long-term adherence.

2. Research Method

2.1 Research Framework

This study aims to explore the triadic efficacy beliefs—self-efficacy, other-efficacy, and relational-inferred self-efficacy—within the instructor–participant relationship in group fitness programs. Drawing upon Social Cognitive Theory (Bandura, 1997) and the tripartite efficacy framework proposed by Lent and Lopez (2002), the

study adopts their categorisation of predicted outcomes for each type of efficacy belief. In addition, this study references the measurement dimensions outlined by Jackson et al. (2012) to develop three analytical dimensions: (1) level of effort, (2) degree of enjoyment, and (3) exercise engagement during leisure time. A mixed-methods approach was adopted, combining literature review and qualitative data collection through semi-structured in-depth interviews. After the interviews were transcribed verbatim, the content was analysed and categorised through inductive thematic analysis. To enhance the study's credibility, procedures for content validity and reliability were implemented. The research structure is illustrated in Figure 1.

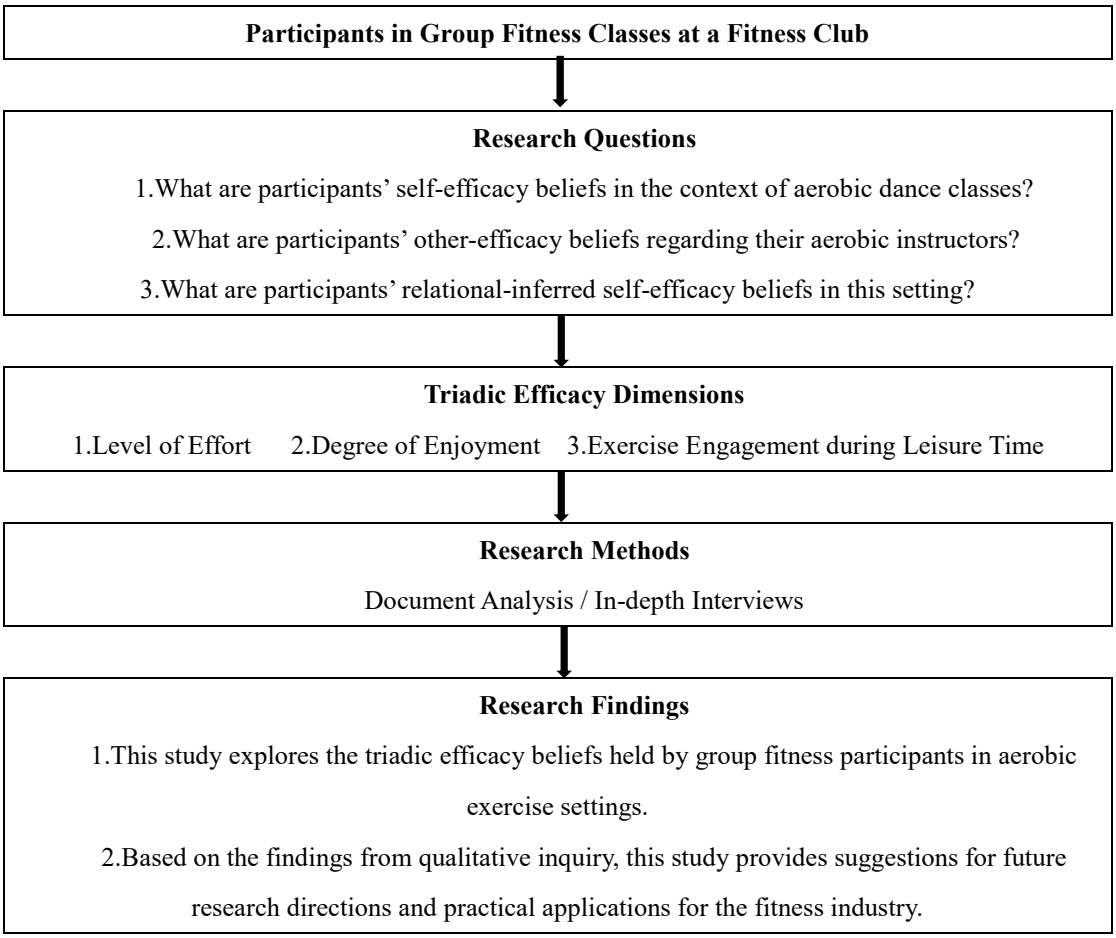

Figure 1.

Research Framework

2.2 Research Participants

This study focused on members aged 20 to 40 years from a chain fitness center located in the Taichung area. A total of eight participants—four male and four female—were recruited. All participants attended at least two group fitness classes per week, primarily involving aerobic dance sessions. The sampling method adopted in this

study was purposive sampling. Participant demographics are summarized in Table 1.

Table 1

Overview of Interview Participants

Code	Age	Gender	Name of the Fitness Center
A	27	Male	Fitness Factorv
B	26	Male	Chuan Zhen Fitness
C	28	Female	Extreme Fitness
D	28	Female	Chuan Zhen Fitness
E	35	Male	Fitness Factory
F	25	Male	World Gym
G	24	Female	Fitness Factory
H	26	Female	Fitness Factory

2.3 Research Procedure and Instruments

The research process began with contacting potential participants, explaining the purpose of the study, and confirming their willingness to participate. Upon agreement, participants were provided with an interview outline, and the time and location for the interview were scheduled. Each interview lasted approximately 60 minutes. Prior to the interview, participants were reminded that the entire session would be audio-recorded. Upon receiving their consent, the formal interview commenced. A semi-structured in-depth interview method was employed, consisting of three main sections: (1) demographic information, (2) experiences with group fitness class participation, and (3) triadic efficacy beliefs, which included self-efficacy, other-efficacy, and relational-inferred self-efficacy. During the interviews, if participants encountered questions they did not fully understand, clarifications were provided by rephrasing or further explanation until comprehension was ensured. After each interview, the audio recordings were transcribed verbatim. The transcriptions were reviewed for accuracy and then returned to participants for member checking. Any discrepancies or errors identified by the participants were immediately corrected to ensure data integrity.

2.4 Data Analysis

Data collection and analysis were conducted concurrently throughout the research process. Upon completion of each interview, the researcher transcribed the recordings verbatim and proceeded with data coding and thematic analysis. Relevant content aligned with the study objectives was selected for further interpretation. A systematic coding scheme was employed to organize the interview data. Each participant was assigned a code from A to H. Gender was numerically coded (1 = male; 2 = female), followed by identifiers for the main interview sections and

corresponding questions. For example, the code "A-1-2-3" refers to Participant A (male), responding to the third question under the second major section of the interview guide.

2.5 Data Analysis

To ensure consistency and accuracy in the interview data, the researcher first conducted a comprehensive review of relevant literature and systematically collected and analyzed the data to strengthen the study's empirical foundation. This study employed triangulation as a strategy to enhance the trustworthiness of qualitative findings. Specifically, three subject-matter experts from related fields were invited to review and evaluate the content, thereby validating the consistency and credibility of the data. Triangulation is commonly used to assess the trustworthiness of qualitative research outcomes. As outlined by Lincoln and Guba (1985) and further supported by Robson and McCartan (2016), four key criteria are typically applied: credibility, transferability, dependability, and confirmability.

3. Findings

3.1 Self-Efficacy Beliefs of Participants in Aerobic Dance Classes

In the context of group fitness programs, participants' beliefs regarding their ability to persist in exercise and actively engage in classes are primarily centered on self-perception. These beliefs reflect an internal understanding of their own level of effort, degree of enjoyment, and amount of physical activity undertaken during leisure time.

3.1.1 Effort investment

Instructional styles were broadly categorized into two types: the energetic–casual style and the authoritarian–serious style. The findings indicate that most participants preferred instructors with an energetic and engaging demeanor in group fitness settings. However, some also expressed an appreciation for structured or directive leadership styles.

"*Energetic and casual styles are more suitable because aerobic dance classes are physically demanding. If the instructor is too serious, it becomes harder to maintain participation. But with a more energetic and casual instructor, the class feels more relaxed and less stressful, which helps achieve the exercise outcome.*" (F-1-3-1)

Energetic instruction was generally perceived as more supportive of sustained effort and learning. Participants noted that an encouraging atmosphere enabled them to engage more comfortably, in contrast to authoritarian styles that tended to create psychological pressure.

"I*t boosts my confidence in exercising. Energetic instructors tend to provide more encouragement. In contrast, those with an authoritarian or directive style tend to be stricter with movement instructions, which creates*

pressure. Energetic instructors are better at using gentler, more flexible language to explain movements—communication really matters." (A-1-3-2)

Observation and Practice—When participants first began attending aerobic classes, not all were immediately skilled in the various routines. Regardless of whether they enjoyed or struggled with a class, they often started by observing the instructor, gradually finding their own rhythm through continued engagement.

"*At first, I would observe the instructor's movements. After the instructor explained them, I would practice more either during class or after.*" (A-1-3-3)

Overcoming Challenges—Becoming proficient in aerobic dance is not the result of attending a single session; rather, it is a cumulative process that requires long-term commitment. While some routines are relatively simple, others can be technically challenging. When encountering difficult movements, participants expressed a strong determination to complete them to the best of their ability.

"*No matter how difficult the movement is, I'll always try it first and do my best to complete what the instructor teaches. But it's also important to follow how your body feels. That's something our instructor tells us—dancing should also be joyful.*" (F-1-3-6)

Committed Practice—For beginners, some initially completed classes without fully grasping the content, or occasionally only completed half of the session. Beyond learning movements step by step, being able to finish an entire class requires both time and focused effort.

"*I try my best to complete all the movements, unless I forget the choreography. But even if I can't fully execute the techniques the instructor shows us, it's probably because my physical ability is not strong enough yet.*" (D-2-3-7)

3.1.2 Enjoyment

Physical Readiness—Before engaging in any activity, participants emphasized the importance of assessing their physical condition to ensure readiness.

"*If I'm not feeling physically well, I'll let myself rest at home. I won't force myself to exercise. I prefer to attend class only when I'm mentally and physically prepared. And if I return after a break, I'll choose lower-intensity classes—something within my body's limits.*" (E-1-3-4)

Passionate Engagement—Although exercise can be difficult, participants recognised that effort is necessary to discover one's potential. While fitness goals may vary, a common belief was that enjoyment is essential to sustaining participation.

"*Even if something feels difficult or unfamiliar at first, our instructor always tells us, 'It will be better next time.' And that's true—you can feel it in your body. So no matter what, as long as I keep going, I know I'll improve. My passion for it remains strong.*" (G-2-3-5)

While many participants expressed enjoyment in exercise, some acknowledged that their enthusiasm could wane when facing unfamiliar or challenging content.

"*Honestly, I don't feel very passionate about it. When I encounter something I'm not good at, I tend to lose the motivation to complete it.*" (F-1-3-5)

3.1.3 Exercise during Leisure

Post-Class Practice—Participants who were willing to invest time outside of class to improve their skills demonstrated strong self-discipline and a commitment to personal growth.

"*After class, I practice at home. In addition to standing up and dancing to review the moves, I also watch videos—both my own and my peers'. I learn from others' strengths through these videos to make up for what I'm lacking*." (D-2-3-8)

4. Conclusion

Based on the relational efficacy framework proposed by Lent and Lopez, which integrates other-efficacy and relational-inferred self-efficacy (RISE) alongside self-efficacy to form the triadic efficacy belief model, this study explores how efficacy beliefs operate within close interpersonal relationships. Previous studies have predominantly examined this model in contexts such as sports, education, and rehabilitation, often focusing on how relational efficacy beliefs developed through dyadic interactions influence one's self-efficacy. In such cases, other-efficacy and RISE function as antecedents to self-efficacy, or as joint constructs used to explain outcomes in relational dynamics. However, few studies have examined triadic efficacy beliefs within the context of recreational physical activity. Therefore, this study investigates the relationship between aerobic instructors and participants, aiming to understand the psychological processes that unfold during group fitness class participation.

Findings from participant interviews reveal notable parallels between self-efficacy and relational-inferred self-efficacy. Within the domain of effort, self-efficacy is reflected in both instructional engagement and goal pursuit. Participants highlighted that differentiated instruction ("teaching according to student needs") plays a crucial role in shaping perceived instructional effectiveness. Furthermore, reaching personal goals requires not only observation of the instructor's movements during class but also the ability to overcome difficulties and commit to consistent practice. Before participants can enjoy the learning process, they must adjust their physical

and mental states to reach an optimal condition. Maintaining such readiness allows them to remain enthusiastic and emotionally engaged, making each class a pleasurable experience. Regarding exercise during leisure time, modern work patterns—characterized by sedentary, office-bound routines—make post-work or weekend workouts a necessary outlet. Many participants demonstrated a willingness to practice outside of class hours to improve their skills and physical condition. Jackson et al. (2012) found that among high school students, all three forms of efficacy beliefs were positively correlated with their physical education engagement, including effort, enjoyment, and out-of-class activity. This supports the notion that, even in different contexts, self-efficacy and relational-inferred self-efficacy are psychologically interconnected and mutually reinforced through participant–instructor interactions.

The findings of this study offer both theoretical and managerial implications. From a theoretical standpoint, future research should further explore how aerobic instructors perceive and influence each dimension of the triadic efficacy model. Examining the reciprocal psychological dynamics between instructors and participants may yield a deeper understanding of how efficacy beliefs—self-efficacy, other-efficacy, and relational-inferred self-efficacy—collectively shape exercise behavior, participant satisfaction, and the quality of interpersonal relationships. Additionally, relational efficacy beliefs may serve as a mediating mechanism between perceived relationship quality and participation outcomes, suggesting fertile ground for further empirical investigation. From a managerial perspective, this study provides practical insights into how participants interpret their experiences in group fitness classes through the lens of triadic efficacy. These insights can inform fitness centers' strategies for recruiting, evaluating, and developing aerobic instructors. In particular, the findings highlight the importance of not only technical teaching competence but also the ability to adapt instructional approaches to participant needs. Since participants' motivation and engagement are influenced by both the instructor's behavior and the perceived relationship, cultivating self-efficacy and relational-inferred efficacy through thoughtful instructional design and interpersonal sensitivity is essential. Incorporating these elements into instructor training programs can significantly enhance participant adherence, satisfaction, and long-term involvement.

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A Note for Submission

1. The YMC Management Review (YMCMR) is hosted by the YMC Management Association. Articles about management, practical discussions and management cases are all welcome for submission. Three areas are especially encouraged for the paper:
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   - ■ The discussion about practical management.
   - ■ A case study about the management.
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4. No submission fee is charged. Once you submit your paper it will be blind reviewed by two referees. According to the international conventions, all papers published are not to be paid when your paper is accepted.
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