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Comparing the Returns of Holding Stocks in the Dow Jones Index Constant vs. Investing in the Actively Updated Dow Index

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ABSTRACT: This study compares the performance of a frozen Static portfolio of Dow Jones Industrial Average (DJIA) constituents with the actively rebalanced Dynamic Dow across three decades: 1990–1999, 2000–2009, and 2010–2019. The objective is to evaluate whether a passive buy-and-hold strategy can match or exceed the returns of the updated index, and to analyze differences in risk, volatility, drawdowns, and sectoral shifts. Performance was assessed using compound annual growth rate (CAGR), volatility, Sharpe ratios, maximum drawdowns, and maximum runups, supplemented by t-tests and regressions for statistical significance. Results show that while average returns were not statistically different, the Dynamic Dow consistently achieved higher Sharpe ratios and lower volatility. It materially reduced losses during the downturn of 2000–2009 and captured stronger runups in bull markets, reflecting the benefits of constituent replacement. Overall, findings suggest that index reconstitution enhances efficiency, reduces downside risk, and better aligns portfolios with structural economic change.

KEYWORDS: Dow Jones Industrial Average; Index rebalancing; Passive investing; Risk-adjusted returns; Survivorship bias.

1.0 INTRODUCTION

The Dow Jones Industrial Average (DJIA) is one of the most widely recognized stock indices in the world. Created in 1896, it has historically been regarded as a barometer of U.S. economic performance and a benchmark for blue-chip investing. Unlike broader indices such as the S&P 500, the DJIA is composed of only 30 large-cap companies selected by a committee to represent key sectors of the U.S. economy. Importantly, the index is periodically updated: firms that become less representative or underperform are removed, while emerging leaders are added to maintain relevance (S&P Dow Jones Indices, 2020).

This process of reconstitution raises a fundamental question:

Does actively updating the index through constituent changes meaningfully improve long-term returns compared to a purely passive strategy that holds the original stocks constant?

In other words, would an investor who froze the DJIA constituents at the start of a period achieve better or worse results than one who tracked the updated index?

Prior research provides mixed evidence. Studies of index effects suggest that removed firms may later rebound while additions sometimes underperform, questioning the benefit of rebalancing (Cai & Houge, 2007; Chen, Noronha & Singal, 2004). Other research highlights the importance of dividends and weighting methodology in explaining the performance of the DJIA (Lin, Selden, Shoven, & Sialm, 2021). These findings tie into broader financial debates. The Efficient Market Hypothesis (Fama, 1970) argues that such changes should not systematically add value, while passive investing advocates contend that turnover introduces hidden costs and tax burdens (Bogle, 1999). Conversely, proponents of active index design suggest that rebalancing reduces exposure to failing firms and keeps portfolios aligned with structural economic shifts.

The purpose of this study is to evaluate these competing perspectives through an empirical comparison of DJIA investment strategies. Specifically, the objectives of this research are threefold:

1. To compare returns of constant (Static) portfolios versus dynamically updated (Dynamic) portfolios of DJIA constituents across three decades (1990–1999, 2000–2009, 2010–2019).
2. To analyze risk, including volatility, Sharpe ratios, and drawdowns, in order to assess whether active rebalancing provides superior risk-adjusted performance.

3. To assess the implications for index investing, identifying which investors benefit more from Static holding versus Dynamic rebalancing, and under what market conditions.

By systematically addressing these objectives, this study contributes to ongoing debates regarding the relative merits of passive investing and active index rebalancing (Fama & French, 1993; Bogle, 1999). It also provides practical insights for blue-chip investors and portfolio managers, offering evidence on the long-term consequences of index construction and reconstitution strategie

2.0 LITERATURE REVIEW

2.1 Index Construction and Methodology

The Dow Jones Industrial Average (DJIA) is distinctive among major stock indices because it is price-weighted rather than market capitalization-weighted. Its composition is determined by an editorial committee at S&P Dow Jones Indices, which periodically updates the index by replacing constituents to ensure sectoral representation and ongoing relevance (S&P Dow Jones Indices, 2020). This discretionary rebalancing mechanism differentiates it from indices such as the S&P 500, where quantitative rules guide inclusion decisions. Prior studies have highlighted that the index weighting methodology and design have a significant influence on long-term performance outcomes (Lin, Selden, Shoven, & Sialm, 2021). In the case of the DJIA, price-weighting amplifies the influence of higher-priced stocks, potentially creating distortions relative to market-cap-weighted indices.

2.2 Survivorship Bias and Historical Constituents

A major challenge in index performance evaluation is survivorship bias. Many historical analyses only consider firms that remain in the index, thereby ignoring the impact of companies that were deleted. This can overstate long-term performance by excluding underperformers. Research on the Russell 2000 and S&P 500 has shown that deleted firms may often outperform additions in subsequent years (Cai & Houge, 2007). For the DJIA, analyzing "frozen" portfolios of original constituents avoids survivorship bias and provides a direct comparison of *as-selected* portfolios versus *as-updated* indices.

2.3 Static vs. Dynamic Index Performance

Direct comparisons between Static and Dynamic DJIA portfolios are rare, though related work on the S&P 500 and Russell 2000 offers insight. Studies suggest that passive buy-and-hold strategies often perform comparably to, or better than, dynamically rebalanced indices, once transaction costs and tax effects are considered (Cai & Houge, 2007). Lin et al. (2021) demonstrate that dividends and weighting structures account for much of the DJIA's historical return, implying that committee-led rebalancing decisions may have less influence during extended bull markets. This raises questions about whether reconstitution provides a meaningful edge in long-term wealth accumulation.

Jeremy Siegel's research on the S&P 500 over a 50-year horizon similarly found that long-term investors who reinvested dividends outperformed most active strategies, and that the bulk of returns came from dividend compounding rather than short-term index changes (Siegel, *Stocks for the Long Run*; Siegel, "The Long-Run Equity Return"). His findings reinforce the idea that stability and reinvestment, rather than turnover, explain much of large-cap index performance, raising questions about whether reconstitution alone provides a meaningful edge in long-term wealth accumulation. However, Siegel's study has notable limitations that this paper addresses. First, his analysis ends in 2007 and therefore omits the global financial crisis, a period in which rebalancing effects are especially pronounced. Second, Siegel presents an overall long-horizon view rather than breaking performance into discrete decades, which limits insight into how results vary across different market regimes. Third, because his study covers only one long time span, it does not differentiate between outcomes in expansionary versus contractionary decades, whereas this paper highlights such contrasts explicitly.

2.4 Index Rebalancing Effects

The index effect, short-term price movements following additions or deletions, has been extensively studied. Chen, Noronha, and Singal (2004) find asymmetric outcomes: stocks added to the S&P 500 tend to experience short-term price increases that often reverse, while deletions suffer initial losses but later outperform. This evidence challenges the assumption that rebalancing decisions automatically enhance long-term returns. In the DJIA context, rebalancing aims to align the index with evolving economic conditions, but may also result in premature deletions of firms that later recover or undervaluation of new entrants.

2.5 Implications for Passive Investors

From a broader perspective, passive investing theory and the Efficient Market Hypothesis (EMH) (Fama, 1970; Fama & French, 1993) argue that systematic outperformance through rebalancing is unlikely, since markets should already incorporate available information into prices. Instead, turnover imposes costs, both explicit (transaction fees) and implicit (tax drag).

Bogle (1999) emphasizes that long-term wealth accumulation is better served by "staying the course" through passive investing, minimizing unnecessary turnover. For blue-chip investors, the choice between Static and Dynamic strategies is therefore not only about returns but also about risk exposure, drawdown resilience, sector representation, and compounding efficiency.

3.0 DATA AND METHODOLOGY

3.1 Data Sources

This study draws on publicly available historical market data to construct both Static and Dynamic DJIA portfolios.

- **Google Finance and Yahoo Finance** were used to collect stock price and total return data for DJIA constituents, adjusted for splits and dividends.
- **Company-specific sources** (e.g., Honeywell, IBM, Microsoft) were consulted to confirm accuracy and capture corporate actions such as spinoffs, mergers, and delistings.
- **DJIA index-level data** was retrieved from Yahoo Finance to represent the Dynamic portfolio. To account for dividends, a 3% dividend reinvestment assumption was applied across all portfolios to approximate the long-run average yield of Dow blue-chip stocks.

3.2 Timeframe

The analysis covers 30 years, divided into three distinct decades to capture contrasting market regimes:

1. **1990–1999**: A prolonged expansionary bull market.
2. **2000–2009**: A drawdown-heavy decade, marked by the dot-com crash and Global Financial Crisis.
3. **2010–2019**: A sustained recovery and bull market. This division allows for comparisons of performance across different economic environments.

3.3 Portfolio Construction

Static Portfolios:

- Constituents were frozen at the start of each decade (January 1, 1990; January 1, 2000; January 1, 2010).
- Returns for each stock were calculated using price appreciation plus the 3% dividend reinvestment assumption.
- Decade-level performance was summarized through compound annual growth rate (CAGR), volatility, and Sharpe ratios.

Dynamic Portfolios:

- The Dynamic Dow was proxied by the official DJIA total return index, which incorporates periodic rebalancing decisions made by S&P Dow Indices.

Below is a table of companies added/removed over the decades.

Effective Date	Added	Removed
1991	Caterpillar (CAT), J.P. Morgan (JPM), Walt Disney (DIS)	American Can, Navistar, U.S. Steel
1997	Travelers (TRV), Hewlett-Packard (HPQ), Johnson & Johnson (JNJ), Walmart (WMT)	Westinghouse Electric, Texaco, Bethlehem Steel, Woolworth
1999	Microsoft (MSFT), Intel (INTC), SBC Communications (later AT&T/T), Home Depot (HD)	Goodyear, Sears Roebuck, Union Carbide, Chevron
2004	AIG, Pfizer (PFE), Verizon (VZ)	AT&T (old), Eastman Kodak, International Paper
2008	Bank of America (BAC), Chevron (CVX), Kraft Foods (KFT)	Altria, Honeywell (HON), AIG

2009	Cisco (CSCO), Travelers (TRV)	General Motors (GM), Citigroup (C)
2012	UnitedHealth Group (UNH)	Kraft Foods (KFT)
2013	Goldman Sachs (GS), Visa (V), Nike (NKE)	Bank of America (BAC), Hewlett-Packard (HPQ), Alcoa (AA)
2015	Apple (AAPL)	AT&T (T)
2018	Walgreens Boots Alliance (WBA)	General Electric (GE)
2020	Salesforce (CRM), Amgen (AMGN), Honeywell (HON, re-added)	ExxonMobil (XOM), Pfizer (PFE), Raytheon Technologies (RTX)

Changes in DJIA Constituents, 1990–2020 (S&P Dow Jones Indices 2020; "Historical Components of the Dow Jones Industrial Average")

3.4 Performance Metrics

Performance was evaluated using the following measures:

- **Compound Annual Growth Rate (CAGR):**

$$CAGR = \left(\frac{End\ Value \times (1.03^{10})}{Start\ Value}\right)^{1/10} - 1$$

To account for dividends, a **3% reinvestment assumption** was applied across all portfolios, reflecting the long-run average dividend yield of Dow blue-chip stocks (Siegel; "Dow Jones Industrial Average Dividend Yield"; Fama and French).

- **Volatility:** Annualized standard deviation of annual returns. For Static portfolios, volatility was calculated stock-by-stock, averaged, and then aggregated at the portfolio level at a decade level. For Dynamic, index-level volatility was used.
- **Sharpe Ratio:**

$$Sharpe = \frac{R_p - R_f}{\sigma_p}$$

where Rp = arithmetic mean return, Rf = average annualized 3-month Treasury rate for each decade, and σp = portfolio volatility. All of these were averages for each decade.

- **Maximum Drawdown (MDD):** Largest peak-to-trough decline within each decade.
- **Maximum Run-up (MRU):** Largest percentage gain from a trough to the following peak within each decade.

3.5 Statistical Tests

Two complementary approaches were used to test the robustness of results:

- **Welch's Two-Sample t-Test (unequal variances assumed):** Applied to mean annual returns of Static vs. Dynamic portfolios, with the null hypothesis:

$$H_0 : \mu_{Static} = \mu_{Dynamic}$$

- **Regression Analysis:** Static returns regressed on Dynamic returns using the model:

$$R_{Static,t} = \alpha + \beta R_{Dynamic,t} + \epsilon_t$$

where α represents systematic out/underperformance, β captures sensitivity, and R^2 measures co-movement.

Both tests were conducted using Excel's Analysis ToolPak. T-tests provided direct comparisons of mean returns, while regressions revealed decade-specific alphas, betas, and explanatory power.

4.0 RESULTS

4.1 Portfolio Performance Summary

Table 1 presents a summary of Static versus Dynamic portfolio performance across the three decades, including average CAGR, volatility, Sharpe ratio, maximum drawdown, and maximum run-up.

Values below computed through Yahoo/Google Finance as cited in references.

Static Portfolio Summary

Decade	Avg CAGR	Avg Volatility	Avg Sharpe Ratio	Max Drawdown	Max Run-Up
1990-99	15.80%	29.20%	0.375	-10.31%	277.48%
2000-09	-4.90%	34.98%	-0.217	-32.40%	76.05%
2010-19	10.99%	15.80%	0.474	-4.63%	149.37%

Dynamic Portfolio:

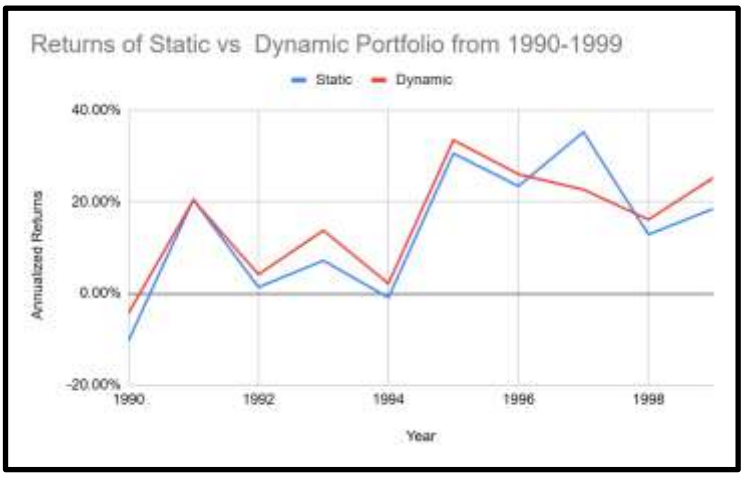
Decade	Avg CAGR	Avg Volatility	Avg Sharpe Ratio	Max Drawdown	Max Run-Up
1990-99	14.99%	18.93%	0.535	-4.34%	336.49%
2000-09	-1.20%	22.09%	-0.176	-33.84%	59.02%
2010-19	10.87%	17.10%	0.603	-5.63%	173.70%

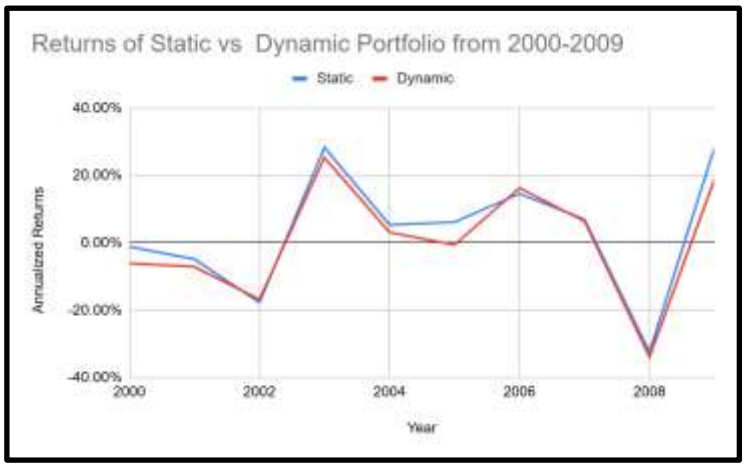
This table highlights the broad similarities in average decadal CAGR across the two strategies, with differences emerging more clearly in volatility and risk-adjusted returns.

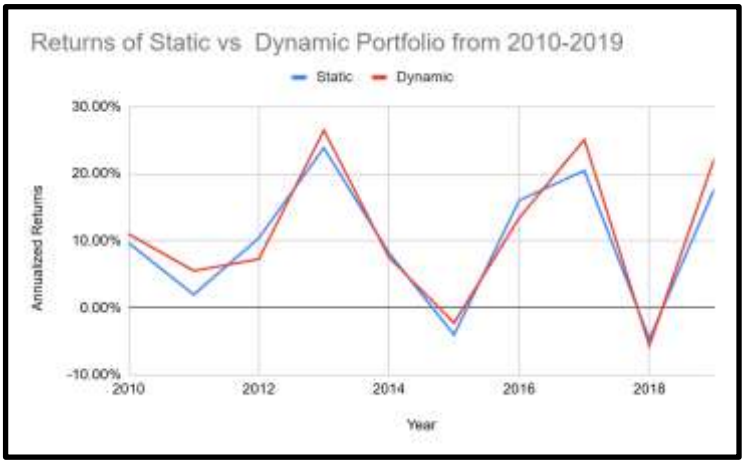
4.2 Risk-Adjusted Performance

The Dynamic portfolio consistently achieved superior risk-adjusted outcomes. Across all decades, its Sharpe ratios (**0.535, –0.176, 0.603**) exceeded those of the Static portfolio (**0.375, –0.217, 0.474**). Similarly, it exhibited lower volatility (**18.93%, 22.09%, 17.10%**) compared to Static (**29.20%, 34.98%, 21.97%**). These findings reflect the effect of rebalancing, where underperforming or highly volatile constituents are replaced, smoothing the overall risk-return profile.

The line graphs demonstrate how the two strategies had similar annualized returns across the three decades, closely following each other, yet different volatilities gave the Dynamic portfolio investors a higher return per unit of risk.







4.3 Long-Run Growth and Downturns

CAGRs were broadly similar in growth decades, with Static slightly outperforming in the 1990s (**15.80% vs. 14.99%**) and both strategies nearly identical in the 2010s (**10.99% vs. 10.87%**). However, in the 2000s downturn, the Dynamic Dow substantially reduced losses (**–1.20% vs. –4.90%**), highlighting the benefit of reconstitution in avoiding bankruptcies and laggards.

4.4 Drawdowns and Runups

Drawdown and runup analysis provide additional insight into risk path dependence. Maximum drawdowns for Static and Dynamic portfolios were **(–10.31%, –4.34%)** in the 1990s, **(–32.40%, –33.84%)** in the 2000s, and **(–4.63%, –5.63%)** in the 2010s. Dynamic generally limited downside losses but both strategies suffered in the 2000s. Maximum runups highlight the opposite effect, with Dynamic capturing stronger upside in expansionary decades (**336.49% vs. 277.48% in the 1990s; 173.70% vs. 149.37% in the 2010s**).

4.5 T-Test Results

Welch's two-sample t-tests were used to test for differences in mean annual returns between Static and Dynamic portfolios. P-values were **0.726 (1990s), 0.737 (2000s), and 0.815 (2010s)**, all above the 5% significance level. These results confirm that while Dynamic produced better risk-adjusted outcomes, the average annualized returns were statistically indistinguishable.

t-Test: Two-Sample Assuming Unequal Variances 1990-1999		
	Static	*Dynamic*
Mean	0.13822	0.15943
Variance	0.021056817	0.01448226
Observations	10	10
Hypothesized Mean Difference	0	
df	17	
t Stat	-0.35578499	
P(T<=t) one-tail	0.363189103	
t Critical one-tail	1.739606726	
P(T<=t) two-tail	0.726378206	
t Critical two-tail	2.109815578	

t-Test: Two-Sample Assuming Unequal Variances 2000-2009		
	Static	*Dynamic*
Mean	0.03361	0.0056
Variance	0.03558585	0.03136473
Observations	10	10
Hypothesized Mean Difference	0	
df	18	
t Stat	0.342322891	
P(T<=t) one-tail	0.368036314	
t Critical one-tail	1.734063607	
P(T<=t) two-tail	0.736072628	
t Critical two-tail	2.10092204	

t-Test: Two-Sample Assuming Unequal Variances 2010-2019		
	Static	*Dynamic*
Mean	0.09974	0.11081
Variance	0.009745436	0.012005465
Observations	10	10
Hypothesized Mean Difference	0	
df	18	
t Stat	-0.237360796	
P(T<=t) one-tail	0.407528754	
t Critical one-tail	1.734063607	
P(T<=t) two-tail	0.815057507	
t Critical two-tail	2.10092204	

4.6 Regression Results

Regression analysis was conducted to examine systematic differences between Static and Dynamic portfolios. Results indicated:

- **1990s:** $\alpha = -0.040$ (not significant), $\beta = 1.119$, $R^2 = 0.862$ → close tracking with no systematic bias.
- **2000s:** $\alpha = 0.0277$ (significant at 5% significance), $\beta = 1.049$, $R^2 = 0.969$ → Static outperformed but closely tracked Dynamic.

2010s: $\alpha = 0.0031$ (not significant), $\beta = 0.873$, $R^2 = 0.938$ → Static less sensitive but strongly correlated.

SUMMARY OUTPUT 1990-1999

Regression Statistics	
Multiple R	0.928332772
R Square	0.861801736
Adjusted R Square	0.844526953
Standard Error	0.057216847
Observations	10

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.163321216	0.16332122	49.8878475	0.000105782
Residual	8	0.02619014	0.00327377		
Total	9	0.189511356			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-0.04024456	0.031077335	-1.29498108	0.23144715	-0.111909025	0.0314199	-0.11190902	0.031419902
Dynamic	1.119391339	0.158483685	7.06313298	0.00010578	0.753927307	1.48485537	0.753927307	1.48485537

SUMMARY OUTPUT 2000-2009

Regression Statistics	
Multiple R	0.984439991
R Square	0.969122096
Adjusted R Square	0.965262359
Standard Error	0.035159188
Observations	10

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.310383301	0.3103833	251.084947	2.51701E-07
Residual	8	0.009889348	0.00123617		
Total	9	0.320272649			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.027737877	0.011124486	2.49340756	0.0373235	0.002084767	0.05339099	0.002084767	0.053390986
Dynamic	1.048593473	0.066175436	15.8456602	2.517E-07	0.895992644	1.2011943	0.895992644	1.201194302

SUMMARY OUTPUT 2010-2019

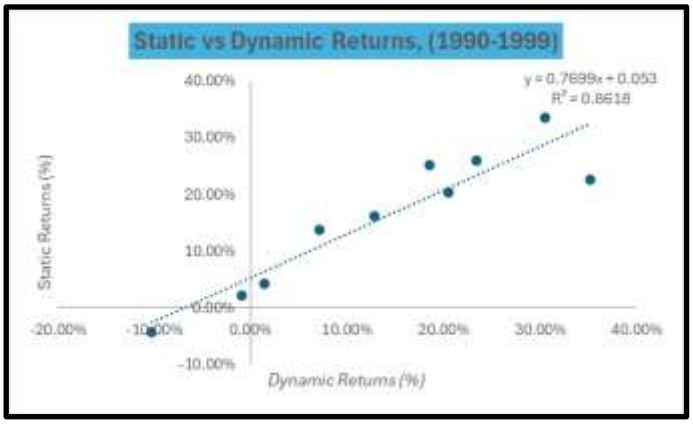
Regression Statistics	
Multiple R	0.968234146
R Square	0.937477361
Adjusted R Square	0.929662031
Standard Error	0.026181562
Observations	10

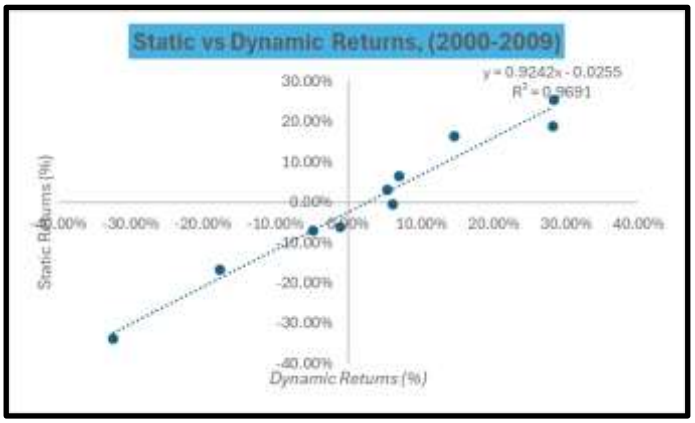
ANOVA

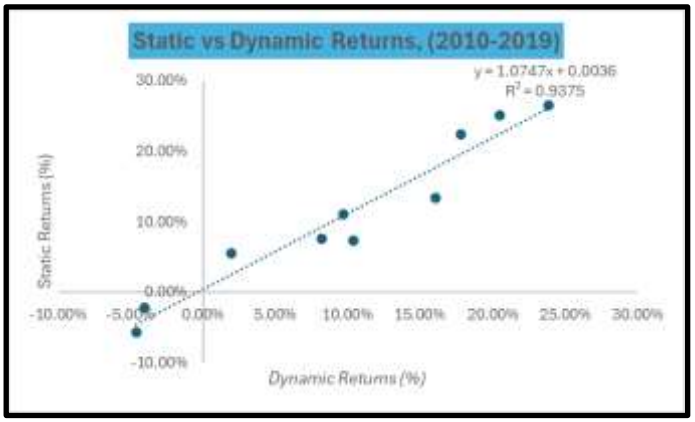
	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.082225131	0.082225131	119.9536512	4.28715E-06
Residual	8	0.005483793	0.000685474		
Total	9	0.087708924			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.003074726	0.012101472	0.254078695	0.805843289	-0.024831319	0.030980771	-0.024831319	0.030980771
Dynamic	0.872351536	0.079649819	10.95233542	4.28715E-06	0.688678724	1.056024349	0.688678724	1.056024349

Scatter plots of Static versus Dynamic returns further illustrate the regression fit and co-movement across decades.







4.7 Interpretation for Investors

For investors, the results indicate that while both Static and Dynamic strategies generate similar long-term average returns, the Dynamic Dow is the **superior choice** for passive investing. By removing failing companies, incorporating new entrants, and reflecting sectoral shifts, the Dynamic Dow consistently provides:

- Higher Sharpe ratios and lower volatility,
- Better downside resilience during downturns, and
- Stronger participation in market recoveries and sectoral rotations.

These results suggest that the **value of index reconstitution lies not in boosting raw returns but in enhancing efficiency, resilience, and adaptability**; characteristics that are especially important for long-term passive investors.

5.0 CONCLUSION

This study compared the performance of Static Dow portfolios, which freeze constituents at the beginning of a decade, with the Dynamic Dow, which incorporates constituent changes as determined by S&P Dow Jones Indices. The analysis covered three decades (1990–1999, 2000–2009, and 2010–2019) and evaluated returns using CAGR, volatility, Sharpe ratio, maximum drawdown, and maximum runup. T-tests and regression analysis were applied to assess statistical significance.

To further illustrate the differences between Static and Dynamic portfolios, we evaluate the growth of an initial **$100 investment** across different horizons.

Investment Horizon	Static Portfolio	Dynamic Portfolio
1990-1999	$339	$418
1990-2009	$400	$379
1990-2019	$997	$1037
2000-2009	$118	$91
2000-2019	$295	$248
2010-2019	$249	$274

This comparison highlights how compounding magnifies even small differences in performance between the Static and Dynamic portfolios. Over the full 1990–2019 horizon, both strategies nearly tenfolded an initial $100, but the Dynamic portfolio ended higher ($1037 vs. $997), reflecting its superior risk-adjusted profile. In the expansionary 1990s, Dynamic significantly outperformed ($418 vs. $339), while in the volatile 2000s, the Static portfolio retained a higher ending value ($118 vs. $91), partly due to differences in sector exposures and constituent replacements during the dot-com and financial crises. By the 2010s, Dynamic again delivered an advantage ($274 vs. $249), benefiting from new entrants such as technology leaders. These results underscore that although long-term absolute returns converge, Dynamic offers greater consistency and resilience, especially when spanning multiple decades, while Static portfolios are more vulnerable to market regime shifts and company failures.

The conclusions of the paper regarding Static versus Dynamic portfolios are thus as follows:

- **Risk-Adjusted Performance:** The Dynamic Dow consistently produced higher Sharpe ratios and lower volatility, suggesting that rebalancing improves efficiency by reducing exposure to distressed or highly volatile companies.
- **Upside Capture:** The Dynamic Dow captured stronger maximum runups in expansionary decades, benefiting from new entrants and sectoral rotation (e.g., technology and healthcare in the 2010s).
- **Drawdowns:** In most cases, Dynamic limited downside risk more effectively than Static, although both portfolios were equally vulnerable to severe market-wide crises (e.g., 2008).
- **Regression Insights:** Static tracked Dynamic closely (R^2 consistently above 0.86), but alpha varied by decade: neutral in the 1990s, positive in the 2000s, and neutral again in the 2010s, showing that deviations are contextual.

Overall, the findings suggest that although Static and Dynamic portfolios deliver broadly similar raw returns, the **Dynamic Dow provides superior risk-adjusted performance, stronger resilience during downturns, and greater alignment with structural economic shifts**. For passive investors, this reinforces the advantage of tracking the rebalanced index rather than freezing constituents, confirming that index reconstitution adds value not by increasing average returns, but by improving the *quality* and *stability* of those returns.

APPENDICES

For the Static Portfolio, below are some companies that were not included in their respective decade, for:

1) Kraft Foods Inc. (removed 2012)- Company split into two, the original ticker is gone: Mondelez International (MDLZ) – global snacks and confectionery; Kraft Foods Group (KRFT) – North American grocery business
2) SBC (removed 2005) – SBC merged with AT&T and adopted AT&T's name/ticker; no CAGR/volatility because SBC ticker no longer trades.
3) Bethlehem Steel (removed 1997) – Bankrupt in 2001; no CAGR/volatility because stock delisted and data ends early.
4) American Can (removed 1991) – Restructured and renamed Primerica/Travelers; no CAGR/volatility because the original ticker was delisted.
5) Westinghouse Electric (removed 1997) – Broke up/sold off divisions; no CAGR/volatility because the original stock delisted.

6) F.W. Woolworth (removed 1997) – Transitioned into Foot Locker; no CAGR/volatility because Woolworth ticker ended.

7) General Motors went bankrupt in 2009 so was considered as a -100% return for the decad

REFERENCES

1. Bogle, John C. *Common Sense on Mutual Funds: New Imperatives for the Intelligent Investor*. Wiley, 1999.
2. Cai, Jie, and Todd Houge. "Long-Term Impact of Russell 2000 Index Rebalancing." *Financial Analysts Journal*, vol. 63, no. 4, 2007, pp. 51–65. JSTOR, https://doi.org/10.2469/faj.v63.n4.4741.
3. Chen, Honghui, Gregory Noronha, and Vijay Singal. "The Price Response to S&P 500 Index Additions and Deletions: Evidence of Asymmetry and a New Explanation." *Journal of Finance*, vol. 59, no. 4, 2004, pp. 1901–29. Wiley Online Library, https://doi.org/10.1111/j.1540-6261.2004.00684.x.
4. Fama, Eugene F. "Efficient Capital Markets: A Review of Theory and Empirical Work." *Journal of Finance*, vol. 25, no. 2, 1970, pp. 383–417. JSTOR, https://doi.org/10.2307/2325486.
5. Fama, Eugene F., and Kenneth R. French. "Common Risk Factors in the Returns on Stocks and Bonds." *Journal of Financial Economics*, vol. 33, no. 1, 1993, pp. 3–56. Elsevier, https://doi.org/10.1016/0304-405X(93)90023-5.
6. Lin, Huaxia, Stephen Selden, John Shoven, and Clemens Sialm. "Replicating the Dow Jones Industrial Average." *NBER Working Paper Series*, no. 28528, 2021, National Bureau of Economic Research, https://doi.org/10.3386/w28528.
7. S&P Dow Jones Indices. *Dow Jones Averages Methodology*. S&P Global, 2020, https://www.spglobal.com/spdji/en/documents/methodologies/methodology-dj-averages.pdf.
8. Siegel, Jeremy J. *Stocks for the Long Run: The Definitive Guide to Financial Market Returns and Long-Term Investment Strategies*. McGraw-Hill, 1994.
9. Siegel, Jeremy J. "The Long-Run Equity Return: A Study of the S&P 500 Over Fifty Years." Wharton School of the University of Pennsylvania, 2007.
10. "Google Finance." Google, https://www.google.com/finance/.
11. "Yahoo Finance." Yahoo, https://finance.yahoo.com