Income-Scaled Monthly Investing: A Historical Counterfactual Study*

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July 2026 — Research Report v1 (audited outputs, terminal valuation 2026-05-29)

Abstract

This paper studies an income-scaled monthly investing rule in which contributions grow with a calendar-year income schedule rather than remaining fixed in dollars. The audited dataset contains 26 tickers and is evaluated through the terminal valuation date reported by the data audit. Primary B starts each asset at its own first investable month, while unified windows use common start and end months for fairer comparison. W2018 is used as the main fair same-window comparison because all configured assets are represented. Within W2018, the highest XIRR row is `NVDA` at 70.98%; in Primary B, the top descriptive XIRR row is `TSLA` at 43.36%. These findings are historical counterfactuals, not a forward-looking asset-selection rule, and are subject to hindsight selection bias and survivorship bias.

1 Introduction

Dollar-cost averaging is often described as fixed-dollar investing. This project instead models a saver whose monthly contribution scales with income over time. That distinction matters because later contributions can become much larger than earlier contributions, so late-cycle market behavior can heavily influence investor outcomes. The study compares historical counterfactual wealth paths under a specified contribution rule; it does not estimate forward-looking expected returns and does not recommend securities. SPY is a strong benchmark because it represents a broad U.S. equity baseline, has long data availability, and is investable through the study period.

2 Research Design

The monthly income path and contribution rule are fixed by project configuration:

- Initial monthly income: 5,000.
- Contribution rate: 30.00%.
- Annual nominal income growth: 5.00%.
- Growth timing: `calendar_year_start`.

*Research and educational purposes only; not investment advice. All results are historical counterfactuals of one configured cash-flow rule on an ex-post asset universe; they carry hindsight selection and survivorship bias by construction and do not constitute a forward-looking selection rule. Every number in this paper is generated from audited output CSV tables.

Execution assumptions are:

- Monthly execution day: `first_trading_day_of_month`.
- Execution price: `adjusted_close`.
- Fractional shares enabled: `True`.
- Transaction costs: 0 bps.
- Tax modeled: `False`.

Primary B starts each asset from its own first investable month and is descriptive when start dates differ. Unified windows use common start and end months; only same-window rows are valid for fair final-value and wealth-multiple ranking. W2018 is the main fair comparison window because all configured assets are represented.

window	requested_start_month	fair_ranking_window
W2000	2000-01	True
W2004	2004-12	True
W2015	2015-11	True
W2018	2018-07	True

3 Data and Audit

The paper is generated from the audited output CSV tables. Data-quality diagnostics are summarized below.

- Number of tickers in `data_audit.csv`: 26.
- Download failure count: 0.
- Missing adjusted-price cells: 0.
- Nonpositive adjusted-price cells: 0.
- Missing first-trading-day observations: 0.
- Terminal valuation date: 2026-05-29.
- `GOOG` lineage: Google_Class_C_or_provider_continuous_series; source: `yfinance:GOOG`.
- `META` lineage: FB_to_META; source: `yfinance:META`.

Compact audit table:

Ticker	First valid	First investable	Terminal	Lineage short
GOOG	2004-08-19	2004-09	2026-05-29	GOOG/provider_continuous
META	2012-05-18	2012-06	2026-05-29	FB_to_META

Full machine-readable data-audit detail remains available in `outputs/tables/data_audit.csv`.

No download failures are reported in `download_failures.csv`.

4 Metrics

The paper separates asset/NAV metrics from investor/cashflow metrics.

- XIRR: money-weighted annualized return using negative monthly contributions and a positive terminal portfolio value.
- TWR CAGR: time-weighted annualized return based on the adjusted-price/NAV path.
- Annualized volatility: variability of the return path, annualized from monthly observations.
- NAV max drawdown: peak-to-trough drawdown of the asset/unitized return path.
- Account value drawdown: peak-to-trough drawdown of the dollar portfolio value, including the effect of external cashflows.
- Below-contribution drawdown: minimum portfolio value divided by cumulative contribution minus one.
- Wealth multiple: final portfolio value divided by total contributions; it is a fair ranking metric only within a same-window comparison.

5 Results: Primary B Descriptive Results

Primary B is descriptive only. Each asset starts from its own first investable month, so Primary B final value is not a fair cross-asset ranking.

Top descriptive rows by XIRR:

Rank	Ticker	Start	Months	Final	XIRR	NAV DD	BCD DD
1	TSLA	2010-07	191	$29.19M	43.36%	-73.17%	-3.79%
2	NVDA	2000-01	317	$355.21M	38.60%	-86.60%	-61.38%
3	AAPL	2000-01	317	$114.28M	31.79%	-78.92%	-56.60%
4	AMZN	2000-01	317	$44.19M	26.14%	-93.28%	-67.77%
5	GOOG	2004-09	261	$12.17M	22.94%	-62.17%	-22.64%
6	META	2012-06	168	$3.27M	22.86%	-75.08%	-23.38%
7	MSFT	2000-01	317	$10.69M	17.58%	-67.39%	-38.89%
8	XLK	2000-01	317	$10.32M	17.36%	-78.50%	-52.33%
18 additional rows omitted							

Top descriptive rows by final value, explicitly descriptive only:

Rank	Ticker	Start	Months	Final	Multiple	XIRR
1	NVDA	2000-01	317	$355.21M	375.20x	38.60%
2	AAPL	2000-01	317	$114.28M	120.71x	31.79%
3	AMZN	2000-01	317	$44.19M	46.68x	26.14%
4	TSLA	2010-07	191	$29.19M	41.36x	43.36%
5	GOOG	2004-09	261	$12.17M	14.24x	22.94%
6	MSFT	2000-01	317	$10.69M	11.30x	17.58%
7	XLK	2000-01	317	$10.32M	10.91x	17.36%
8	WMT	2000-01	317	$5.24M	5.53x	13.05%
18 additional rows omitted						

Long-history examples:

Ticker	Start	Months	Final	XIRR	NAV DD	BCD DD
NVDA	2000-01	317	$355.21M	38.60%	-86.60%	-61.38%
AAPL	2000-01	317	$114.28M	31.79%	-78.92%	-56.60%
AMZN	2000-01	317	$44.19M	26.14%	-93.28%	-67.77%
SPY	2000-01	317	$4.63M	12.25%	-52.90%	-35.11%

6 Results: W2018 Same-Window Fair Comparison

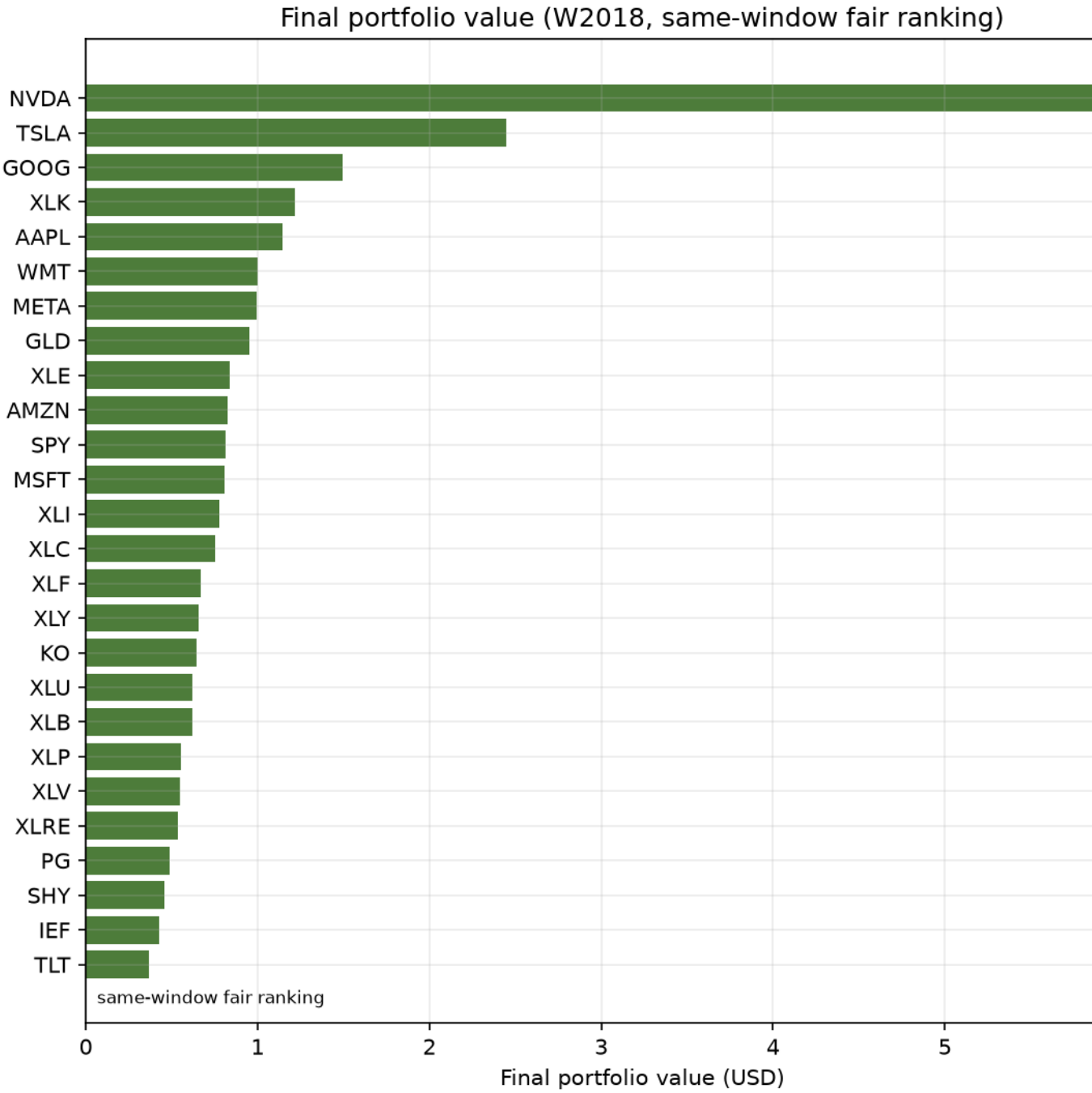
W2018 is the main fair same-window comparison. All W2018 asset rows share the same configured start/end window and the same total contributions. W2018 total contributions represented in the ranking tables: $418,667.22. Final value and wealth multiple are fair ranking metrics only in this same-window setting.

W2018 XIRR ranking:

Rank	Ticker	Final	XIRR	TWR	Vol	NAV DD	BCD DD
1	NVDA	$6.17M	70.98%	56.90%	51.75%	-60.17%	-35.53%
2	TSLA	$2.44M	45.81%	45.61%	75.51%	-73.17%	-37.47%
3	GOOG	$1.49M	32.97%	27.27%	29.43%	-38.50%	-8.36%
4	XLK	$1.21M	27.66%	25.08%	26.66%	-29.75%	-11.30%
5	AAPL	$1.15M	26.16%	28.08%	31.52%	-30.89%	-19.89%
6	WMT	$999.3K	22.65%	21.49%	19.09%	-19.02%	0.00%
7	META	$997.2K	22.59%	15.98%	39.68%	-75.08%	-53.90%
8	GLD	$950.1K	21.35%	17.38%	15.33%	-17.33%	-1.93%
9	XLE	$837.3K	18.10%	9.95%	32.53%	-60.38%	-50.06%
10	AMZN	$828.1K	17.82%	15.66%	32.17%	-50.95%	-26.10%
16 additional rows omitted							

W2018 final value and wealth multiple ranking:

Rank	Ticker	Contrib	Final	Multiple	XIRR	NAV DD
1	NVDA	$418.7K	$6.17M	14.74x	70.98%	-60.17%
2	TSLA	$418.7K	$2.44M	5.84x	45.81%	-73.17%
3	GOOG	$418.7K	$1.49M	3.57x	32.97%	-38.50%
4	XLK	$418.7K	$1.21M	2.90x	27.66%	-29.75%
5	AAPL	$418.7K	$1.15M	2.74x	26.16%	-30.89%
6	WMT	$418.7K	$999.3K	2.39x	22.65%	-19.02%
7	META	$418.7K	$997.2K	2.38x	22.59%	-75.08%
8	GLD	$418.7K	$950.1K	2.27x	21.35%	-17.33%
9	XLE	$418.7K	$837.3K	2.00x	18.10%	-60.38%
10	AMZN	$418.7K	$828.1K	1.98x	17.82%	-50.95%
16 additional rows omitted						


Final portfolio value (W2018, same-window fair ranking)
NVDA
TSLA
GOOG
XLK
AAPL
WMT
META
GLD
XLE
AMZN
SPY
MSFT
XLI
XLC
XLF
XLY
KO
XLU
XLB
XLP
XLV
XLRE
PG
SHY
IEF
TLT
same-window fair ranking
0
1
2
3
4
5
Final portfolio value (USD)

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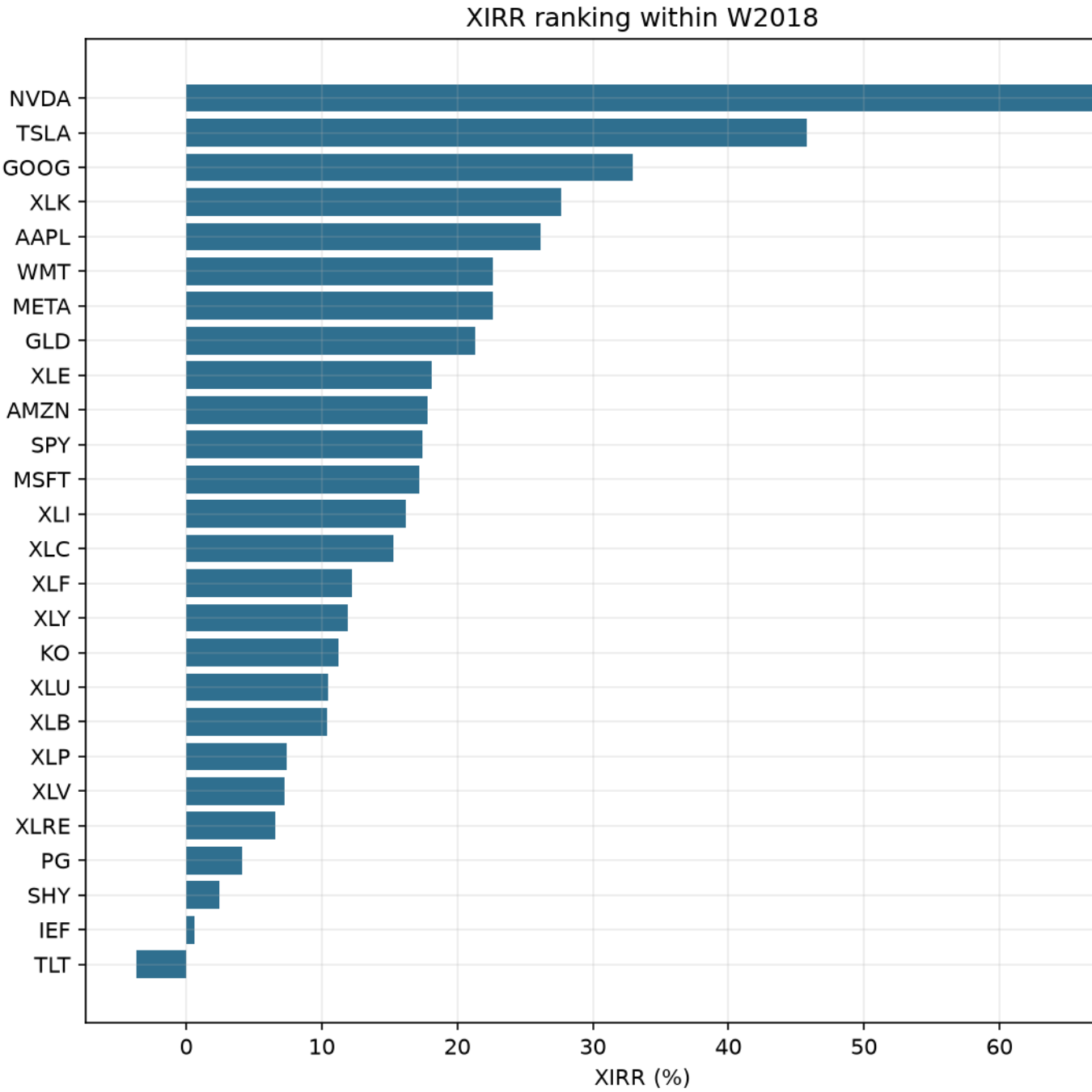
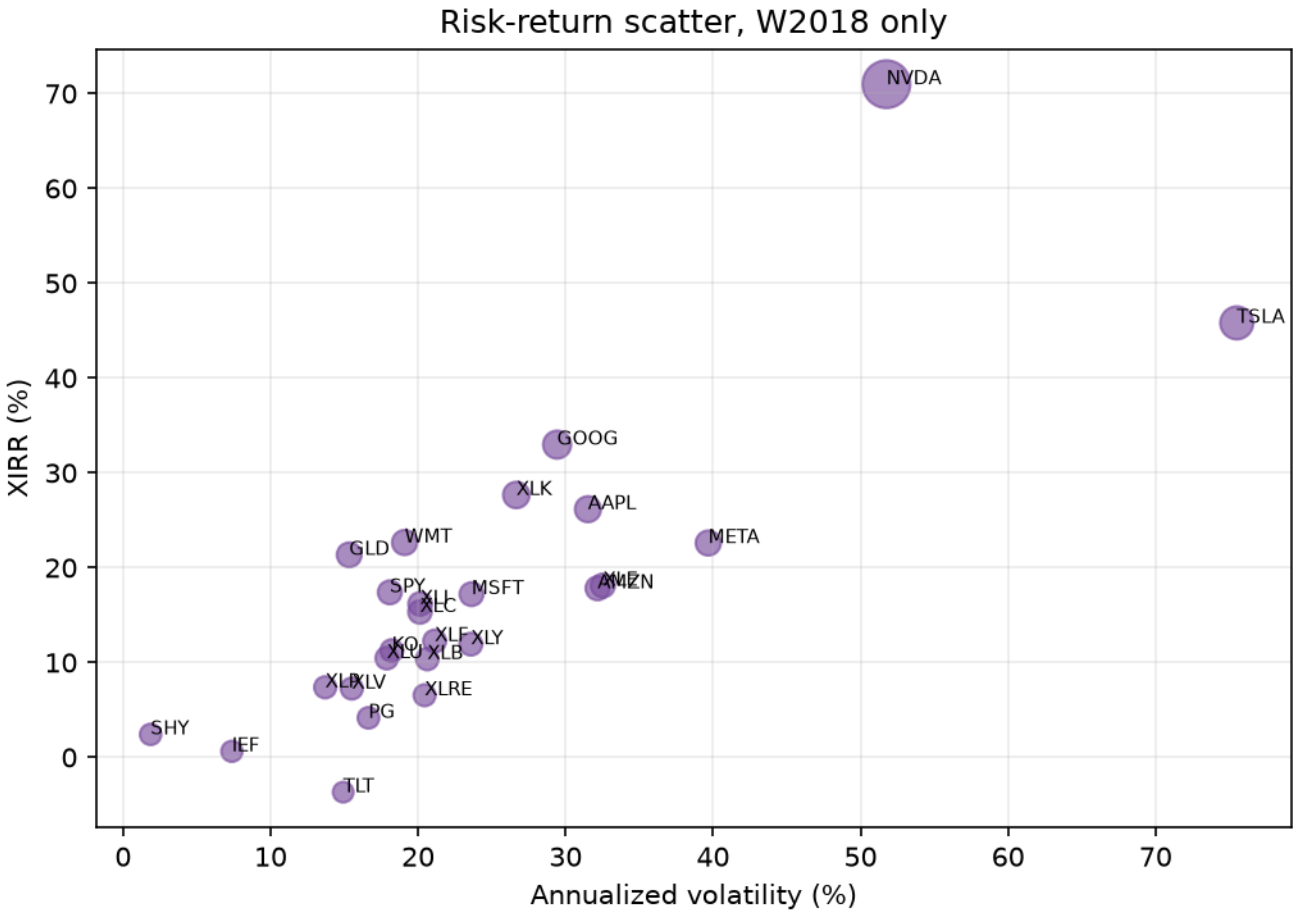
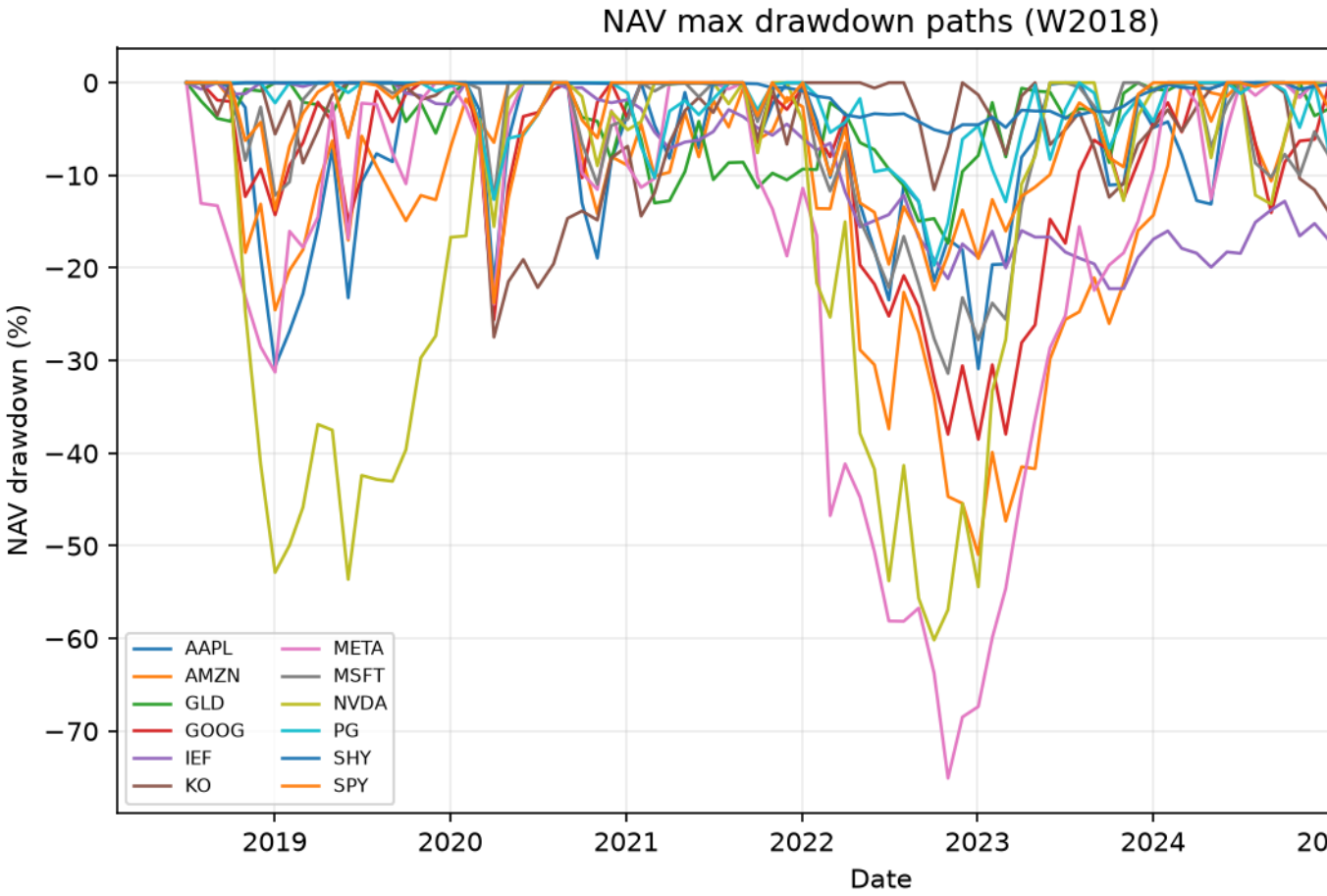

XIRR ranking within W2018
NVDA
TSLA
GOOG
XLK
AAPL
WMT
META
GLD
XLE
AMZN
SPY
MSFT
XLI
XLC
XLF
XLY
KO
XLU
XLB
XLP
XLV
XLRE
PG
SHY
IEF
TLT
0
10
20
30
40
50
60
XIRR (%)

width=85% }

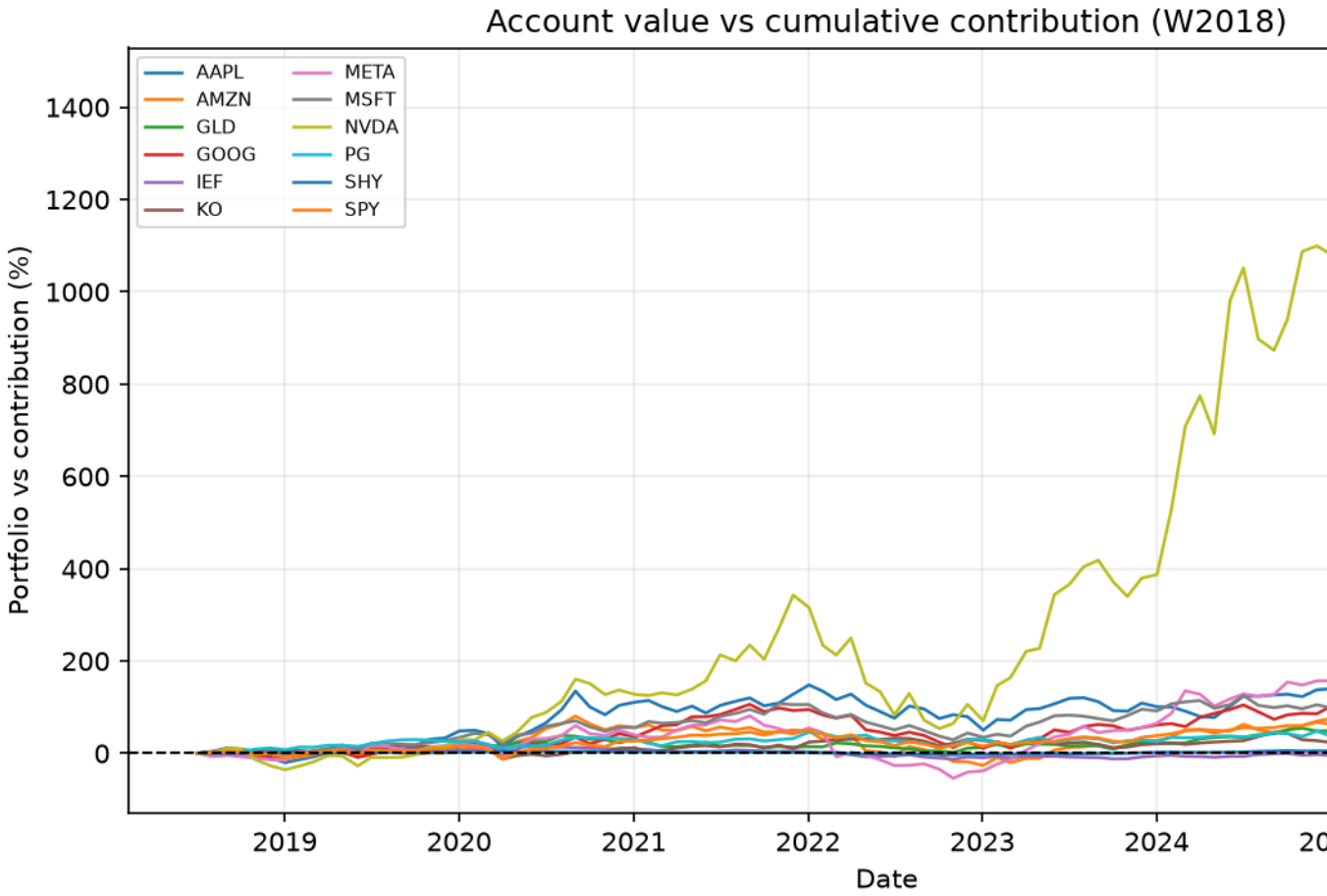

Risk-return scatter, W2018 only
XIRR (%)
Annualized volatility (%)
NVDA
TSLA
GOOG
XLK
AAPL
META
WMT
GLD
SPY
MSFT
XLC
XLF
XLY
XLU
XLB
XLP
XLV
XLRE
PG
SHY
IEF
TLT
0
10
20
30
40
50
60
70

{

width=85% }


NAV max drawdown paths (W2018)
NAV drawdown (%)
0
−10
−20
−30
−40
−50
−60
−70
2019
2020
2021
2022
2023
2024
Date
AAPL
AMZN
GLD
GOOG
IEF
KO
META
MSFT
NVDA
PG
SHY
SPY

width=85% }



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7 Results: Risk and Path Pain

Risk and path pain are not fully summarized by final value. This section compares return metrics with drawdown metrics from W2018 rows.

- **High return / high pain** (7 rows): NVDA, TSLA, AAPL, META, XLE, AMZN, XLI. Median XIRR 22.59%; median BCD DD -35.53%.
- **High return / moderate pain** (6 rows): GOOG, XLK, WMT, GLD, SPY, MSFT. Median XIRR 22.00%; median BCD DD -6.82%.
- **Steady positive return** (7 rows): KO, XLU, XLP, XLV, PG, SHY, IEF. Median XIRR 7.25%; median BCD DD -5.19%.
- **Defensive or low-return assets** (6 rows): XLC, XLF, XLY, XLB, XLRE, TLT. Median XIRR 11.14%; median BCD DD -19.02%.

Selected W2018 rows used in the risk/path discussion:

Ticker	XIRR	Vol	NAV DD	BCD DD	Final
NVDA	70.98%	51.75%	-60.17%	-35.53%	$6.17M
TSLA	45.81%	75.51%	-73.17%	-37.47%	$2.44M
META	22.59%	39.68%	-75.08%	-53.90%	$997.2K
GOOG	32.97%	29.43%	-38.50%	-8.36%	$1.49M
XLK	27.66%	26.66%	-29.75%	-11.30%	$1.21M
AAPL	26.16%	31.52%	-30.89%	-19.89%	$1.15M
WMT	22.65%	19.09%	-19.02%	0.00%	$999.3K
GLD	21.35%	15.33%	-17.33%	-1.93%	$950.1K
SPY	17.39%	18.09%	-23.79%	-12.50%	$814.4K
TLT	-3.68%	14.93%	-46.21%	-28.30%	$365.3K

NVDA and TSLA illustrate very high return with substantial path pain. META, GOOG, XLK, and AAPL show technology-cycle exposure with different drawdown profiles. WMT, GLD, and SPY provide counterexamples where the path and benchmark context matter, while TLT reflects the difficult 2018-2026 rate environment for long-duration Treasury exposure.

8 Benchmark Context

Benchmark rows are historical context anchors under configured components, weights, and rebalance rules. Benchmark rows are not forward-looking recommendations. If benchmark start months differ, final value, net profit, total contributions, and wealth multiple are descriptive rather than fair rankings.

Portfolio	Start	Rebal	Contrib	Final	XIRR	NAV DD	BCD DD
eq_10	2012-06	annual	$646.7K	$7.03M	32.74%	-32.98%	0.00%
60/40	2002-08	annual	$898.2K	$2.53M	9.22%	-28.47%	-11.70%
SPY	2000-01	none	$946.7K	$4.63M	12.25%	-52.90%	-35.11%

Benchmark components and rebalance rules:

- `equal_weight_10_stocks`: AAPL, MSFT, GOOG, META, TSLA, NVDA, AMZN, WMT, KO, PG, 10% each, annual rebalance.
- `sixty_forty_spy_ief`: SPY 60%, IEF 40%, annual rebalance.
- `spy_dca`: SPY 100%, no rebalance.

9 Discussion

The most extreme outcomes are concentrated in super-winner rows such as `NVDA`, but those outcomes were accompanied by severe drawdown exposure and are only visible ex post. Technology-cycle exposure dominates many of the high-return rows, which makes the results sensitive to sector concentration and the selected asset universe. SPY's W2018 row has XIRR 17.39% and final value $814,424.29, making it a strong broad-market baseline. Behavioral feasibility is central: a path with high terminal wealth may require holding through deep NAV and below-contribution

drawdowns. The 5% income-growth assumption causes later contributions to matter more, so the 2020-2026 period has substantial influence on investor-experience metrics. Bond ETF rows are shaped by the 2018-2026 rate environment, especially long-duration exposure. GLD and WMT act as path-risk counterexamples: they can look different from high-growth technology rows even when same-window comparison rules are applied.

10 Limitations

- Hindsight selection bias: the asset list contains assets known after the fact and does not show how they would have been identified in advance.
- Survivorship bias: delisted, failed, merged, or unavailable alternatives are not represented unless they are explicitly present in the input tables.
- Unequal start dates: Primary B descriptive metrics are not fair final-value rankings when first investable months differ.
- Income schedule sensitivity: the configured income-growth path causes later months to receive larger dollar contributions.
- Tax not modeled: outputs are pre-tax and do not model dividends, bond interest, commodity-fund tax treatment, or realized capital gains.
- Adjusted-price dependency: results depend on correct adjusted-price handling for splits, dividends, and ticker lineage.
- Data-source dependency: provider revisions, missing adjusted prices, or lineage treatment can change the generated tables and therefore this report.
- Benchmark caveat: benchmark rows are context comparisons under configured component and rebalance rules, not forward-looking recommendations.
- No transaction costs: the core configuration uses zero transaction costs.
- No behavioral stopping rule: the simulations assume continuous participation through drawdowns.
- No ex-ante asset-selection model: the study does not specify how future winners would have been identified in advance.

11 Conclusion

In this ex-post selected asset universe, income-scaled monthly investing into historical super-winners produced extreme wealth outcomes, but those outcomes were paired with severe drawdowns and are not evidence of a forward-looking selection rule. W2018 is the cleanest fair comparison window because it places the configured assets on the same start/end footing. SPY remains a strong benchmark for interpreting the results. The results should be treated as historical counterfactuals, not investment recommendations.

12 Appendix

12.1 Appendix A. Machine-Readable Source Tables

Full detailed audit, W2018 ranking, and benchmark configuration tables are available as CSV files. They are not repeated as full-width PDF tables because the CSVs are the machine-readable source of truth.

File	Contents
outputs/tables/data_audit.csv	Ticker-level audit, lineage, terminal valuation date, and miss
outputs/tables/download_failures.csv	Any download failures that prevent treating generated outpu
outputs/tables/asset_metrics.csv	Primary B and unified-window asset metrics used in result t
outputs/tables/metrics_by_asset_window.csv	Detailed asset/window rows including fair-ranking flags.
outputs/tables/portfolio_benchmark_metrics.csv	Benchmark metrics, components, weights, and rebalance con
outputs/tables/portfolio_paths.csv	Portfolio path data for chart and path-level reproducibility.

12.2 Appendix B. Compact Audit Status

check	status
Data audit	26 ticker rows; terminal 2026-05-29.
W2018 rows	26 same-window asset rows in CSV outputs.
Benchmark rows	3 configured benchmark rows in CSV outputs.
Full tables	Machine-readable details are intentionally kept in CSV files to avoid PDF table overflow.

12.3 Appendix C. Reproducibility

Regenerate the paper from the repository root:

```
python3 scripts/generate_analysis_report.py
python3 scripts/generate_paper.py
```

The generated Markdown is the source of truth for the PDF.

12.4 Appendix D. Output File List

- `paper/income_dca_paper.md`
- `paper/income_dca_paper.pdf`
- `outputs/reports/income_dca_analysis_report_v1.md`
- `outputs/slides/income_dca_presentation_v1.pptx`
- `outputs/charts/final_value_ranking.png`
- `outputs/charts/xirr_ranking.png`
- `outputs/charts/risk_return_scatter.png`
- `outputs/charts/nav_drawdown.png`
- `outputs/charts/below_contribution_drawdown.png`

12.5 Appendix E. Review and Audit Status Summary

Review	Verdict
final_full_repository_audit_rereview	PASS
real_data_results_audit	PASS
report_ppt_reproducibility_review	PASS

Review	Verdict
report_ppt_polish_v1_1_review	PASS WITH MINOR ISSUES
ppt_caveat_minor_fix_review	PASS