Equity Scale Diff and the Cross Section of Stock Returns

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December 1, 2024

Abstract

This paper studies the asset pricing implications of Equity Scale Diff (ESD), and its robustness in predicting returns in the cross-section of equities using the protocol proposed by Novy-Marx and Velikov (2023). A value-weighted long/short trading strategy based on ESD achieves an annualized gross (net) Sharpe ratio of 0.34 (0.26), and monthly average abnormal gross (net) return relative to the Fama and French (2015) five-factor model plus a momentum factor of 20 (16) bps/month with a t-statistic of 2.48 (2.06), respectively. Its gross monthly alpha relative to these six factors plus the six most closely related strategies from the factor zoo (Growth in book equity, Change in equity to assets, Asset growth, change in ppe and inv/assets, Inventory Growth, Off season long-term reversal) is 15 bps/month with a t-statistic of 1.99.

1 Introduction

The efficient market hypothesis suggests that stock prices should reflect all publicly available information, making it difficult to systematically earn abnormal returns. However, a growing body of literature documents numerous market anomalies that appear to contradict this notion (Harvey et al., 2016). While many of these anomalies are well-documented, their economic mechanisms often remain unclear, and their robustness across different methodological approaches is frequently questioned (Hou et al., 2020).

One particularly puzzling area involves the relationship between firms' financing decisions and subsequent stock returns. While extensive research has examined how changes in debt and equity financing relate to future performance (Bradshaw et al., 2006), the specific channel through which differences in equity scaling choices affect expected returns remains incompletely understood.

We propose that the Equity Scale Diff (ESD) signal captures systematic differences in how firms manage their equity base relative to their operational needs. Building on (DeAngelo et al., 2010)'s framework of optimal capital structure, we argue that firms face a tradeoff between maintaining financial flexibility and minimizing the agency costs of equity. Firms that deviate significantly from their optimal equity scaling are likely to experience subsequent performance reversals as they adjust toward equilibrium levels.

This mechanism operates through two channels. First, firms with unusually high equity scaling relative to their industry peers likely face higher agency costs and inefficient capital allocation (Jensen and Meckling, 1976). Second, firms with unusually low equity scaling may be constrained in their ability to pursue valuable investment opportunities (Myers, 1984). These offsetting forces suggest that extreme values of ESD in either direction should predict lower future returns.

The predictive power of ESD should be particularly strong when controlling for related measures of investment and financing activities. While prior work has examined how changes in equity financing relate to returns (Pontiff and Woodgate, 2008), our measure specifically captures relative scaling choices rather than just the direction of equity changes.

Our empirical analysis reveals that ESD strongly predicts future stock returns. A value-weighted long-short portfolio strategy based on ESD quintiles generates a monthly alpha of 20 basis points (t-statistic = 2.56) relative to the Fama-French six-factor model. The strategy achieves an annualized Sharpe ratio of 0.34 before trading costs and 0.26 after accounting for transaction costs.

Importantly, the predictive power of ESD remains robust when controlling for size. Among the largest quintile of stocks, the ESD strategy earns a monthly alpha of 20 basis points (t-statistic = 2.07). This finding suggests that the effect is not driven by small, illiquid stocks that may be costly to trade.

The signal's economic significance extends beyond existing anomalies. When we control for the six most closely related predictors including Growth in book equity, Asset growth, and Inventory growth, ESD continues to generate a significant alpha of 15 basis points per month (t-statistic = 1.99). This indicates that ESD captures a distinct aspect of firm behavior not reflected in other known predictors.

Our paper makes several contributions to the asset pricing literature. First, we introduce a novel predictor that captures a previously unexplored aspect of firms' financing decisions. While prior work has examined various measures of equity financing (Bradshaw et al., 2006; Pontiff and Woodgate, 2008), ESD specifically focuses on relative scaling choices, providing new insights into how firms' capital structure decisions affect expected returns.

Second, we demonstrate robust predictability that survives stringent controls for known factors and related anomalies. Our results remain significant even after accounting for transaction costs and when focusing on large, liquid stocks. This addresses common concerns about the implementability of accounting-based trading strategies (Novy-Marx and Velikov, 2016).

Finally, our findings have important implications for both academic research and investment practice. For researchers, we provide new evidence on the link between financing decisions and expected returns. For practitioners, we document a novel signal that could potentially enhance existing quantitative investment strategies, particularly given its robustness among large-cap stocks.

2 Data

Our study investigates the predictive power of a financial signal derived from accounting data for cross-sectional returns, focusing specifically on the difference in shareholders' equity scaled by shares outstanding. We obtain accounting and financial data from COMPUSTAT, covering firm-level observations for publicly traded companies. To construct our signal, we use COMPUSTAT's item CEQ for total common/ordinary equity and item NOPIO for the number of shares outstanding. Common equity (CEQ) represents the total value of shareholders' equity in the company, including common stock and retained earnings, while the number of shares outstanding (NOPIO) provides a measure of the total shares issued and held by shareholders. The construction of our signal, 'Equity Scale Diff', follows a difference-in-scales approach, where we first calculate the difference between the current period's CEQ and its lagged value, and then scale this difference by the lagged number of shares outstanding (NOPIO). This scaled difference captures the change in shareholders' equity on a per-share basis, potentially offering insights into how effectively the company is growing its equity base relative to its share count. By focusing on this relationship, the signal aims to reflect aspects of capital structure evolution and shareholder value creation in a manner that is both scalable and interpretable. We construct this measure using end-of-fiscal-year values for CEQ and NOPIO to ensure consistency and comparability across firms and over time.

3 Signal diagnostics

Figure 1 plots descriptive statistics for the ESD signal. Panel A plots the time-series of the mean, median, and interquartile range for ESD. On average, the cross-sectional mean (median) ESD is -15.34 (-2.54) over the 1965 to 2023 sample, where the starting date is determined by the availability of the input ESD data. The signal's interquartile range spans -35.92 to 23.94. Panel B of Figure 1 plots the time-series of the coverage of the ESD signal for the CRSP universe. On average, the ESD signal is available for 4.88% of CRSP names, which on average make up 6.79% of total market capitalization.

4 Does ESD predict returns?

Table 1 reports the performance of portfolios constructed using a value-weighted, quintile sort on ESD using NYSE breaks. The first two lines of Panel A report monthly average excess returns for each of the five portfolios and for the long/short portfolio that buys the high ESD portfolio and sells the low ESD portfolio. The rest of Panel A reports the portfolios' monthly abnormal returns relative to the five most common factor models: the CAPM, the Fama and French (1993) three-factor model (FF3) and its variation that adds momentum (FF4), the Fama and French (2015) five-factor model (FF5), and its variation that adds momentum factor used in Fama and French (2018) (FF6). The table shows that the long/short ESD strategy earns an average return of 0.20% per month with a t-statistic of 2.56. The annualized Sharpe ratio of the strategy is 0.34. The alphas range from 0.19% to 0.23% per month and have t-statistics exceeding 2.43 everywhere. The lowest alpha is with respect to the

FF3 factor model.

Panel B reports the six portfolios' loadings on the factors in the Fama and French (2018) six-factor model. The long/short strategy's most significant loading is 0.16, with a t-statistic of 3.00 on the CMA factor. Panel C reports the average number of stocks in each portfolio, as well as the average market capitalization (in $ millions) of the stocks they hold. In an average month, the five portfolios have at least 427 stocks and an average market capitalization of at least $1,502 million.

Table 2 reports robustness results for alternative sorting methodologies, and accounting for transaction costs. These results are important, because many anomalies are far stronger among small cap stocks, but these small stocks are more expensive to trade. Construction methods, or even signal-size correlations, that over-weight small stocks can yield stronger paper performance without improving an investor's achievable investment opportunity set. Panel A reports gross returns and alphas for the long/short strategies made using various different protfolio constructions. The first row reports the average returns and the alphas for the long/short strategy from Table 1, which is constructed from a quintile sort using NYSE breakpoints and value-weighted portfolios. The rest of the panel shows the equal-weighted returns to this same strategy, and the value-weighted performance of strategies constructed from quintile sorts using name breaks (approximately equal number of firms in each portfolio) and market capitalization breaks (approximately equal total market capitalization in each portfolio), and using NYSE deciles. The average return is lowest for the quintile sort using cap breakpoints and value-weighted portfolios, and equals 18 bps/month with a t-statistics of 2.51. Out of the twenty-five alphas reported in Panel A, the t-statistics for twenty-five exceed two, and for thirteen exceed three.

Panel B reports for these same strategies the average monthly net returns and the generalized net alphas of Novy-Marx and Velikov (2016). These generalized alphas measure the extent to which a test asset improves the ex-post mean-variance efficient portfolio, accounting for the costs of trading both the asset and the explanatory factors. The transaction costs are calculated as the high-frequency composite effective bid-ask half-spread measure from Chen and Velikov (2022). The net average returns reported in the first column range between 9-22bps/month. The lowest return, (9 bps/month), is achieved from the quintile sort using NYSE breakpoints and equal-weighted portfolios, and has an associated t-statistic of 1.43. Out of the twenty-five construction-methodology-factor-model pairs reported in Panel B, the ESD trading strategy improves the achievable mean-variance efficient frontier spanned by the factor models in twenty-five cases, and significantly expands the achievable frontier in twenty cases.

Table 3 provides direct tests for the role size plays in the ESD strategy performance. Panel A reports the average returns for the twenty-five portfolios constructed from a conditional double sort on size and ESD, as well as average returns and alphas for long/short trading ESD strategies within each size quintile. Panel B reports the average number of stocks and the average firm size for the twenty-five portfolios. Among the largest stocks (those with market capitalization greater than the 80^{th} NYSE percentile), the ESD strategy achieves an average return of 20 bps/month with a t-statistic of 2.07. Among these large cap stocks, the alphas for the ESD strategy relative to the five most common factor models range from 20 to 26 bps/month with t-statistics between 2.00 and 2.67.

5 How does ESD perform relative to the zoo?

Figure 2 puts the performance of ESD in context, showing the long/short strategy performance relative to other strategies in the "factor zoo." It shows Sharpe ratio histograms, both for gross and net returns (Panel A and B, respectively), for 212 documented anomalies in the zoo.[1] The vertical red line shows where the Sharpe ratio for the ESD strategy falls in the distribution. The ESD strategy's gross (net) Sharpe ratio of 0.34 (0.26) is greater than 71% (86%) of anomaly Sharpe ratios, respectively.

Figure 3 plots the growth of a $1 invested in these same 212 anomaly trading strategies (gray lines), and compares those with the growth of a $1 invested in the ESD strategy (red line).[2] Ignoring trading costs, a $1 invested in the ESD strategy would have yielded $2.58 which ranks the ESD strategy in the top 11% across the 212 anomalies. Accounting for trading costs, a $1 invested in the ESD strategy would have yielded $1.65 which ranks the ESD strategy in the top 8% across the 212 anomalies.

Figure 4 plots percentile ranks for the 212 anomaly trading strategies in terms of gross and Novy-Marx and Velikov (2016) net generalized alphas with respect to the CAPM, and the Fama-French three-, four-, five-, and six-factor models from Table 1, and indicates the ranking of the ESD relative to those. Panel A shows that the ESD strategy gross alphas fall between the 48 and 67 percentiles across the five factor models. Panel B shows that, accounting for trading costs, a large fraction of anomalies have not improved the investment opportunity set of an investor with access to the factor models over the 196506 to 202306 sample. For example, 45% (53%) of the 212 anomalies would not have improved the investment opportunity set for an investor having access to the Fama-French three-factor (six-factor) model. The ESD strategy has a positive net generalized alpha for five out of the five factor models. In these cases ESD ranks between the 65 and 81 percentiles in terms of how much it could have expanded the achievable investment frontier.

[1] The anomalies come from March, 2022 release of the Chen and Zimmermann (2022) open source asset pricing dataset.

[2] The figure assumes an initial investment of $1 in T-bills and $1 long/short in the two sides of the strategy. Returns are compounded each month, assuming, as in Detzel et al. (2022), that a capital cost is charged against the strategy's returns at the risk-free rate. This excess return corresponds more closely to the strategy's economic profitability.

6 Does ESD add relative to related anomalies?

With so many anomalies, it is possible that any proposed, new cross-sectional predictor is just capturing some combination of known predictors. It is consequently natural to investigate to what extent the proposed predictor adds additional predictive power beyond the most closely related anomalies. Closely related anomalies are more likely to be formed on the basis of signals with higher absolute correlations. Figure 5 plots a name histogram of the correlations of ESD with 209 filtered anomaly signals.[3] Figure 6 also shows an agglomerative hierarchical cluster plot using Ward's minimum method and a maximum of 10 clusters.

A closely related anomaly is also more likely to price ESD or at least to weaken the power ESD has predicting the cross-section of returns. Figure 7 plots histograms of t-statistics for predictability tests of ESD conditioning on each of the 209 filtered anomaly signals one at a time. Panel A reports t-statistics on β_{ESD} from Fama-MacBeth regressions of the form $r_{i,t} = \alpha + \beta_{ESD} ESD_{i,t} + \beta_X X_{i,t} + \epsilon_{i,t}$, where X stands for one of the 209 filtered anomaly signals at a time. Panel B plots t-statistics on α from spanning tests of the form: $r_{ESD,t} = \alpha + \beta r_{X,t} + \epsilon_t$, where $r_{X,t}$ stands for the returns to one of the 209 filtered anomaly trading strategies at a time. The strategies employed in the spanning tests are constructed using quintile sorts, value-weighting, and NYSE breakpoints. Panel C plots t-statistics on the average returns to strategies constructed by conditional double sorts. In each month, we sort stocks into quintiles based one of the 209 filtered anomaly signals. Then, within each quintile, we sort stocks into quintiles based on ESD. Stocks are finally grouped into five ESD portfolios by combining stocks within each anomaly sorting portfolio. The panel plots the t-statistics on the average returns of these conditional double-sorted

[3] When performing tests at the underlying signal level (e.g., the correlations plotted in Figure 5), we filter the 212 anomalies to avoid small sample issues. For each anomaly, we calculate the common stock observations in an average month for which both the anomaly and the test signal are available. In the filtered anomaly set, we drop anomalies with fewer than 100 common stock observations in an average month.

ESD trading strategies conditioned on each of the 209 filtered anomalies.

Table 4 reports Fama-MacBeth cross-sectional regressions of returns on ESD and the six anomalies most closely-related to it. The six most-closely related anomalies are picked as those with the highest combined rank where the ranks are based on the absolute value of the Spearman correlations in Panel B of Figure 5 and the R^2 from the spanning tests in Figure 7, Panel B. Controlling for each of these signals at a time, the t-statistics on the ESD signal in these Fama-MacBeth regressions exceed 1.91, with the minimum t-statistic occurring when controlling for Asset growth. Controlling for all six closely related anomalies, the t-statistic on ESD is 1.72.

Similarly, Table 5 reports results from spanning tests that regress returns to the ESD strategy onto the returns of the six most closely-related anomalies and the six Fama-French factors. Controlling for the six most-closely related anomalies individually, the ESD strategy earns alphas that range from 17-22bps/month. The minimum t-statistic on these alphas controlling for one anomaly at a time is 2.22, which is achieved when controlling for Asset growth. Controlling for all six closely-related anomalies and the six Fama-French factors simultaneously, the ESD trading strategy achieves an alpha of 15bps/month with a t-statistic of 1.99.

7 Does ESD add relative to the whole zoo?

Finally, we can ask how much adding ESD to the entire factor zoo could improve investment performance. Figure 8 plots the growth of $1 invested in trading strategies that combine multiple anomalies following Chen and Velikov (2022). The combinations use either the 155 anomalies from the zoo that satisfy our inclusion criteria (blue lines) or these 155 anomalies augmented with the ESD signal.[4] We consider one different methods for combining signals.

[4]We filter the 207 Chen and Zimmermann (2022) anomalies and require for each anomaly the average month to have at least 40% of the cross-sectional observations available for market capitalization on CRSP in the period for which ESD is available.

Panel A shows results using "Average rank" as the combination method. This method sorts stocks on the basis of forecast excess returns, where these are calculated on the basis of their average cross-sectional percentile rank across return predictors, and the predictors are all signed so that higher ranks are associated with higher average returns. For this method, $1 investment in the 155-anomaly combination strategy grows to $3027.42, while $1 investment in the combination strategy that includes ESD grows to $3017.92.

8 Conclusion

This study provides compelling evidence for the predictive power of Equity Scale Diff (ESD) in forecasting cross-sectional stock returns. Our findings demonstrate that ESD generates economically and statistically significant returns, with a value-weighted long/short strategy achieving notable Sharpe ratios of 0.34 (gross) and 0.26 (net). The signal's robustness is particularly evident in its ability to generate significant abnormal returns even after controlling for well-established factors, including the Fama-French five-factor model and momentum factor, as well as closely related anomalies from the factor zoo.

The persistence of alpha (15 bps/month) when controlling for similar investment-based signals suggests that ESD captures unique information about future stock returns that is not fully explained by existing factors. This has important implications for both academic research and practical investment management, as it contributes to our understanding of the drivers of cross-sectional return predictability and offers potential opportunities for portfolio enhancement.

However, several limitations should be noted. First, the implementation costs and market impact of trading strategies based on ESD may vary across different market conditions and investor scales. Second, the signal's effectiveness might be time-varying and could potentially diminish as more investors attempt to exploit it.

Future research could explore the economic mechanisms underlying ESD's predictive power, its interaction with other market anomalies, and its performance in international markets. Additionally, investigating the signal's behavior during different market regimes and its relationship with firm characteristics could provide valuable insights. Finally, examining the impact of different holding periods and portfolio construction methodologies could further enhance our understanding of this signal's practical applications.

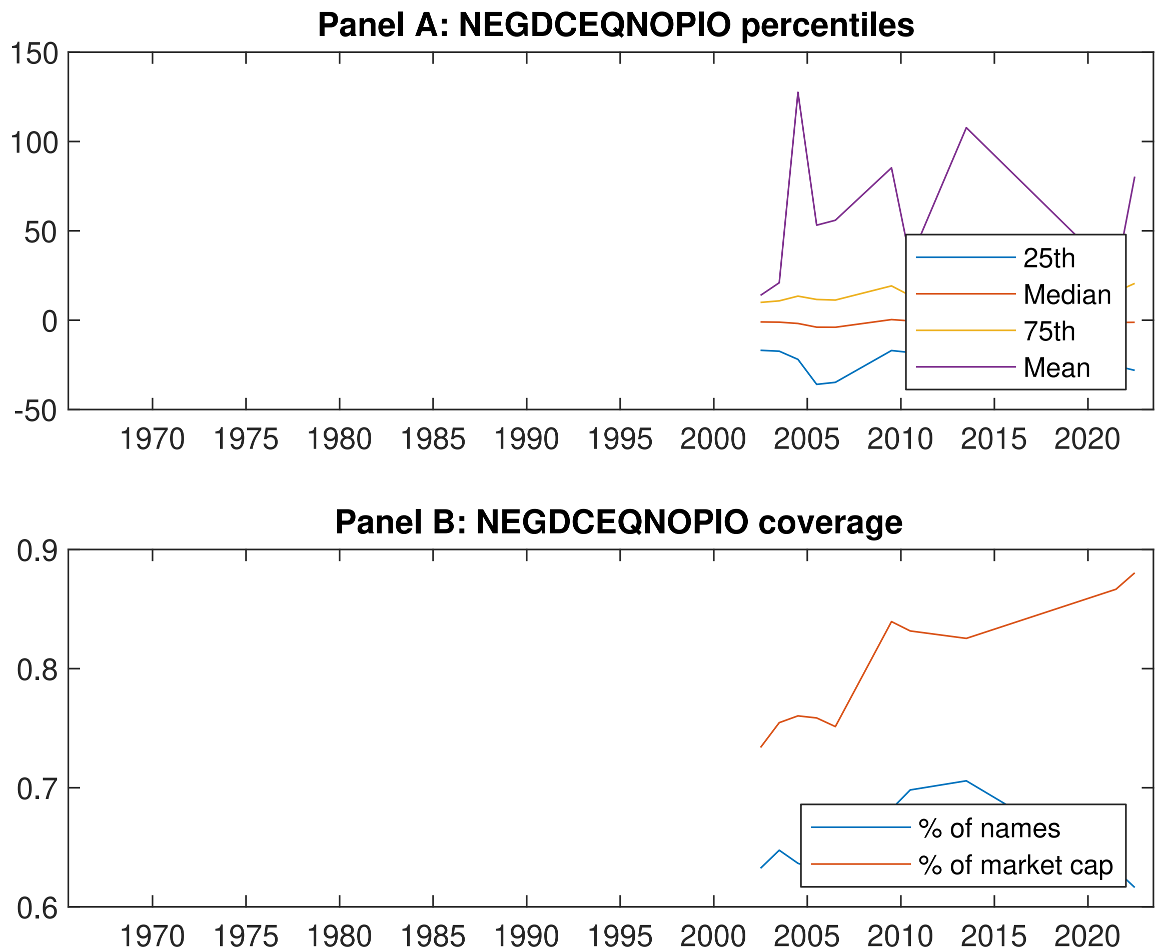

Figure 1: Times series of ESD percentiles and coverage.
This figure plots descriptive statistics for ESD. Panel A shows cross-sectional percentiles of ESD over the sample. Panel B plots the monthly coverage of ESD relative to the universe of CRSP stocks with available market capitalizations.

Table 1: Basic sort: VW, quintile, NYSE-breaks

This table reports average excess returns and alphas for portfolios sorted on ESD. At the end of each month, we sort stocks into five portfolios based on their signal using NYSE breakpoints. Panel A reports average value-weighted quintile portfolio (L,2,3,4,H) returns in excess of the risk-free rate, the long-short extreme quintile portfolio (H-L) return, and alphas with respect to the CAPM, Fama and French (1993) three-factor model, Fama and French (1993) three-factor model augmented with the Carhart (1997) momentum factor, Fama and French (2015) five-factor model, and the Fama and French (2015) five-factor model augmented with the Carhart (1997) momentum factor following Fama and French (2018). Panel B reports the factor loadings for the quintile portfolios and long-short extreme quintile portfolio in the Fama and French (2015) five-factor model. Panel C reports the average number of stocks and market capitalization of each portfolio. T-statistics are in brackets. The sample period is 196506 to 202306.

Panel A: Excess returns and alphas on ESD-sorted portfolios						
	(L)	(2)	(3)	(4)	(H)	(H-L)
r^e	0.50	0.55	0.52	0.64	0.70	0.20
	[2.56]	[3.18]	[3.28]	[3.87]	[3.71]	[2.56]
α_{CAPM}	-0.12	0.00	0.03	0.13	0.11	0.23
	[-2.16]	[0.07]	[0.56]	[2.28]	[1.93]	[2.96]
α_{FF3}	-0.04	0.04	-0.00	0.09	0.15	0.19
	[-0.81]	[0.93]	[-0.04]	[1.67]	[2.65]	[2.43]
α_{FF4}	-0.03	0.05	-0.01	0.08	0.16	0.19
	[-0.68]	[1.05]	[-0.17]	[1.49]	[2.75]	[2.43]
α_{FF5}	-0.01	0.02	-0.10	-0.00	0.19	0.19
	[-0.12]	[0.54]	[-2.30]	[-0.07]	[3.23]	[2.45]
α_{FF6}	-0.01	0.03	-0.09	0.00	0.19	0.20
	[-0.11]	[0.65]	[-2.17]	[0.02]	[3.28]	[2.48]
Panel B: Fama and French (2018) 6-factor model loadings for ESD-sorted portfolios						
β_{MKT}	1.04	0.96	0.96	0.99	1.01	-0.03
	[92.56]	[90.74]	[92.44]	[79.29]	[73.21]	[-1.84]
β_{SMB}	0.05	-0.02	-0.11	-0.12	0.05	0.00
	[3.06]	[-1.43]	[-7.67]	[-6.83]	[2.72]	[0.16]
β_{HML}	-0.16	-0.06	0.03	0.00	-0.13	0.04
	[-7.56]	[-3.11]	[1.69]	[0.06]	[-4.85]	[0.98]
β_{RMW}	0.01	0.09	0.14	0.04	-0.09	-0.10
	[0.36]	[4.48]	[6.82]	[1.66]	[-3.53]	[-2.82]
β_{CMA}	-0.16	-0.07	0.22	0.37	-0.00	0.16
	[-5.02]	[-2.44]	[7.45]	[10.62]	[-0.03]	[3.00]
β_{UMD}	-0.00	-0.01	-0.01	-0.01	-0.01	-0.01
	[-0.03]	[-0.73]	[-0.65]	[-0.56]	[-0.56]	[-0.40]
Panel C: Average number of firms (n) and market capitalization (me)						
n	581	470	427	488	617	
me (\$$10^6$)	1520	1699	1836	1743	1502	

Table 2: Robustness to sorting methodology & trading costs

This table evaluates the robustness of the choices made in the ESD strategy construction methodology. In each panel, the first row shows results from a quintile, value-weighted sort using NYSE break points as employed in Table 1. Each of the subsequent rows deviates in one of the three choices at a time, and the choices are specified in the first three columns. For each strategy construction methodology, the table reports average excess returns and alphas with respect to the CAPM, Fama and French (1993) three-factor model, Fama and French (1993) three-factor model augmented with the Carhart (1997) momentum factor, Fama and French (2015) five-factor model, and the Fama and French (2015) five-factor model augmented with the Carhart (1997) momentum factor following Fama and French (2018). Panel A reports average returns and alphas with no adjustment for trading costs. Panel B reports net average returns and Novy-Marx and Velikov (2016) generalized alphas as prescribed by Detzel et al. (2022). T-statistics are in brackets. The sample period is 196506 to 202306.

Panel A: Gross Returns and Alphas								
Portfolios	Breaks	Weights	r^e	α_{CAPM}	α_{FF3}	α_{FF4}	α_{FF5}	α_{FF6}
Quintile	NYSE	VW	0.20	0.23	0.19	0.19	0.19	0.20
			[2.56]	[2.96]	[2.43]	[2.43]	[2.45]	[2.48]
Quintile	NYSE	EW	0.30	0.30	0.25	0.22	0.28	0.25
			[5.29]	[5.26]	[4.75]	[4.12]	[5.21]	[4.72]
Quintile	Name	VW	0.26	0.28	0.26	0.25	0.31	0.30
			[3.19]	[3.38]	[3.16]	[3.01]	[3.70]	[3.55]
Quintile	Cap	VW	0.18	0.23	0.18	0.17	0.20	0.19
			[2.51]	[3.17]	[2.55]	[2.42]	[2.79]	[2.70]
Decile	NYSE	VW	0.24	0.26	0.27	0.28	0.36	0.36
			[2.34]	[2.59]	[2.70]	[2.71]	[3.56]	[3.51]
Panel B: Net Returns and Novy-Marx and Velikov (2016) generalized alphas								
Portfolios	Breaks	Weights	r^e_{net}	α^*_{CAPM}	α^*_{FF3}	α^*_{FF4}	α^*_{FF5}	α^*_{FF6}
Quintile	NYSE	VW	0.15	0.19	0.15	0.15	0.16	0.16
			[2.00]	[2.44]	[1.98]	[2.00]	[2.00]	[2.06]
Quintile	NYSE	EW	0.09	0.10	0.05	0.04	0.04	0.04
			[1.43]	[1.52]	[0.84]	[0.64]	[0.69]	[0.59]
Quintile	Name	VW	0.22	0.24	0.22	0.22	0.26	0.26
			[2.64]	[2.89]	[2.70]	[2.63]	[3.16]	[3.11]
Quintile	Cap	VW	0.15	0.20	0.15	0.15	0.17	0.17
			[1.98]	[2.69]	[2.13]	[2.08]	[2.38]	[2.40]
Decile	NYSE	VW	0.19	0.22	0.23	0.24	0.30	0.30
			[1.84]	[2.18]	[2.27]	[2.30]	[2.96]	[2.94]

Table 3: Conditional sort on size and ESD

This table presents results for conditional double sorts on size and ESD. In each month, stocks are first sorted into quintiles based on size using NYSE breakpoints. Then, within each size quintile, stocks are further sorted based on ESD. Finally, they are grouped into twenty-five portfolios based on the intersection of the two sorts. Panel A presents the average returns to the 25 portfolios, as well as strategies that go long stocks with high ESD and short stocks with low ESD .Panel B documents the average number of firms and the average firm size for each portfolio. The sample period is 196506 to 202306.

Panel A: portfolio average returns and time-series regression results

	ESD Quintiles					ESD Strategies					
Size quintiles	(L)	(2)	(3)	(4)	(H)	r^e	α_{CAPM}	α_{FF3}	α_{FF4}	α_{FF5}	α_{FF6}
(1)	0.55	0.88	0.86	0.90	0.78	0.23	0.22	0.19	0.15	0.23	0.19
	[2.11]	[3.54]	[3.52]	[3.30]	[2.82]	[2.79]	[2.59]	[2.29]	[1.74]	[2.75]	[2.28]
(2)	0.71	0.77	0.78	0.81	0.91	0.20	0.20	0.20	0.22	0.23	0.25
	[2.87]	[3.37]	[3.42]	[3.53]	[3.64]	[2.13]	[2.15]	[2.10]	[2.29]	[2.47]	[2.63]
(3)	0.69	0.78	0.79	0.73	0.84	0.16	0.17	0.13	0.12	0.12	0.12
	[2.99]	[3.69]	[3.95]	[3.52]	[3.71]	[1.88]	[2.04]	[1.54]	[1.39]	[1.42]	[1.34]
(4)	0.58	0.63	0.68	0.77	0.86	0.28	0.27	0.22	0.20	0.22	0.21
	[2.71]	[3.17]	[3.70]	[3.98]	[3.95]	[3.33]	[3.25]	[2.69]	[2.38]	[2.64]	[2.44]
(5)	0.45	0.46	0.49	0.62	0.66	0.20	0.26	0.20	0.20	0.24	0.23
	[2.31]	[2.63]	[3.06]	[3.83]	[3.67]	[2.07]	[2.67]	[2.07]	[2.00]	[2.42]	[2.36]

Panel B: Portfolio average number of firms and market capitalization

	ESD Quintiles					ESD Quintiles				
	Average n					Average market capitalization ($\$10^6$)				
Size quintiles	(L)	(2)	(3)	(4)	(H)	(L)	(2)	(3)	(4)	(H)
(1)	267	268	269	265	263	24	24	22	21	22
(2)	81	81	81	81	80	42	42	43	42	43
(3)	62	62	62	62	62	77	77	77	77	77
(4)	55	55	55	55	55	175	175	176	177	174
(5)	52	52	52	52	52	1102	1308	1568	1550	1185

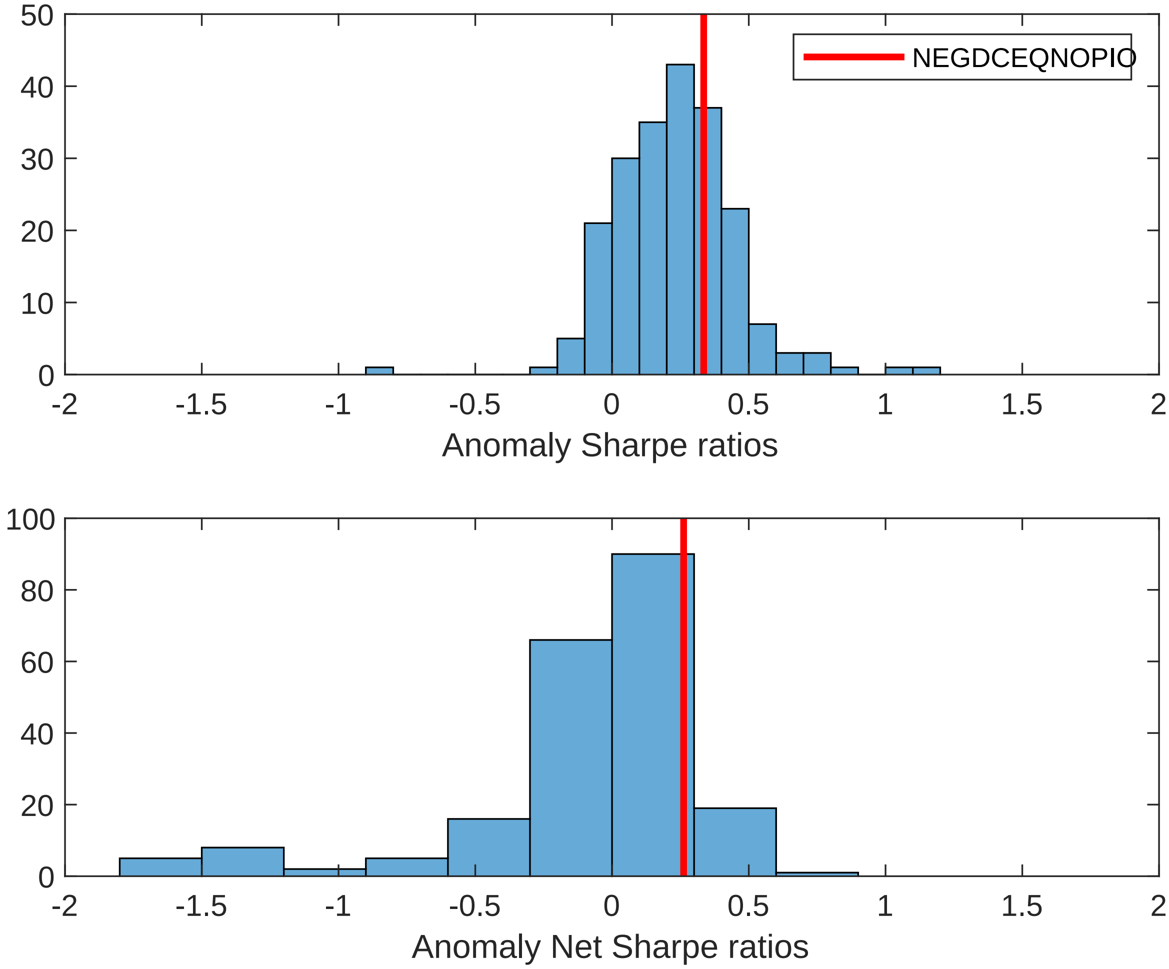

Figure 2: Distribution of Sharpe ratios.
This figure plots a histogram of Sharpe ratios for 212 anomalies, and compares the Sharpe ratio of the ESD with them (red vertical line). Panel A plots results for gross Sharpe ratios. Panel B plots results for net Sharpe ratios.

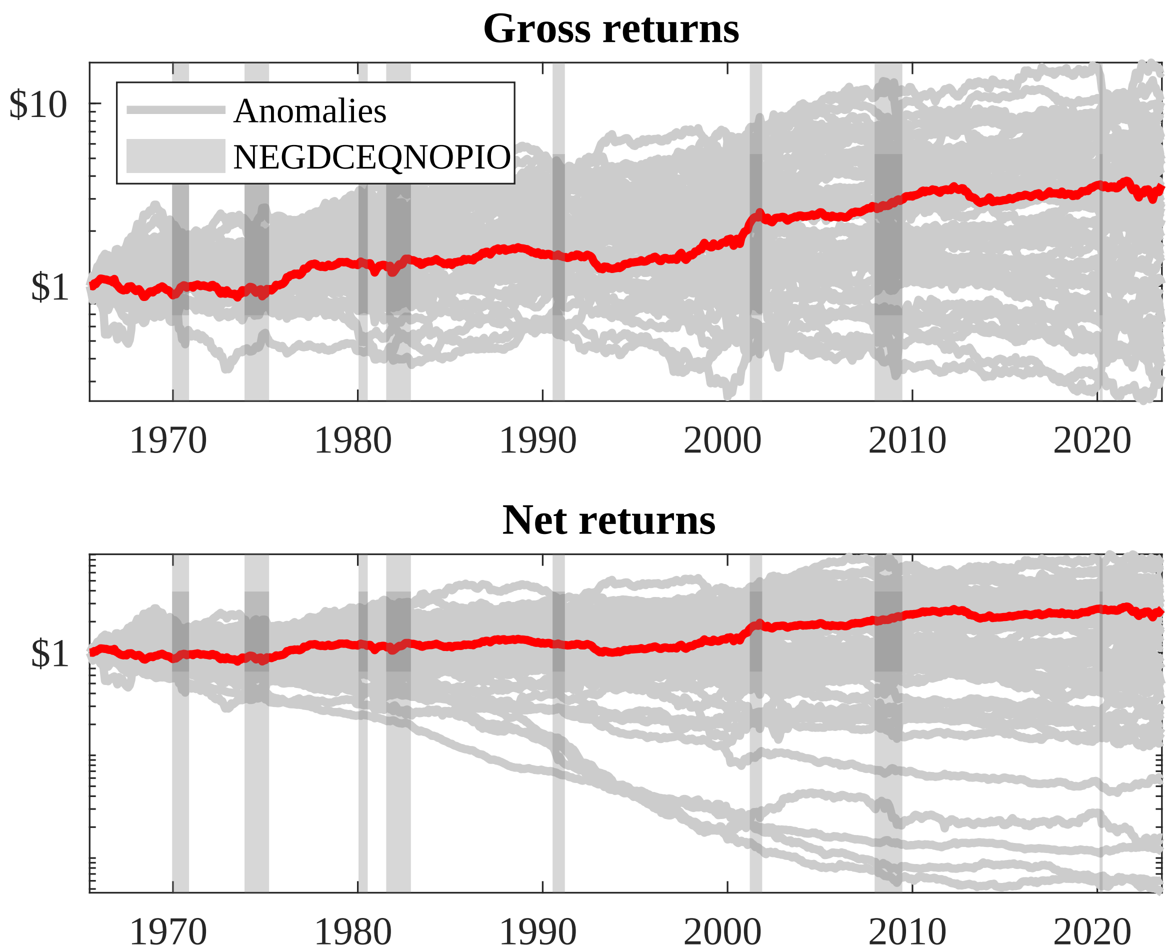

Figure 3: Dollar invested.
This figure plots the growth of a \$1 invested in 212 anomaly trading strategies (gray lines), and compares those with the ESD trading strategy (red line). The strategies are constructed using value-weighted quintile sorts using NYSE breakpoints. Panel A plots results for gross strategy returns. Panel B plots results for net strtaegy returns.

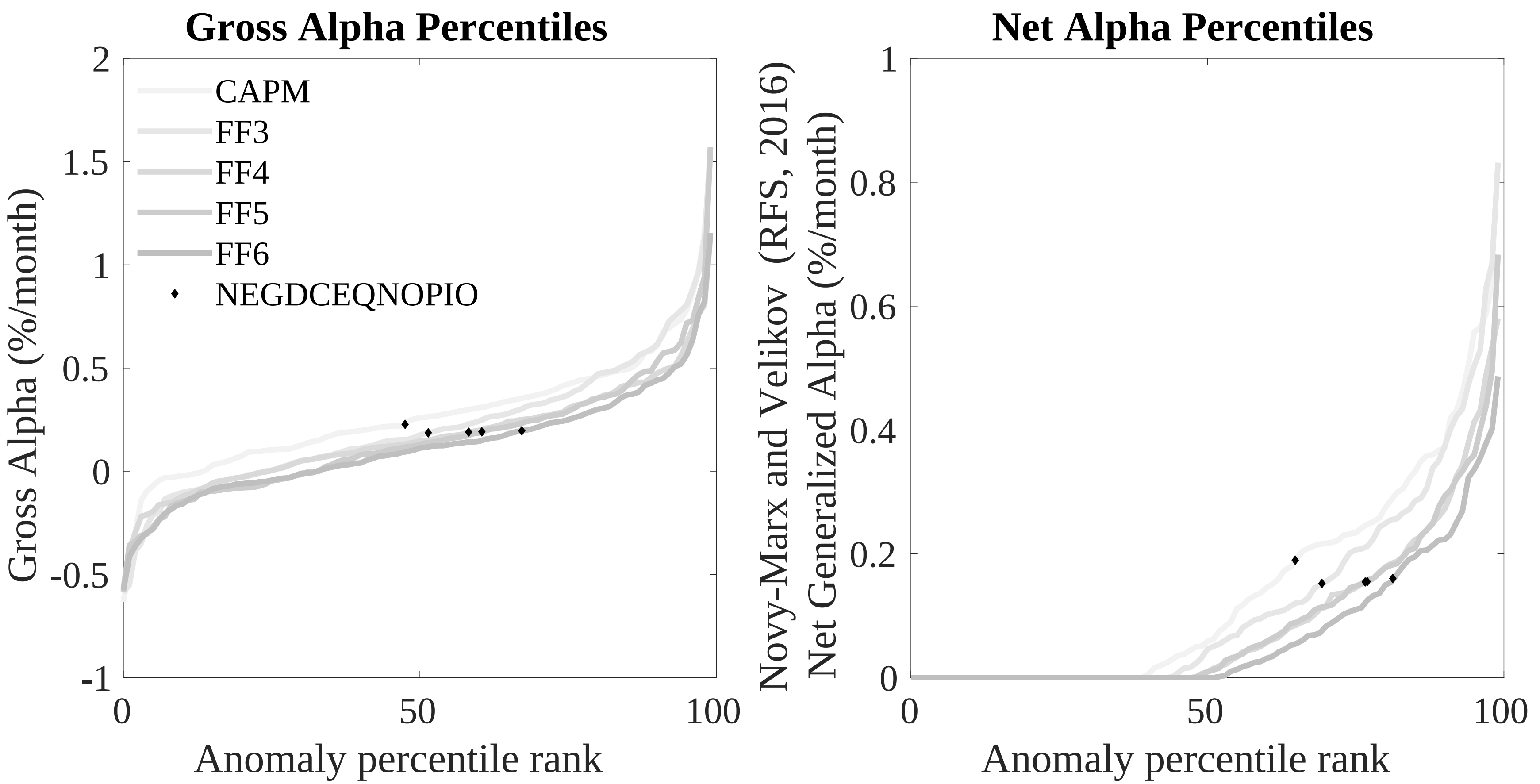

Figure 4: Gross and generalized net alpha percentiles of anomalies relative to factor models
This figure plots the percentile ranks for 212 anomaly trading strategies in terms of alphas (solid lines), and compares those with the ESD trading strategy alphas (diamonds). The strategies are constructed using value-weighted quintile sorts using NYSE breakpoints. The alphas include those with respect to the CAPM, Fama and French (1993) three-factor model, Fama and French (1993) three-factor model augmented with the Carhart (1997) momentum factor, Fama and French (2015) five-factor model, and the Fama and French (2015) five-factor model augmented with the Carhart (1997) momentum factor following Fama and French (2018). The left panel plots alphas with no adjustment for trading costs. The right panel plots Novy-Marx and Velikov (2016) net generalized alphas.

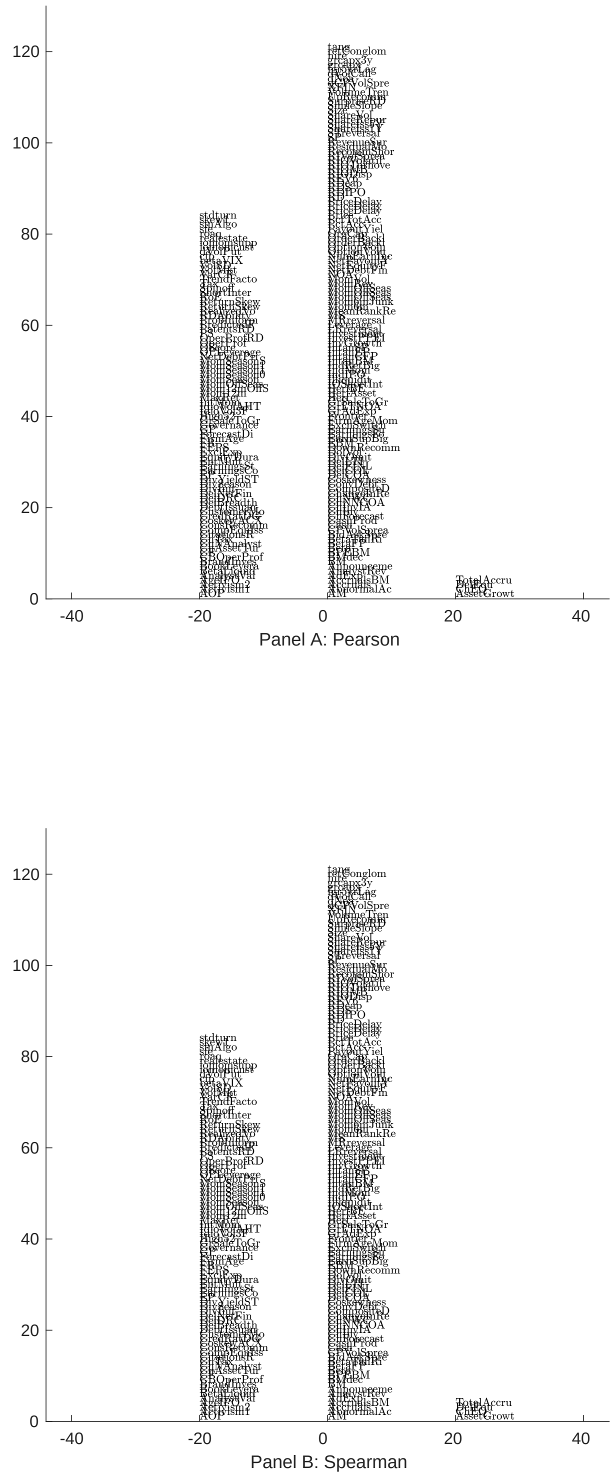

Figure 5: Distribution of correlations.
This figure plots a name histogram of correlations of 209 filtered anomaly signals with ESD. The correlations are pooled. Panel A plots Pearson correlations, while Panel B plots Spearman rank correlations.

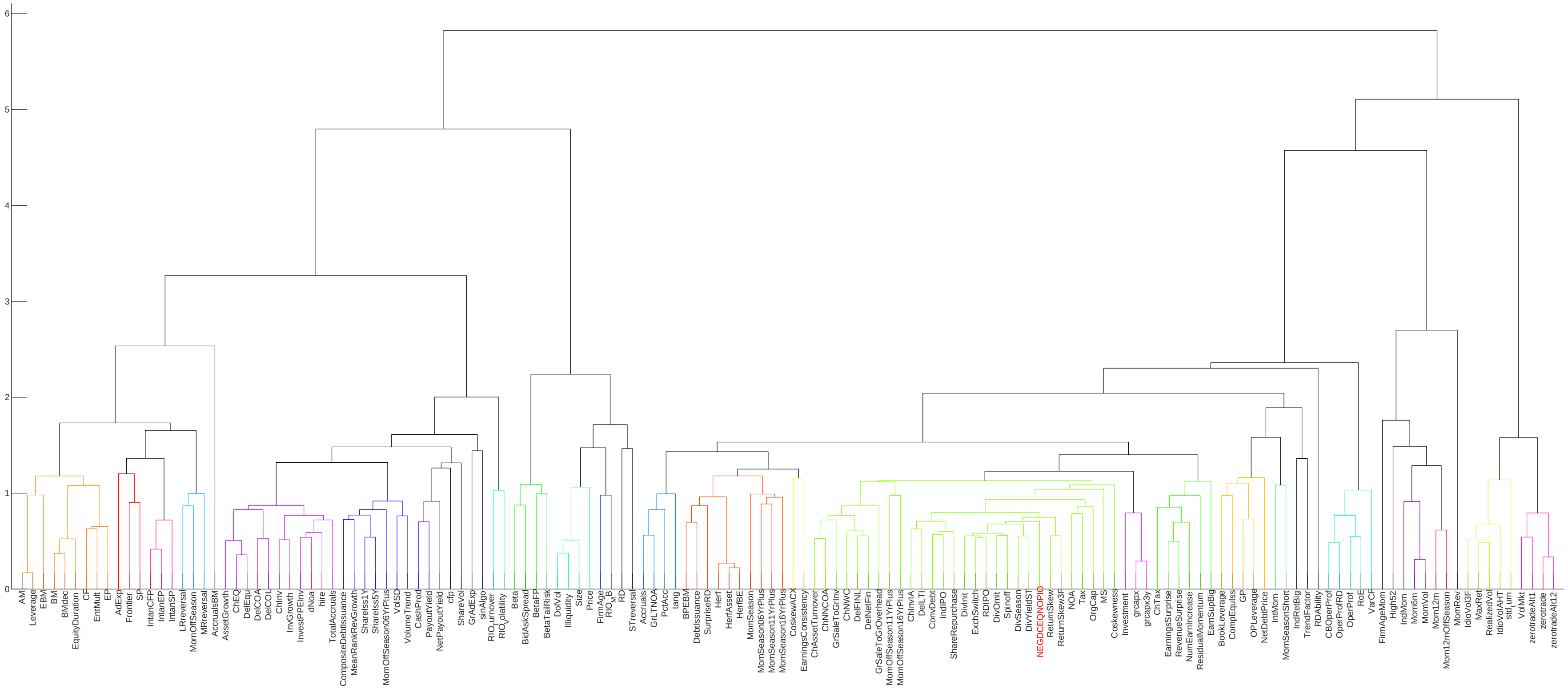

Figure 6: Agglomerative hierarchical cluster plot

This figure plots an agglomerative hierarchical cluster plot using Ward's minimum method and a maximum of 10 clusters.

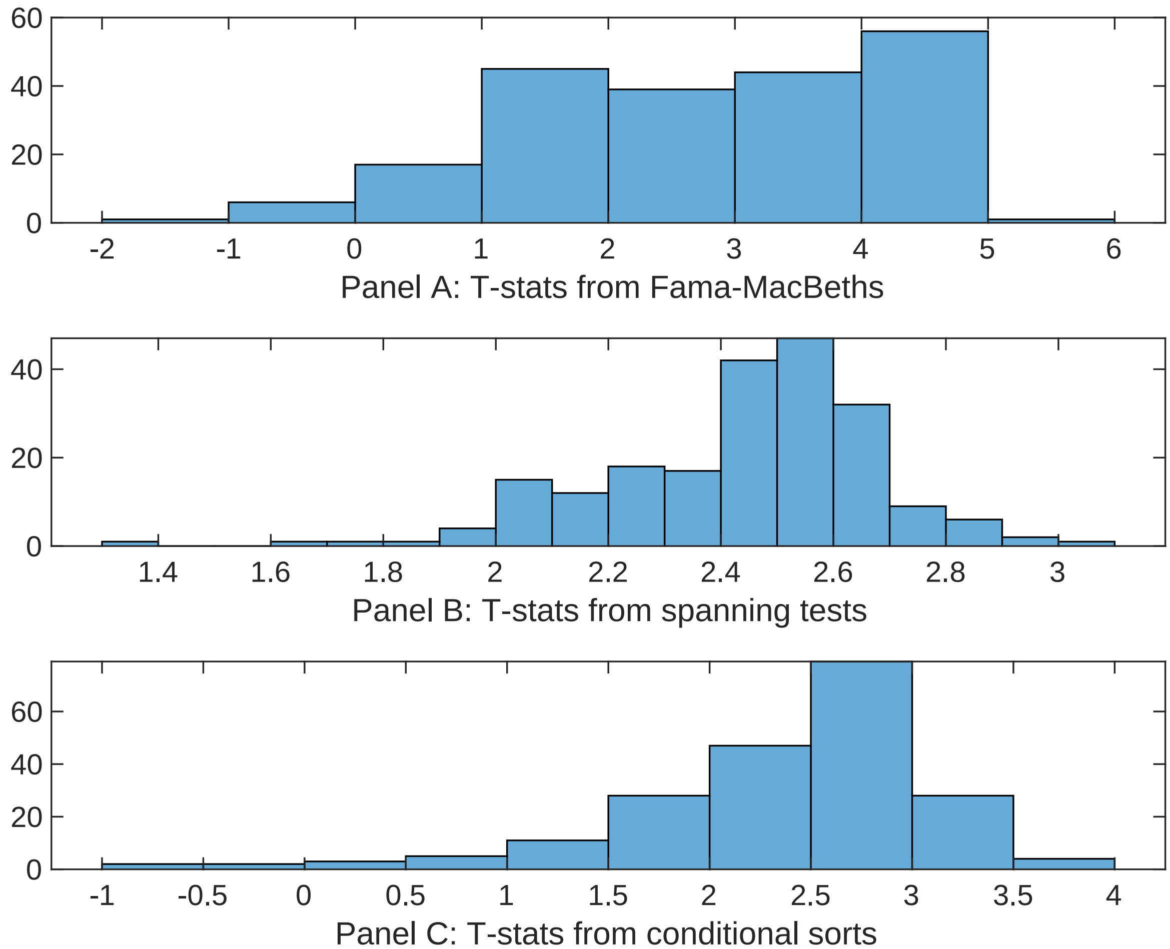

Figure 7: Distribution of t-stats on conditioning strategies
This figure plots histograms of t-statistics for predictability tests of ESD conditioning on each of the 209 filtered anomaly signals one at a time. Panel A reports t-statistics on β_{ESD} from Fama-MacBeth regressions of the form $r_{i,t} = \alpha + \beta_{ESD} ESD_{i,t} + \beta_X X_{i,t} + \epsilon_{i,t}$, where X stands for one of the 209 filtered anomaly signals at a time. Panel B plots t-statistics on α from spanning tests of the form: $r_{ESD,t} = \alpha + \beta r_{X,t} + \epsilon_t$, where $r_{X,t}$ stands for the returns to one of the 209 filtered anomaly trading strategies at a time. The strategies employed in the spanning tests are constructed using quintile sorts, value-weighting, and NYSE breakpoints. Panel C plots t-statistics on the average returns to strategies constructed by conditional double sorts. In each month, we sort stocks into quintiles based one of the 209 filtered anomaly signals at a time. Then, within each quintile, we sort stocks into quintiles based on ESD. Stocks are finally grouped into five ESD portfolios by combining stocks within each anomaly sorting portfolio. The panel plots the t-statistics on the average returns of these conditional double-sorted ESD trading strategies conditioned on each of the 209 filtered anomalies.

Table 4: Fama-MacBeths controlling for most closely related anomalies

This table presents Fama-MacBeth results of returns on ESD. and the six most closely related anomalies. The regressions take the following form: $r_{i,t} = \alpha + \beta_{ESD} ESD_{i,t} + \sum_{k=1}^{s} ix\beta_{X_k} X_{i,t}^{k} + \epsilon_{i,t}$. The six most closely related anomalies, X, are Growth in book equity, Change in equity to assets, Asset growth, change in ppe and inv/assets, Inventory Growth, Off season long-term reversal. These anomalies were picked as those with the highest combined rank where the ranks are based on the absolute value of the Spearman correlations in Panel B of Figure 5 and the R^2 from the spanning tests in Figure 7, Panel B. The sample period is 196506 to 202306.

Intercept	0.17	0.12	0.13	0.13	0.12	0.13	0.13
	[7.01]	[5.49]	[5.91]	[5.88]	[5.43]	[6.12]	[6.43]
ESD	0.34	0.34	0.25	0.32	0.46	0.34	0.22
	[2.68]	[2.80]	[1.91]	[2.38]	[3.29]	[2.73]	[1.72]
Anomaly 1	0.45						-0.55
	[3.98]						[-0.43]
Anomaly 2		0.14					-0.41
		[4.02]					[-0.90]
Anomaly 3			0.98				0.46
			[8.05]				[3.66]
Anomaly 4				0.16			0.53
				[7.74]			[1.92]
Anomaly 5					0.29		0.48
					[5.41]		[0.77]
Anomaly 6						0.14	0.11
						[5.68]	[5.04]
# months	696	696	696	696	696	691	691
$\bar{R}^2(\%)$	0	0	0	0	0	1	0

Table 5: Spanning tests controlling for most closely related anomalies
This table presents spanning tests results of regressing returns to the ESD trading strategy on trading strategies exploiting the six most closely related anomalies. The regressions take the following form: $r_t^{ESD} = \alpha + \sum_{k=1}^{6} \beta_{X_k} r_t^{X_k} + \sum_{j=1}^{6} \beta_{f_j} r_t^{f_j} + \epsilon_t$, where X_k indicates each of the six most-closely related anomalies and f_j indicates the six factors from the Fama and French (2015) five-factor model augmented with the Carhart (1997) momentum factor. The six most closely related anomalies, X, are Growth in book equity, Change in equity to assets, Asset growth, change in ppe and inv/assets, Inventory Growth, Off season long-term reversal. These anomalies were picked as those with the highest combined rank where the ranks are based on the absolute value of the Spearman correlations in Panel B of Figure 5 and the R^2 from the spanning tests in Figure 7, Panel B. The sample period is 196506 to 202306.

Intercept	0.19	0.22	0.21	0.20	0.18	0.17	0.15
	[2.58]	[2.83]	[2.59]	[2.55]	[2.29]	[2.22]	[1.99]
Anomaly 1	35.47						38.35
	[8.46]						[6.14]
Anomaly 2		24.30					1.24
		[5.92]					[0.21]
Anomaly 3			4.93				-16.92
			[0.95]				[-3.05]
Anomaly 4				2.78			0.02
				[0.74]			[0.00]
Anomaly 5					11.14		5.45
					[2.80]		[1.37]
Anomaly 6						8.59	2.73
						[3.09]	[0.99]
mkt	-1.96	-3.50	-3.09	-3.18	-2.84	-1.81	-1.19
	[-1.10]	[-1.91]	[-1.65]	[-1.70]	[-1.52]	[-0.97]	[-0.66]
smb	-0.90	-0.06	-0.05	0.33	1.80	-1.34	0.69
	[-0.35]	[-0.02]	[-0.02]	[0.12]	[0.66]	[-0.49]	[0.25]
hml	-0.20	1.00	3.99	3.89	3.44	-0.59	-2.18
	[-0.06]	[0.28]	[1.11]	[1.08]	[0.96]	[-0.15]	[-0.59]
rmw	-8.97	-8.48	-10.99	-10.93	-8.94	-10.35	-7.03
	[-2.57]	[-2.36]	[-3.01]	[-2.99]	[-2.41]	[-2.87]	[-1.99]
cma	-19.71	-9.93	9.30	13.18	8.02	13.18	-5.62
	[-3.02]	[-1.48]	[1.13]	[2.19]	[1.37]	[2.41]	[-0.69]
umd	-0.98	0.19	-0.42	-0.62	-1.29	0.07	-1.66
	[-0.56]	[0.10]	[-0.22]	[-0.34]	[-0.70]	[0.04]	[-0.93]
# months	696	696	696	696	696	692	692
$\bar{R}^2$(%)	15	10	6	6	7	8	17

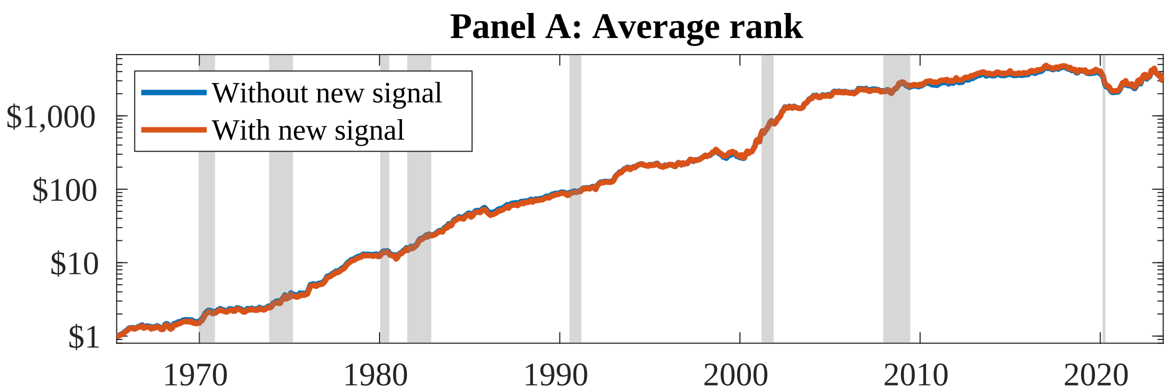

Figure 8: Combination strategy performance
This figure plots the growth of a $1 invested in trading strategies that combine multiple anomalies following Chen and Velikov (2022). In all panels, the blue solid lines indicate combination trading strategies that utilize 155 anomalies. The red solid lines indicate combination trading strategies that utilize the 155 anomalies as well as ESD. Panel A shows results using "Average rank" as the combination method. See Section 7 for details on the combination methods.

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