

Carhart (1997) Mutual Fund Performance Persistence Disappears Out of Sample

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Abstract: Carhart (1997) found that U.S. equity mutual funds' past-year returns positively predict their raw excess return and one-factor alpha over the next year. Based on these results, an investor may believe that she can earn higher returns by buying mutual funds with high past-year returns. We find that significant performance persistence does not exist in the post-Carhart 1994 to 2018 period. Even during the Carhart 1963 to 1993 period, performance persistence weakened in later years. The disappearance of performance persistence is due to lower returns to favorable styles, as well as less favorable style tilts and increased style-adjusted underperformance by past winning funds.

Carhart (1997) is a seminal study in mutual fund performance persistence. He finds that among U.S. equity mutual funds, past returns do predict future performance. Funds in the top decile of one-year returns earn a positive and significant one-factor alpha over the next year of 0.22% per month, while funds in the bottom decile have a negative and significant one-factor alpha over the next year of -0.45% per month. The top decile also outperforms the bottom decile on a raw return basis by 0.67% per month. Because past performance does not predict *four*-factor alphas, Carhart attributes the predictability of raw returns and one-factor alphas mostly to individual stock-level momentum (Jegadeesh and Titman, 1993): funds with high recent returns hold more high-momentum stocks, and holdings are persistent, so these funds' future returns benefit from the momentum effect; the opposite is true for funds with low recent returns.

Based on Carhart (1997), an investor may believe that she can earn higher average returns by buying mutual funds with the highest past one-year returns. She may choose to do so either because she believes that momentum is due to mispricing or because she finds the rationally priced expected reward for bearing momentum risk to be attractive. But in this paper, we find that in the post-Carhart period from 1994 to 2018, the best-performing mutual funds from the previous year no longer earn significantly positive one-factor alphas in the following year, nor are their future one-factor alphas significantly different from the worst-performing funds from the previous year. Even within the 1963 to 1993 time period studied by Carhart, performance persistence weakens after 1979.

I. Data

Data on mutual fund returns and characteristics are gathered from the CRSP Survivor-Bias-Free U.S. Mutual Fund Database. To estimate one-factor alphas, we use the CRSP value-weighted market return in excess of the risk-free rate. Factor portfolio returns for estimating four-factor alphas are taken from Ken French's website.

We examine domestic equity mutual funds, excluding sector, hedged, and short funds.¹ We exclude pure index funds, ETFs, and ETNs. CRSP contains multiple entries for a mutual fund if it has different share classes, so we aggregate all share classes to the fund level by value-weighting

¹ Funds with CRSP style codes beginning with EDC and EDY, excluding EDYH (hedged) and EDYS (short). Following Kacperczyk et al. (2006), funds with Wiesenberger Fund Type Code G, G-I, AGG, GCI, GRI, GRO, LTG, MCG, and SCG are also kept if common stocks make up between 80% and 105% of their portfolio.

them.² Carhart reports that his sample contained 1,892 unique funds. After aggregation, our sample has 1,601 unique funds from 1962 to 1993.

II. Replication and out-of-sample extension

The left third of Table 1 displays Carhart's main results from his Table 3, and the middle third shows our attempts to replicate his results over the 1962 to 1993 time period.

Every January 1, we form ten equal-weighted portfolios of mutual funds based on their lagged one-year return reported on CRSP (which is net of expenses) and hold them for one year. Decile 1 contains the best performing 10% of mutual funds (by number of funds, not net assets) in the past year, decile 2 contains the next 10%, and so on. Each portfolio is rebalanced to equally weight each fund each month. We thus obtain a monthly time series of returns for each portfolio. One-factor alphas are the intercept from the time-series regression of the portfolio return in excess of the risk-free rate on the CRSP value-weighted U.S. stock market return in excess of the risk-free rate. Four-factor alphas are the intercept from the time-series regression of the excess portfolio return on the excess U.S. value-weighted stock market return and the size, value, and momentum factor portfolio returns (SMB, HML, and MOM).³

Our 1962 to 1993 results are qualitatively similar to Carhart's. Average raw excess returns in the post-formation year increase nearly monotonically with past-year returns. We obtain a highly significant difference ($p = 0.00001$) between the top and bottom deciles' raw excess returns of 0.75% per month, which is comparable to Carhart's figure of 0.67%. One-factor alphas also significantly increase with past-year returns. We estimate a 0.74% per month difference ($p = 0.00001$) between the top and bottom deciles, compared to 0.67% for Carhart. The top decile has a significantly positive one-factor alpha (0.33%, $p = 0.011$), while the bottom decile has a significantly negative one-factor alpha (-0.42%, $p = 0.0002$). Finally, we find that much of this difference attenuates once we additionally control for size, value, and momentum. The difference between the top and bottom decile four-factor alphas is 0.24% per month and not statistically significant ($p = 0.105$) in our sample, whereas in Carhart's sample, it is similar in magnitude and

² We first aggregate using the WFICN number from MFLINKS if available. For entries in CRSP without a WFICN number, we aggregate using the CRSP Class Group if available. CRSP Class Group is available only beginning in 1998, but we use the earliest available value for pre-1998 years. Entries without either a WFICN number or CRSP Class Group are treated as individual mutual funds.

³ Following Carhart (1997), for the four-factor alpha estimations, we use the excess stock market return from Ken French's website, which differs slightly from the CRSP value-weighted market return.

statistically significant (0.29%, $p = 0.033$). In both sets of results, the top decile's four-factor alpha is not significantly different from zero, while the bottom decile's four-factor alpha is significantly negative.

The last third of Table 1 shows what happens when we conduct the Carhart analysis on the 1994 to 2018 time period. Over this more recent interval, the top decile no longer earns significantly positive CAPM alpha; in fact, the point estimate is negative (-0.04%, $p = 0.802$). The spread between the top and bottom deciles' one-factor alphas is positive but not significant (0.23%, $p = 0.306$). Furthermore, the four-factor alpha for the top decile actually becomes significantly negative (-0.19%, $p = 0.034$). The bottom decile's four-factor alpha remains negative, but is no longer significant (-0.16%, $p = 0.101$). As a result, the difference between the top and bottom deciles' four-factor alphas is negative and insignificant (-0.03%, $p = 0.845$).

In untabulated results, we find that the difference between the top and bottom decile one-factor alphas over the entire 1963 to 2018 sample period is highly statistically significant (0.52%, $p = 0.0001$). The one-factor alpha of the top decile is only marginally significant (0.17%, $p = 0.090$), whereas the one-factor alpha of the bottom decile is highly significant (-0.35%, $p = 0.00001$). The 1963 to 1979 period is an important driver of the significant difference between the top and bottom deciles. If we estimate the top minus bottom decile one-factor alpha over the years from τ to 2018, this alpha is statistically significant for all $\tau < 1980$, and insignificant for all $1980 \leq \tau \leq 2018$ with the exception of $\tau = 1982$. Repeating this exercise for the top decile one-factor alpha, we find that it is *never* positive and significant at the 5% level for any value of τ .

Another way to see the importance of the pre-1980 period for the finding of one-factor alpha predictability is to estimate one-factor alphas over rolling ten-year windows. Figure 1 shows the point estimates of these alphas for the top fund decile, bottom fund decile, and the difference between these two deciles; Figure 2 shows the corresponding T-statistics. The point estimates and T-statistics of the top decile's one-factor alpha trend downward, while those of the bottom decile trend upward. Accordingly, the long-short one-factor alpha trends downward and actually becomes negative in the ten-year windows that end in 2012 or later.

What accounts for the deterioration in the one-factor alpha gap between past winning funds and past losing funds? Figure 3 shows using ten-year rolling estimation windows that over time, there is a modest decline in the extent to which past winning funds load more on momentum and value than past losing funds. Estimating loadings over either the entire 1963 to 1993 or the entire

1994 to 2018 window, the top minus bottom decile MOM loading falls across windows from 0.49 to 0.43 (p -value of difference = 0.235), and the top minus bottom decile HML loading falls from 0.07 to -0.06 (p -value of difference = 0.110). Figure 4 shows that the value and momentum factor portfolios themselves have performed worse in recent years. Estimating over the entire 1963 to 1993 or 1994 to 2018 window, we find that one-factor alphas of the value and momentum factor portfolios have declined from 0.58% ($p = 0.000006$) and 0.84% ($p = 0.000003$) per month, respectively, to 0.21% ($p = 0.228$) and 0.62% ($p = 0.027$) per month. Figures 5 and 6 show that the four-factor alpha of past winning funds deteriorated in the 21st century, becoming significantly negative in the ten-year windows ending from 2011 to 2018. In sum, the decline in the persistence of past winning funds' performance is driven by multiple factors: they invested somewhat less heavily in favorable styles, which themselves became less profitable, and their style-adjusted performance also worsened.

III. Conclusion

Carhart (1997) documented using data from 1962 to 1993 that mutual fund performance was persistent when measured by one-factor alpha, and he attributed much of this to individual stock-level momentum. However, we find that this persistence is no longer present in the period from 1994 to 2018.

References

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Table 1: Monthly raw excess returns and alphas for mutual funds sorted by past-year performance

Description: This table reports average excess returns and one-factor and four-factor alphas for portfolios of mutual funds formed based on their previous calendar year's return. Portfolios are sorted on January 1 each year and equally weighted monthly. We show the Carhart (1997) results, our replication of those results, and the results from the out-of-sample period of 1994 to 2018. T-statistics are shown in parentheses below the point estimates.

Interpretation: We are able to qualitatively replicate the Carhart results in the matching sample period, but the persistence in performance as measured by one-factor alphas disappears in the out-of-sample period.

Decile	Carhart (1997) results			Replication: 1963 to 1993			Out of sample: 1994 to 2018		
	Excess return	1-factor alpha	4-factor alpha	Excess return	1-factor alpha	4-factor alpha	Excess return	1-factor alpha	4-factor alpha
1 (high)	0.68	0.22 (2.10)	-0.12 (-1.60)	0.76	0.33 (2.54)	-0.04 (-0.37)	0.60	-0.04 (-0.25)	-0.19 (-2.14)
2	0.59	0.14 (1.75)	-0.10 (-1.78)	0.65	0.21 (2.32)	0.02 (0.31)	0.60	-0.01 (-0.13)	-0.13 (-2.26)
3	0.43	-0.01 (-0.08)	-0.18 (-3.65)	0.50	0.06 (0.78)	-0.07 (-1.21)	0.59	-0.01 (-0.21)	-0.10 (-2.50)
4	0.45	0.02 (0.33)	-0.12 (-2.81)	0.44	-0.00 (-0.01)	-0.07 (-1.59)	0.56	-0.03 (-0.70)	-0.10 (-2.89)
5	0.38	-0.05 (-1.10)	-0.14 (-3.31)	0.40	-0.03 (-0.62)	-0.06 (-1.42)	0.51	-0.06 (-2.05)	-0.10 (-3.13)
6	0.40	-0.02 (-0.46)	-0.12 (-2.82)	0.36	-0.07 (-1.36)	-0.10 (-2.20)	0.49	-0.08 (-2.45)	-0.10 (-2.87)
7	0.36	-0.06 (-1.39)	-0.14 (-3.09)	0.38	-0.06 (-1.10)	-0.07 (-1.64)	0.49	-0.08 (-1.77)	-0.09 (-2.17)
8	0.34	-0.10 (-1.86)	-0.13 (-2.52)	0.34	-0.10 (-1.72)	-0.04 (-0.84)	0.48	-0.08 (-1.36)	-0.08 (-1.33)
9	0.23	-0.21 (-3.24)	-0.20 (-3.11)	0.21	-0.23 (-3.44)	-0.15 (-2.56)	0.48	-0.10 (-1.18)	-0.07 (-0.93)
10 (low)	0.01	-0.45 (-4.58)	-0.40 (-4.33)	0.01	-0.42 (-3.78)	-0.28 (-2.70)	0.34	-0.26 (-2.37)	-0.16 (-1.65)
1 – 10 spread	0.67	0.67 (4.68)	0.29 (2.13)	0.75 (4.59)	0.74 (4.53)	0.24 (1.63)	0.27 (1.21)	0.23 (1.03)	-0.03 (-0.20)

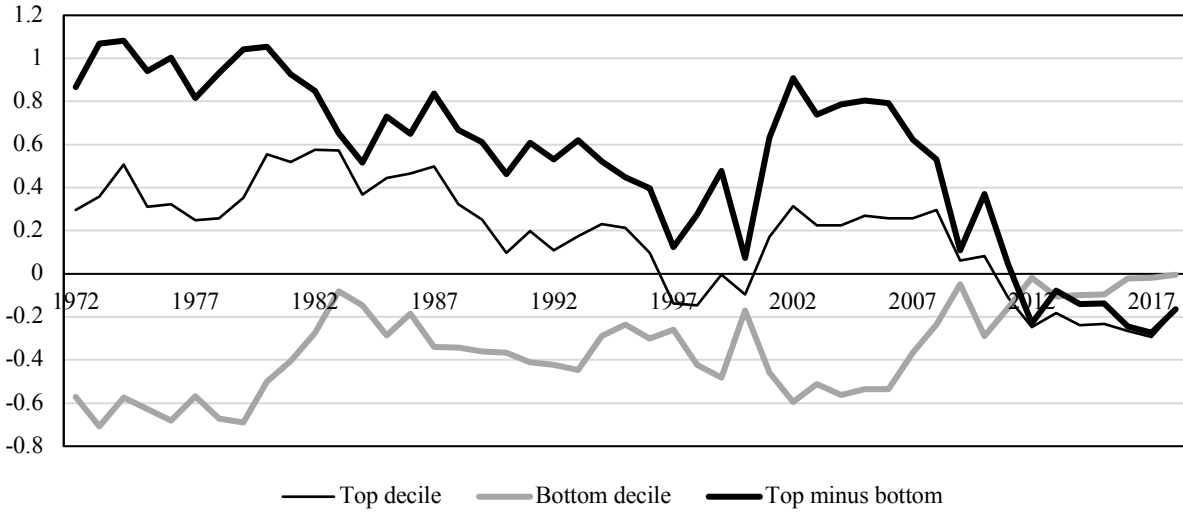


Figure 1: Ten-year rolling one-factor alphas

Description: This figure shows one-factor alphas for the top decile of funds based on past-year returns, the bottom decile of funds based on past-year returns, and the difference between the top and bottom deciles. These alphas are estimated over ten-year rolling windows that end in the year indicated on the horizontal axis.

Interpretation: The difference between the top and bottom decile fund alphas has been declining over time.

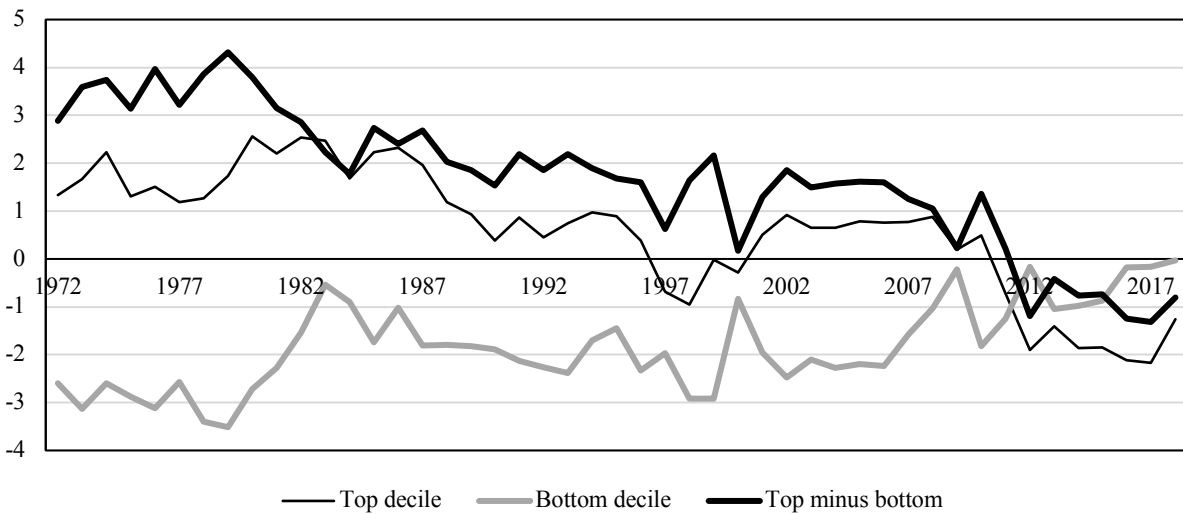


Figure 2: T-statistics of ten-year rolling one-factor alphas

Description: This figure shows the T-statistics of the one-factor alphas for the top decile of funds based on past-year returns, the bottom decile of funds based on past-year returns, and the difference between the top and bottom deciles. These alphas are estimated over ten-year rolling windows that end in the year indicated on the horizontal axis.

Interpretation: Statistical significance in the difference between the top and bottom decile fund one-factor alphas is driven by the earliest years of the sample.

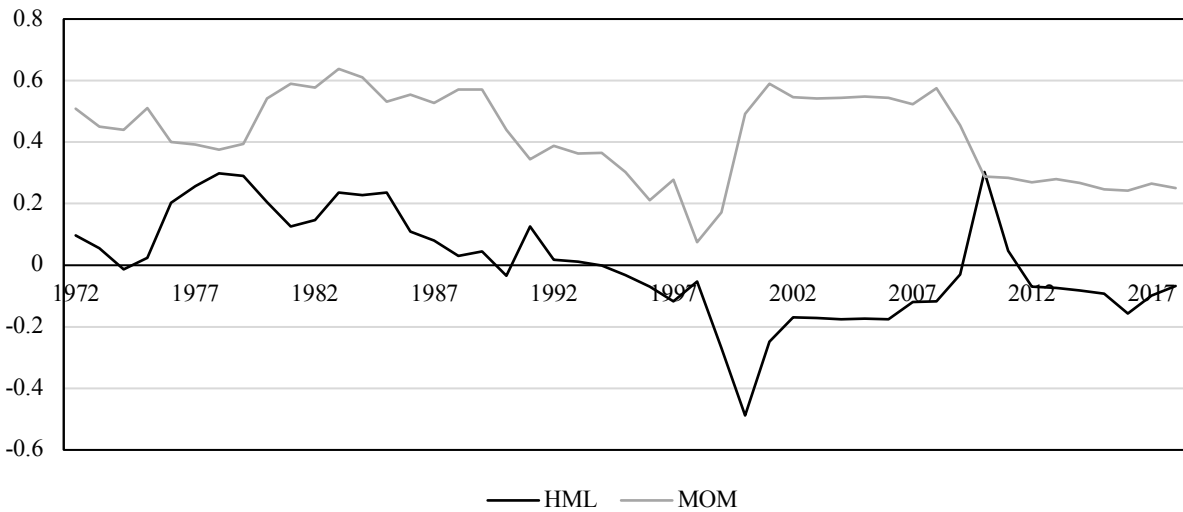


Figure 3: Ten-year rolling loadings on HML and MOM of top decile minus bottom decile fund portfolio

Description: The factor loadings on the top minus bottom decile fund portfolio are estimated over ten-year rolling windows that end in the year indicated on the horizontal axis.

Interpretation: The differences between the top and bottom fund decile factor loadings on HML and MOM have been declining over time.

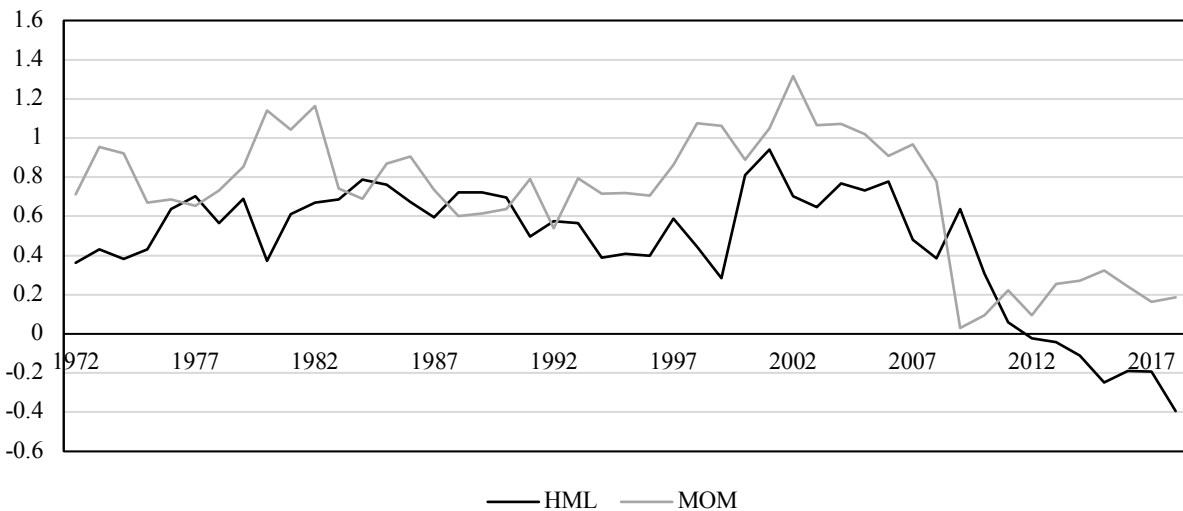


Figure 4: Ten-year rolling one-factor alphas of HML and MOM factor portfolios

Description: The alphas are estimated over ten-year rolling windows that end in the year indicated on the horizontal axis.

Interpretation: The one-factor alphas of HML and MOM have been declining over time.

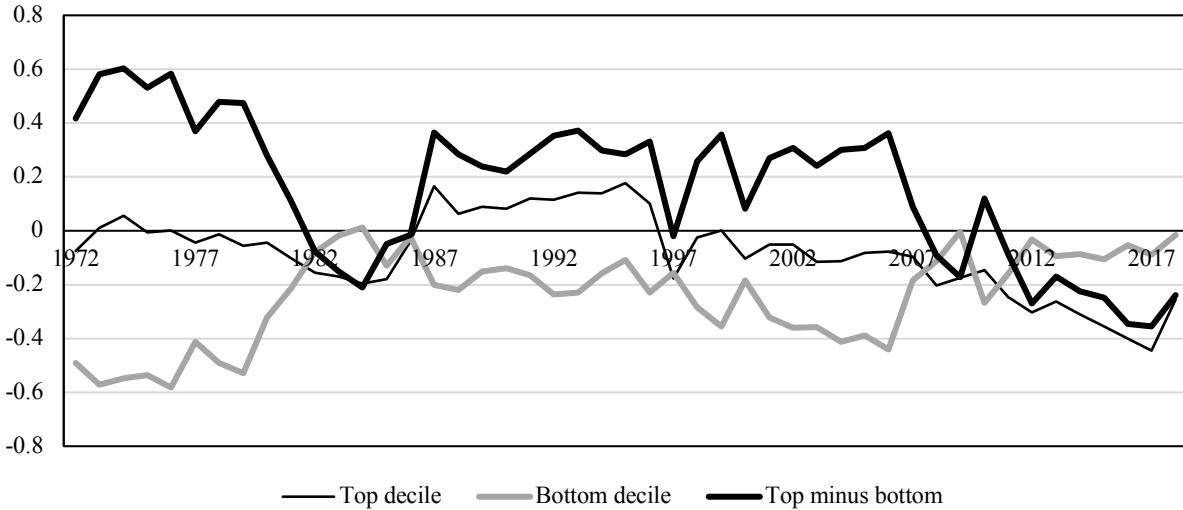


Figure 5: Ten-year rolling four-factor fund alphas

Description: This figure shows four-factor alphas for the top decile of funds based on past-year returns, the bottom decile of funds based on past-year returns, and the difference between the top and bottom deciles. These alphas are estimated over ten-year rolling windows that end in the year indicated on the horizontal axis.

Interpretation: Past winning funds underperformed past losing funds in the final years of the sample.

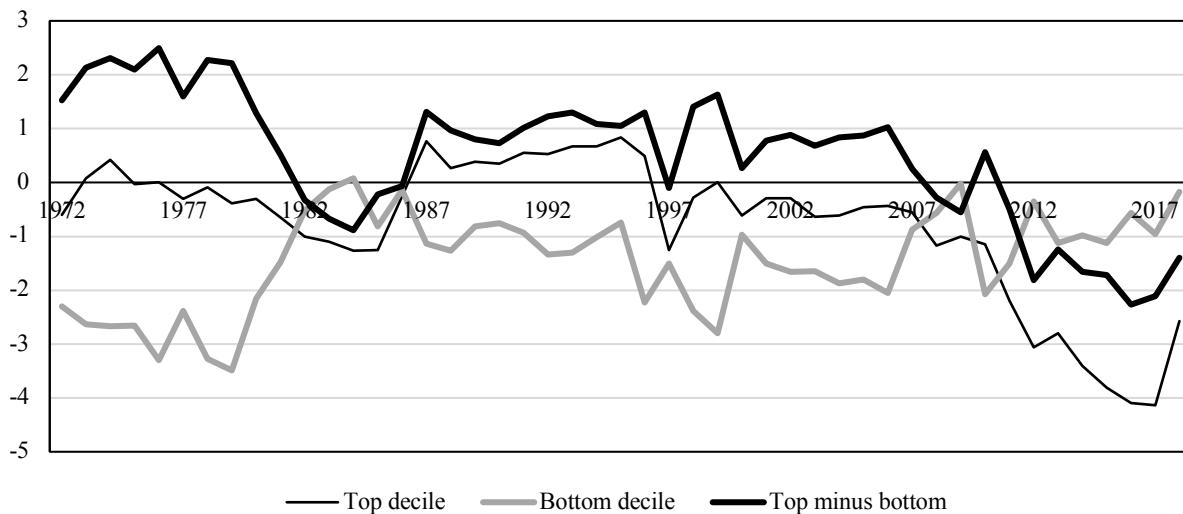


Figure 6: T-statistics of ten-year rolling four-factor fund alphas

Description: This figure shows the T-statistics of the four-factor alphas for the top decile of funds based on past-year returns, the bottom decile of funds based on past-year returns, and the difference between the top and bottom deciles. These alphas are estimated over ten-year rolling windows that end in the year indicated on the horizontal axis.

Interpretation: Past winning funds underperformed past losing funds in the final years of the sample.