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AQR's Momentum Funds (A)

In early 2009, after significant research and reflection, Cliff Asness, founder and principal at AQR, was considering the launch of three new retail mutual funds that would offer investors exposure to 'Momentum,' a new investment style. While momentum strategies were commonplace among hedge funds, the new AQR funds would become the first retail funds to focus on this strategy.

The Momentum Strategy

AQR defined stock momentum as 'the phenomenon that stocks which have performed well in the past relative to other stocks (winners) continued to perform well in the future, and stocks that have performed relatively poorly (losers) continue to perform poorly.' This *relative* performance was a key component of momentum, as it implied existence and ability to implement the strategy irrespective of up or down markets.

The first academic paper demonstrating the high returns associated with the momentum strategy was a 1993 publication by Narasimhan Jegadeesh and Sheridan Titman. Among the most important extensions of this work were Clifford Asness's 1994 paper showing the robust profitability of momentum investing strategies, and a paper by Mark Grinblatt and Tobias Moskowitz in 1999 demonstrating the role that industry affiliation played in momentum's performance.[1] Asness was a founding partner at AQR, and Moskowitz, a professor at the University of Chicago, served as a consultant at AQR. Since the original academic work, hundreds of papers had been published on momentum. While explanations for the phenomenon differed, there was widespread agreement about its existence and pervasiveness. In particular, the momentum phenomenon had also been found to exist in international equity markets and across various asset classes.

[1] See Jegadeesh, Narasimhan, and Sheridan Titman, "Returns to buying winners and selling losers: implications for stock market efficiency," Journal of Finance, 48, 1993; Asness, Clifford S., "The power of past stock returns to explain future stock returns," Goldman Sachs Asset Management, 1994; Grinblatt, Mark, and Tobias Moskowitz, "Do industries explain momentum?" Journal of Finance, 54, 1999.

Professors Daniel Bergstresser (HBS), Lauren Cohen (HBS), Randolph Cohen (MIT Sloan School of Management) and Christopher Malloy (HBS) prepared this case. HBS cases are developed solely as the basis for class discussion. Cases are not intended to serve as endorsements, sources of primary data, or illustrations of effective or ineffective management.

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Some argued that momentum investors experienced outsized average returns as compensation for bearing undiversifiable risk. Evidence in support of this explanation was the fact that high-momentum stocks had a strong tendency to move together, making it difficult to obtain momentum profits without exposing oneself to the possibility of substantial loss.

Others argued that momentum profits were caused by cognitive errors and irrationalities in the market. One set of theories saw momentum as a result of overreaction to news – e.g., a company made a positive announcement, leading to a price increase, which then caused additional buying in the form of an irrational bandwagon effect. This effect was driven by investors who mistakenly expected that good news should be followed by more good news. This follow-on buying would create a momentum effect.

A second set of behavioral theories took the opposite approach, explaining momentum as a consequence of *underreaction*, or slow reaction to news. For example, consider an announcement of news that, in a rational world, would merit a 10% increase in the stock price. Holders of the underreaction view would argue that it is common for the stock to increase, say, 6% immediately, and then have the remaining 4% price growth over the subsequent year. The momentum effect would be driven by this "drift" resulting from the information slowly leaking into prices.

While the debate raged on in the halls of academia as to momentum's cause, investment vehicles were designed by a variety of firms in an attempt to profit from the strategy. In general this opportunity was only available to deep-pocketed institutional investors. Hedge funds frequently included momentum among their strategies, and institutional equity funds often had a momentum tilt to their portfolios. AQR wondered whether momentum would also be an attractive strategy if offered to retail investors.

Empirical evidence on momentum

There was ample empirical evidence on price momentum in equities. The most common such strategies followed Jegadeesh and Titman in using a prior or "backtest" period to define good performing (winner) stocks and poorly performing (loser) stocks, and then formed a portfolio that bought winner stocks and sold loser stocks, and held this portfolio into the future. Although there were many variations of this strategy, including changing the past time window over which to define winners and losers, or altering the horizon of the holding period after portfolios were defined, a very common formulation was based on a pre-ranking period of roughly past year returns, and then a future holding period of 1 month. Specifically, at the beginning of each month all firms were assigned to one of ten portfolios ranked according to past year returns (skipping the prior month).[2] Stocks in the lowest decile of past returns (decile 1) were assigned to the loser portfolio of stocks, while stocks in the highest decile of past returns (decile 10) were assigned to the winner portfolio. Momentum returns were then computed as the returns to the long-short portfolio that went long (decile 10) winner stocks and short (decile 1) loser stocks over the following month. At the end of every month, stocks were re-ranked, and a new portfolio of (winner stocks - loser stocks) was formed and held during the next month.

[2] It was common to skip the prior month (t-1) when computing past year returns (i.e., to use t-12 to t-2 returns rather than t-12 to t-1 returns), because of evidence in Jegadeesh (1990) that stocks with high returns last month tend to reverse in the following month. See Jegadeesh, Narasimhan, "Evidence of predictable behavior in security markets," Journal of Finance, 45, 1990 and Asness, Clifford S., "The power of past stock returns to explain future stock returns," Goldman Sachs Asset Management, 1994.

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Jegadeesh and Titman (JT) published their findings in 1993. Many investors believed that an easily explained strategy like momentum would lose its efficacy once it became well known. Thus the performance of momentum both before and *after* the publication of the JT paper was particularly relevant. Kenneth French of Dartmouth's Tuck School of Business maintained a data library online[3] which showed the historical performance of many quantitative strategies. Included was data on a momentum-based factor that its creators, French and University of Chicago economist Eugene Fama, called UMD (for Up minus Down) or MOM; in this formulation, momentum was computed from the highest 30th percentile of past return stocks (UP) minus the lowest 30th percentile of past returns stocks (DOWN). According to the average returns from the annual UMD data on French's site, UMD's returns were actually slightly larger in the post-1992 period (1993-2008):

- Pre- Jegadeesh and Titman paper, 1927-1992: 10.79%
- Post- Jegadeesh and Titman paper, 1993-2008: 11.48%
- Full sample period, 1927-2008: 10.92%

Exhibit 1 shows the annual returns to the Fama-French UMD momentum strategy over the entire 1927-2008 period, while **Exhibit 2** shows the cumulative performance of a dollar invested in UMD in 1927 versus a dollar invested in the overall market (CRSP NYSE/Nasdaq value-weight portfolio) in 1927. **Exhibit 3** provides summary statistics over the entire sample period for the momentum "10 minus 1" portfolio, as well as the individual long and short component portfolios (i.e., deciles 1 and 10). **Exhibit 4** presents the average monthly returns from 1927 to 2008 for all ten portfolios formed on past returns, as well as the long-short "10 minus 1" momentum portfolio.

AQR

AQR was established in 1998 and headquartered in Greenwich, CT. The founding principals of the firm included Clifford Asness, David Kabiller, Robert Krail, and John Liew, who had all worked together at Goldman Sachs before leaving to start AQR.

Asness, Krail, and Liew had all met in the Finance PhD program at the University of Chicago, where Asness' dissertation had focused on momentum investing. AQR had grown substantially from its start in 1998, and by early 2009 AQR had over 200 employees and managed over $19 billion in assets. A large portion of these assets were invested in hedge fund strategies. The hedge fund strategies included strategies focused on pure absolute return alpha, and often involved taking both long and short positions in securities and using financial derivatives.

In addition, AQR had created strategic partnerships that helped it branch into other investment spaces (e.g., CNH Partners was a merger arbitrage and convertible arbitrage affiliate of AQR, and was located in the same office building as AQR). While the existing hedge-fund channels had proven profitable, AQR also saw mutual funds as an exceptionally large pool of capital that was increasingly growing in sophistication and needs.

[3] http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.

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Entering the mutual fund market

The mutual fund market would be a new market for AQR. Hedge funds were targeted to institutions and high-net-worth investors. Mutual funds, on the other hand, were offered to all investors. By contrast, anyone could invest in mutual funds. In 1940, perceiving ordinary investors as vulnerable to exploitation, the United States Congress passed the Investment Companies Act, which required open-end mutual funds to calculate net asset value (NAV) every day and to stand ready at any time to purchase and sell their shares at that NAV. By comparison, most hedge funds allowed investors to cash out only at the end of the quarter, and sometimes even less often.

The retail mutual fund market was divided into different channels. One channel was the direct channel: fund companies such as Vanguard often sold their funds directly to investors. A second channel was the financial advisor channel: fund companies such as American Funds and Dimensional Fund Advisors sold mutual funds to investors who purchased funds with the assistance of financial advisors or brokers. AQR planned to focus primarily on this financial advisor channel.

A. Long-only feature of Mutual Funds

Hedge funds, as the name would imply, often took both long and short positions in securities. Mutual funds were legally limited in their use of short positions and leverage. This constraint created an issue in transporting momentum and other hedge fund strategies to retail mutual funds. The academic research on the momentum effect considered both the outperformance of winners and the underperformance of losers. A hedge fund following a momentum strategy would both purchase winners and sell losers short. A long-only mutual fund following a momentum strategy would be able to take long positions in winners but unable to take short positions in losers.

B. Open-end feature of Mutual Funds

Another important issue, as alluded to above, was the capital stickiness within the funds. Because the law mandated that retail mutual funds be open ended, i.e. that consumers could sell their shares at any time, AQR could not depend upon investors to be patient. Hedge funds could lock-up capital for long periods by allowing redemptions only at pre-specified dates. They could pursue longer-term strategies without worrying about customers asking to unwind positions at an inopportune time. By contrast, open-end mutual funds had to be ready to return capital at the end of each trading day in response to investor demand.

The law also subjected open-end mutual funds to more stringent reporting and compensation requirements. In general mutual funds could not take a percentage of profits as fees, as was common in hedge funds. Regulations also required mutual funds to adopt "prudent" investment strategies; they had to be diversified, avoiding holding too much of one company, or too much of one industry. AQR did not anticipate these regulations would cause any difficulty for the Momentum Fund.

Establishing a momentum index

The obvious way to demonstrate to potential investors that momentum strategies offered strong performance potential was to show a "backtest" – a sequence of returns that would have resulted from implementing the strategy starting from a date far in the past. From this data, one could then compute important statistics such as the mean returns, return standard deviation, and market beta (see **Exhibit 3**). Similarly, an index could be created which was especially helpful when the investment style was new, as it gave investors a chance to familiarize themselves with both the

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construction of the underlying strategy, and its past performance. In this way, the index served an important educational role for investors interested in the new momentum strategy. U.S. securities regulations did not permit backtest results to be used in marketing mutual fund products (though they were commonly used in the marketing materials of private partnerships such as hedge funds). The performance of an index, however, could be published by an index provider even for periods prior to the creation of the index, as long as it was not referenced in any mutual fund marketing materials.

The academic literature had produced a widely-accepted long-short benchmark for momentum: the previously-mentioned UMD of Fama and French. Although UMD was transparent and widely accepted in academia, it was not an appropriate index for the momentum products that AQR intended to launch. First, UMD was long-short, while AQR's fund would be long-only. Second, UMD was rebalanced monthly, which would require an enormous amount of trading to replicate. Third, UMD used all listed stocks, whereas AQR wanted to use only stocks with reasonable market capitalization and liquidity, as the "open-end" feature of mutual funds necessitated a certain amount of daily liquidity in the product.

AQR developed three separate long-only momentum indexes: a large-cap US momentum index, a small-cap momentum index, and a large-cap international momentum index.

The indexes were calculated in a relatively transparent way. The first step was to define the universe. For the large cap index the underlying universe was the largest 1000 stocks in the US. For the small-cap momentum index the underlying universe was the next-largest 2000 stocks in the US market. The international index was based on a universe of about 1000 large international stocks.

Within each universe, each quarter the stocks were ranked on the basis of their performance over months t-12 through t-2 (again ignoring the most recent month). From this ranking, the top third were selected for the index. The index was the performance of a value-weighted index of those top third of stocks. Value- (or "cap-") weighting simply means weighting each firm in the portfolio by its respective market capitalization. This both matched the practice of other well-known indices, and had the added benefit of the momentum index not taking on disproportionate exposure to the smallest-**c**ap firms.

AQR contracted with Standard & Poor's, Inc. to have S&P serve as the calculation agent for these new indexes. In principle, other investment managers would be able to launch momentum-based products based on the AQR momentum indexes, as long as they were willing to pay a licensing fee to AQR for the use of the index.

Implementing the momentum strategy

The actual implementation of the momentum strategy posed a number of important, and yet fairly open, discretionary decisions on the part of AQR.

The AQR Momentum Index gave AQR a convenient way to demonstrate the strong historical performance of momentum strategies. But it also posed a question for AQR: was the goal of the fund to match the index, or beat it? After all, most funds benchmarked to the S&P 500 would be far from satisfied if they merely matched the index, and would be deeply disappointed if they matched the index's performance before deducting fees and trading costs. But given the lack of availability of momentum investing for typical holders of mutual funds, such an outcome could add enormous value when the benchmark was momentum. And, since the index was well-constructed to capture

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most of the benefits of momentum investing, outperforming the index would be a difficult challenge. Moreover, any attempt to outperform would lead to a risk of tracking error – deviations from the index which might be viewed negatively by investors. Among the issues to consider in determining the tradeoff between returns and tracking error were:

1) How often to rebalance? The index was rebalanced quarterly, but simple logic suggested that more frequent rebalancing would add to performance if transaction costs were ignored (why keep holding a stock for three months if, six weeks into the quarter, it no longer had the characteristics of a high-momentum stock)?

2) Whether to trade "boundary" stocks on the edges of the list? For example, suppose that XYZ Corp. was a high-momentum stock held by the portfolio. One quarter later, it was ranked 350th in momentum – no longer in the top one-third of the 1000 stocks in the Russell. Meanwhile ABC Corp., not yet in the portfolio, ranked 333rd. ABC would be in the index next quarter and XYZ not. Should the fund sell its entire XYZ position and buy ABC? This could lead to a significant trading cost – e.g., one pays transaction costs for both the sale of XYZ and for the purchase of ABC in order to make this recomposition. And the difference in expected return between #333 and #350 was probably quite small. On the other hand, not doing the trade meant failing to track the index. And it still left open the question: how large of a gap in rank must there be to justify a trade?

3) When should the trading happen? If the decision was made to sell XYZ, should the trade be implemented fast (e.g. in one day), which could increase trading costs, or slowly (e.g. two weeks), which could increase tracking error?

4) What was the likely impact of taxes? While trading costs affected reported returns, tax effects of trading did not. But taxes could have an enormous effect on after-tax returns for taxable investors (obviously, tax exempt investors benefited fully from the before-tax returns). Fund management decisions affected taxes in multiple ways, e.g. realization (or not) of capital gains and losses, and holding positions for longer periods in order to make gains long-term instead of short-term. Momentum strategies tended to have higher turnover than many other strategies, and yet could offset part of this "cost" of turnover by being tax-efficient by nature: gainers tended to be held (often to the point of being long-term and therefore being taxed at a much lower rate) whereas losers tended to be sold (leading to realized capital losses and reduced tax bills). Perhaps the strategies could be managed to further save on taxes by incurring some tracking error. How much tracking error should the fund endure to save tax-sensitive investors money come April 15th?

5) Should other sources of outperformance be considered? As quantitative investors, AQR felt confident that their organization was well-informed about what kinds of stocks tended to outperform. Two well-known effects from which AQR had profited in the past were value (the tendency of stocks with low multiples such as market-to-book or price-to-earnings ratios to outperform on average) and short-term reversal (the tendency of stocks which had high returns over the past week or month to underperform stocks with low recent returns – the reason momentum was usually defined excluding the past month's returns). Should the fund purchase stocks that had high momentum but that AQR believed were likely to perform poorly in the near future? If such other effects could not be used as core components of the strategy, could they at least be used to assist in trade timing (e.g., "we'll buy this stock in a week or so when we aren't trading into the teeth of the one-week reversal effect")?

To provide some insight into this, AQR calculated the correlation between the returns to the momentum strategy (UMD), and the returns to other popular strategies, including: i.) *Mkt-Rf*, the market risk premium, market return over a proxy for the risk-free rate (90 day T-bills), ii.) *SMB*, a

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size-based strategy that goes long low-capitalization stocks and short high-capitalization stocks, and iii.) *HML*, a value strategy that goes long high book value-to-market value ratio (e.g., Value) stocks and short low book value-to-market value ratio (e.g., Growth) stocks.[4] These correlations are in **Exhibit 5**. As seen, momentum has a nearly zero correlation with *Mkt-Rf* and *SMB*, and in fact a quite negative correlation with *HML*. This made momentum a potentially attractive complement (from a portfolio correlation perspective) to any portfolio that already had a Value (high book value-to-market value ratio) tilt.

Decision Point

The AQR large-cap momentum index had historically outperformed the Russell 1000 benchmark by 210 basis points per annum since 1980. Perhaps more relevant, it had outperformed the Russell 1000 Growth index by 320 basis points per year over the same period. Outperformance in small-cap and international markets was even more impressive. A product with such returns could be enormously appealing to consumers and lucrative for AQR, given that its quantitative foundations made it profitable at scale. Yet, questions remained. Issues that seemed so simple when designing an index became astonishingly thorny when translated to the real world. And if managers made the wrong decisions, transaction costs could blunt momentum's edge, eliminating its appeal to investors. And if that was to be the case, better to not launch the product at all than to have a high-profile disappointment tarnish the firm he had founded. Cliff Asness faced some difficult choices.

[4] More details on the construction of each of these strategies, along with their historical returns, can be found at Kenneth French's data library http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.

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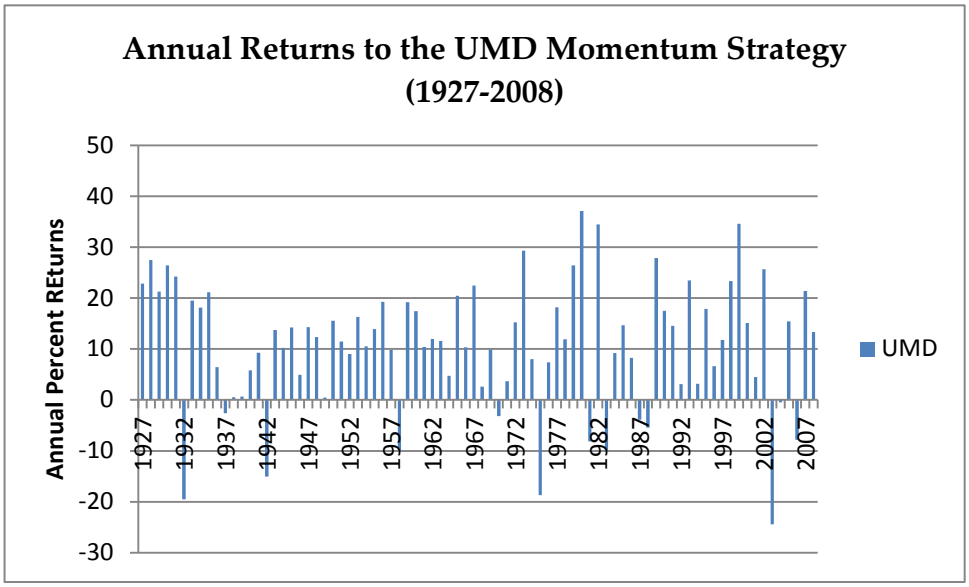
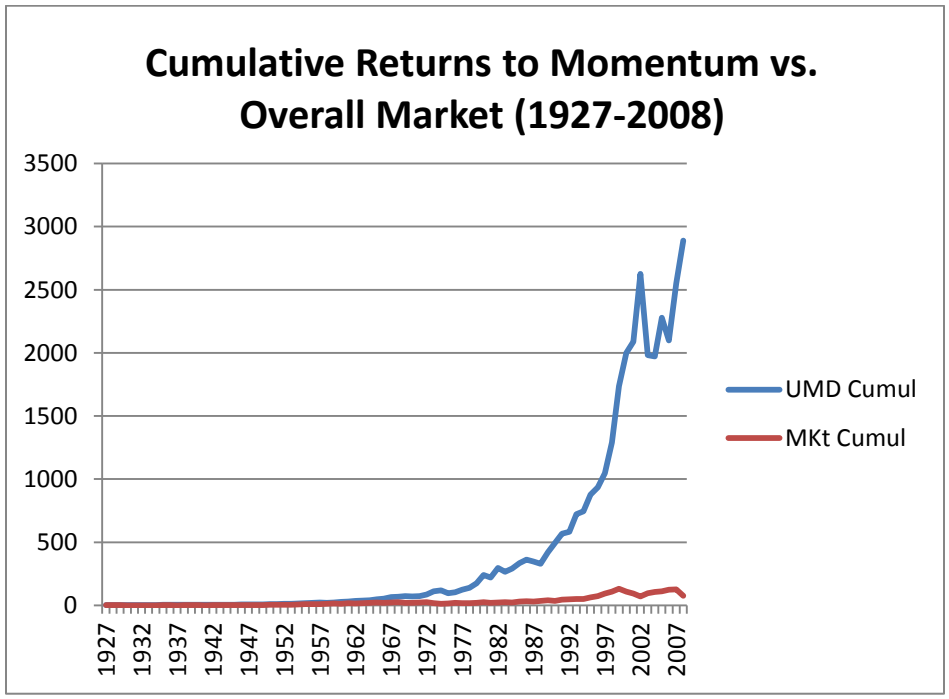
Exhibit 1 Past 80 years of Momentum Returns



Source: Adapted from Kenneth French's Online Data Library, http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.

Exhibit 2 Returns to One Dollar Invested in Momentum vs. Overall Value-Weight Market



Source: Adapted from Kenneth French's Online Data Library, http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.

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Exhibit 3 Summary Statistics on Momentum Returns and Component Returns (1927-2008)

	Short (Decile 1)	Long (Decile 10)	L/S (10-1)
Average annual return	2.42	20.42	17.99
S.D. of annual return	30.35	28.52	21.21
Maximum annual return	79.61	89.33	74.61
Maximum annual return (year)	2003	1928	1928
75th percentile return	22.16	36.10	30.52
50th percentile return	2.61	19.07	18.89
25th percentile return	-16.25	-1.57	10.43
Minimum annual return	-69.21	-46.34	-51.48
Minimum annual return (year)	2008	1937	1932
Average # of stocks in portfolio	476	376	844
Estimated 1-factor alpha (yearly)	-7.34	11.23	18.57
CAPM beta: RMRF	1.28	1.20	-0.08
Estimated alpha (yearly)	1.20	4.44	3.24
Multifactor factor loading: RMRF	1.14	1.16	0.02
Multifactor factor loading: HML	-0.09	-0.12	-0.03
Multifactor factor loading: SMB	0.48	0.23	-0.25
Multifactor factor loading: UMD	-0.80	0.64	1.43

Source: Adapted from Kenneth French's Online Data Library, http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.

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Exhibit 4 Annual Value-Weight Returns to Portfolios Formed on Past Returns (1927-2008)

Average Annual Value-Weight Returns to Portfolios Formed on Past Returns (t-12 to t-2)

Year	Low	2	3	4	5	6	7	8	9	High	High-Low
1927	18.48	9.07	17.17	26.26	32.73	25.11	35.40	27.19	39.44	67.43	48.95
1928	14.72	23.20	21.38	26.09	25.53	34.27	41.87	42.82	48.69	89.33	74.61
1929	-57.59	-47.84	-34.22	-21.34	-2.32	-13.33	5.95	1.32	0.25	-29.87	27.72
1930	-54.58	-48.38	-50.44	-49.55	-31.69	-31.66	-32.42	-19.73	-22.90	-20.87	33.71
1931	-64.51	-58.34	-60.56	-52.91	-53.87	-49.74	-49.39	-42.47	-34.78	-24.23	40.28
1932	25.69	-2.46	-12.21	-7.47	9.31	-1.33	-17.06	-14.37	-12.36	-25.79	-51.48
1933	64.45	67.30	53.29	94.86	48.35	68.61	55.22	83.80	82.27	52.31	-12.14
1934	-6.67	-2.42	-9.87	0.16	-11.03	3.73	8.62	-1.35	6.42	15.33	22.00
1935	24.05	84.96	30.90	37.39	44.59	35.53	46.87	48.38	55.08	75.00	50.95
1936	32.37	22.85	24.37	28.69	38.51	29.36	36.34	24.37	50.56	46.80	14.43
1937	-46.25	-30.35	-33.03	-37.85	-37.11	-35.54	-32.29	-28.54	-41.90	-46.34	-0.09
1938	30.89	27.17	30.16	27.67	24.98	28.73	50.18	25.96	16.95	24.61	-6.28
1939	-10.67	12.40	0.41	0.26	3.92	1.41	6.43	5.85	-2.36	-0.25	10.42
1940	-16.25	-11.04	-4.35	2.03	-6.16	-5.80	-7.87	-11.14	-9.91	-3.24	13.01
1941	-28.06	-14.71	-15.22	-6.62	-13.03	-12.03	-3.87	-3.31	-2.23	-7.34	20.72
1942	37.75	33.73	23.10	19.98	7.80	15.74	13.95	4.61	14.46	17.96	-19.79
1943	37.74	21.12	26.30	30.32	31.18	25.30	33.13	36.05	40.99	51.35	13.61
1944	21.85	20.54	18.65	26.08	18.30	25.55	26.58	35.49	36.47	33.50	11.65
1945	42.26	32.69	27.11	39.62	31.32	51.93	41.69	52.17	60.74	74.67	32.41
1946	-16.25	-13.18	-0.18	-7.80	4.00	-3.49	-0.55	-5.63	-9.42	-3.06	13.19
1947	-13.12	-7.46	0.07	2.98	4.91	5.98	13.74	7.98	-0.49	4.18	17.30
1948	-14.25	-0.88	-5.12	9.21	1.22	-0.78	-2.29	6.53	5.08	8.52	22.77
1949	30.51	22.00	22.85	19.10	19.61	14.98	23.04	22.33	15.82	27.04	-3.47
1950	17.08	27.21	19.56	30.14	32.78	27.73	26.37	38.86	43.53	34.97	17.89
1951	13.04	13.74	15.49	13.74	21.20	16.13	24.49	28.03	30.65	20.70	7.66
1952	3.13	9.01	8.42	6.06	11.10	17.59	14.13	18.88	12.66	18.39	15.26
1953	-19.72	-5.53	-5.89	-5.95	1.85	3.34	3.52	3.80	10.07	-0.65	19.07
1954	48.69	40.04	40.86	43.60	34.48	56.33	48.36	54.43	48.53	65.31	16.62
1955	14.52	15.24	15.84	18.28	25.02	22.73	38.93	23.79	30.86	39.07	24.55
1956	-6.44	-0.95	3.00	6.54	8.26	9.04	10.31	10.66	12.14	12.45	18.89
1957	-25.75	-21.47	-13.10	-10.35	-6.12	-10.63	-6.49	-9.00	-15.05	-1.88	23.87
1958	71.75	55.46	50.19	41.24	51.60	48.40	37.88	36.06	43.07	53.01	-18.74
1959	-1.98	-2.07	12.16	18.74	13.53	11.83	15.24	25.30	16.52	35.19	37.17
1960	-12.90	-10.22	-3.73	-10.07	1.67	-1.26	-2.47	1.49	13.36	17.67	30.57
1961	33.93	17.99	18.35	19.86	34.29	31.99	31.51	21.02	31.02	30.33	-3.60
1962	-20.06	-21.89	-20.30	-13.73	-9.51	-5.21	-12.49	-7.11	-4.87	-9.59	10.47
1963	6.73	15.69	16.15	24.70	14.05	18.04	19.33	16.98	28.01	28.93	22.20
1964	8.72	17.57	16.81	13.84	15.47	14.65	13.13	23.96	10.22	20.64	11.92
1965	22.26	10.37	9.53	13.53	9.39	6.76	8.64	23.71	25.36	51.56	29.30
1966	-14.33	-11.86	-12.75	-14.03	-8.26	-1.78	-6.98	-6.82	-0.99	5.40	19.73
1967	36.66	32.25	24.69	23.93	13.02	23.97	23.17	36.30	38.86	66.10	29.44
1968	20.10	19.89	11.75	3.97	24.89	8.60	1.86	11.83	23.05	33.62	13.52
1969	-35.72	-17.35	-9.57	-15.83	-14.63	-13.59	-10.29	-12.82	-10.67	-5.71	30.01
1970	-20.67	-2.38	11.98	9.31	11.60	4.39	2.82	3.58	-5.18	-8.41	12.26
1971	11.75	15.98	33.82	14.84	10.38	23.85	19.10	9.69	14.21	28.19	16.44
1972	-3.88	6.19	6.23	7.29	20.02	20.31	18.32	12.26	25.85	30.50	34.38
1973	-52.92	-48.51	-38.47	-31.43	-22.07	-18.93	-12.83	-17.63	-14.24	-2.72	50.20
1974	-39.23	-30.15	-26.39	-18.18	-28.87	-29.56	-26.98	-18.70	-21.69	-30.38	8.85

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1975	55.62	51.87	50.19	43.34	37.34	42.45	24.50	26.39	34.24	41.03	-14.59
1976	18.09	18.98	18.33	33.63	37.85	26.77	34.76	27.02	26.57	33.57	15.48
1977	-17.86	-11.49	-7.22	-2.66	-3.09	-0.20	1.06	8.12	9.44	15.51	33.37
1978	-0.17	6.65	7.53	6.91	-2.56	9.59	4.30	13.33	23.53	30.40	30.57
1979	17.10	14.89	17.37	12.29	16.40	22.52	19.20	37.40	41.14	57.69	40.59
1980	29.65	15.01	20.05	15.42	8.51	32.71	35.57	50.13	56.84	53.80	24.15
1981	-0.66	11.74	4.53	8.33	1.74	-7.90	-6.20	-11.14	-6.91	-13.98	-13.32
1982	-11.17	3.78	18.79	17.52	9.54	27.12	30.58	31.67	41.35	35.30	46.47
1983	34.37	37.37	23.46	24.75	20.63	13.55	22.53	14.22	18.40	16.37	-18.00
1984	-20.28	-1.06	6.92	3.47	9.83	9.87	6.71	3.84	2.74	-3.74	16.54
1985	10.64	26.56	31.48	39.53	31.34	40.50	31.26	33.70	31.61	36.30	25.66
1986	-1.54	10.74	22.69	16.15	18.66	13.24	18.09	20.06	20.47	18.77	20.31
1987	-8.36	14.90	11.36	2.43	-4.39	-3.15	-4.52	2.88	-2.26	10.52	18.88
1988	17.82	30.94	31.37	25.04	18.46	11.74	18.23	11.24	19.98	12.54	-5.28
1989	-9.26	7.70	14.02	22.96	28.96	25.30	31.83	36.59	42.80	40.93	50.19
1990	-41.67	-23.42	-15.47	-13.27	-8.84	-3.71	-1.45	-2.00	-0.64	-6.77	34.90
1991	26.09	46.53	45.46	27.14	29.61	31.28	31.55	38.61	35.01	60.20	34.11
1992	7.65	13.76	7.26	14.80	11.15	9.70	5.37	7.12	4.45	18.79	11.14
1993	1.00	3.73	-1.74	0.56	4.51	10.62	10.53	23.37	20.36	35.27	34.27
1994	-3.60	2.10	-0.33	-1.80	-2.41	2.75	0.94	-0.80	-3.14	-0.22	3.38
1995	17.82	23.65	33.41	38.38	31.39	36.11	38.55	37.86	38.65	35.48	17.66
1996	14.51	14.34	19.91	28.03	16.97	18.58	23.38	28.22	19.11	18.16	3.65
1997	5.08	26.13	39.34	27.53	25.76	32.74	33.71	39.28	23.85	32.94	27.86
1998	0.46	-0.49	19.58	15.37	10.68	14.59	23.81	27.35	28.25	54.69	54.23
1999	12.86	14.18	1.61	-3.22	5.31	1.51	1.01	19.91	13.27	62.11	49.25
2000	-47.53	6.35	-8.17	22.24	2.25	5.52	-10.95	1.39	-8.22	-21.85	25.68
2001	-17.03	-9.34	-15.39	-1.00	0.20	-13.52	-1.39	-3.64	-11.18	-7.93	9.10
2002	-37.28	-37.00	-24.06	-23.38	-18.03	-19.83	-4.03	-13.76	-5.85	-11.53	25.75
2003	79.61	64.57	42.41	43.58	22.79	24.92	18.87	20.95	31.86	41.88	-37.73
2004	23.03	6.86	12.27	17.23	7.02	10.55	13.39	9.83	17.39	8.88	-14.15
2005	2.08	4.53	-1.29	2.10	5.97	7.01	5.97	17.62	11.91	19.34	17.26
2006	22.42	19.48	21.57	14.99	21.31	12.07	12.76	12.08	12.12	3.92	-18.50
2007	-18.83	-8.78	-5.63	-2.81	2.72	6.91	7.70	19.92	9.25	24.79	43.62
2008	-69.21	-53.80	-44.61	-34.96	-29.89	-33.28	-26.78	-6.36	-39.68	-38.84	30.37
Average	2.42	7.51	7.95	10.22	10.05	11.17	12.47	14.75	15.60	20.42	17.99

Source: Adapted from Kenneth French's Online Data Library, http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.

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Exhibit 5 Correlation of Momentum Returns and Other Common Strategies (1927-2008)

Correlation Coefficients (1927-2008)				
	Mkt-RF	**SMB**	**HML**	**UMD**
Mkt-Rf	1.00	0.41	0.11	-0.03
SMB	0.41	1.00	0.08	-0.09
HML	0.11	0.08	1.00	-0.30
UMD	-0.03	-0.09	-0.30	1.00

Summary Stats (1927-2008)				
	Mkt-RF	**SMB**	**HML**	**UMD**
Mean	7.64	3.56	5.14	10.92
StdDev	21.01	14.37	14.04	12.34

Source: Adapted from Kenneth French's Online Data Library, http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.

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