Industry momentum in an earlier time: Evidence from the Cowles data

Andrew C. Szakmary[a*], Xiwen Zhou[a]

[a] *Department of Finance, Robins School of Business, University of Richmond, Richmond, VA 23173, USA*

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Abstract

Virtually all evidence on the efficacy of momentum strategies arises from the post-1962 era, and momentum returns across different markets and asset classes are highly positively correlated. We examine industry momentum in an earlier time, and find these strategies would have earned returns over the 1871-1925 and 1871-1938 periods that are moderately similar to those in the modern era. We also show that the market state dependence of industry momentum strategies is similar between the two eras. Overall, our findings confirm that both the profitability and state-dependence of momentum strategies are pervasive and unlikely to be due solely to data-mining.

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* Corresponding Author. Tel.: +1 804 289 8251; fax: +1 804 289 8878.
E-mail addresses: aszakmar@richmond.edu, xiwen.zhou@richmond.edu

I. Introduction and Literature Review

Beginning with Jegadeesh and Titman (1993), a voluminous literature has documented the profitability of intermediate-horizon momentum strategies, whereby securities that have experienced relatively high (low) returns over prior formation periods up to 12 months continue to earn relatively high (low) returns over subsequent holding periods of up to 12 months. In addition to individual U.S. stocks, the profitability of momentum strategies has been demonstrated for foreign stocks in all but a handful of countries (Rouwenhorst 1998, Griffin, Ji and Martin 2003, Chui, Titman and Wei 2010), and several studies beginning with Asness, Liew and Stevens (1997) and Chan, Hameed and Tong (2000) demonstrate the efficacy of momentum strategies implemented with country stock indices. Albeit sometimes with shorter formation and/or holding periods, classic momentum strategies sorting on past cross-sectional returns have also been found to be profitable in industry stock indices (Moskowitz and Grinblatt 1999 and numerous other studies discussed below), commodity futures (Shen, Szakmary and Sharma 2007, Miffre and Rallis 2007) and exchange rates (Harris and Yilmaz 2009, Serban 2010). Recently, Asness, Moskowitz and Pedersen (2013) confirm the profitability of both value and momentum strategies across many different markets and asset classes along with a strong common factor structure among their returns: both momentum and value strategy returns exhibit high positive correlation across markets/asset classes but negative correlation with each other.

Overall, it is clear from the literature that the profitability of momentum strategies is quite pervasive across many different countries, markets and asset classes, including equity indices grouped by industry. Given these extensive findings, it appears on the surface that yet another study of the momentum phenomenon is hardly necessary. It is noteworthy, however, that virtually all of the existing momentum evidence stems from post-1962 data (which we will hereafter refer to as the modern era), and that as Asness, Moskowitz and Pedersen (2013) show, returns resulting from momentum (and value) strategies implemented across countries and asset classes are more highly positively correlated than those resulting from passive investments in the same countries/asset classes. Thus, the simultaneous global existence of individual stock momentum, country index momentum, industry momentum, exchange rate momentum, commodity futures momentum, etc. in the modern era does not necessarily prove that data mining is not a factor underlying the profitability of momentum strategies. To completely rule out data mining, it would be helpful to determine if these strategies would have worked during a time period that has not previously been examined. Another issue is that while the existence of momentum is well-established, the causes are unclear. As Asness, Moskowitz and Pedersen (2013) show, while momentum strategies load positively on a global liquidity factor, exposure to this factor cannot explain the simultaneous profitability of value strategies that load negatively on the same factor. After two decades of research, we still do not conclusively know to what extent momentum ultimately results from behavioral biases, institutional constraints, and/or rational risk aversion. Examining whether momentum was present in a much earlier time period with very different technology, institutions and regulatory structures may shed further light on the causes of the momentum phenomenon.

The literature that is most closely related to our paper consists of those studies that have examined industry momentum. Moskowitz and Grinblatt (1999) form 20 value-weighted industry portfolios over the 1963-1995 period, and apply momentum strategies to these industry portfolios. Although they find profitability to be highest for one-month formation and holding periods with no gap between the two (which, for reasons explained below, we cannot replicate with the Cowles data), Moskowitz and Grinblatt do report significant profitability for 6-12 month formation and holding periods with a one-month gap between the formation and holding periods.

Among other significant findings, they report that unlike when the strategies are implemented at the level of individual stocks, the profitability of industry momentum strategies is primarily driven by long positions, and (more controversially) they claim that once individual stock returns are adjusted for industry effects, momentum profits from individual equities are weaker and generally statistically insignificant; however, this latter claim is not supported by Grundy and Martin (2001) and some other studies discussed below.

Other studies have since substantially refined and extended Moskowitz and Grinblatt's (1999) initial industry momentum findings. Swinkels (2002), using 40 Datastream industry indices over the 1973-2000 period, confirms that many skip-a-month industry momentum strategies with 6-12 month formation and holding periods are significantly profitable in the United States and even more so in Europe, but not in Japan (one of the few countries where individual stock momentum is also not significantly profitable). Giannikos and Ji (2007) examine industry momentum strategies in 37 countries over a similar time period; they exclusively use 6-month formation and holding periods with a one-month lag. While they do not report significant profitability for every country, they do find significant profits for every region when results are aggregated across the Americas (excluding the U.S.), Europe and Asia. Moreover, Giannikos and Ji show that all of this profitability is essentially accounted for by past winning industries outperforming the market rather than past losers underperforming, and that everywhere *other than in the U.S.* past winning industries earn significantly higher returns in January than in other months.[1] Finally, supporting Grundy and Martin (2001), Giannikos and Ji show that individual stock momentum and industry momentum are separate effects that do not

[1] Many of these findings are further confirmed in a subsequent paper, Ji and Giannikos (2010), which also documents reversals (albeit generally not statistically significant) in industry momentum profits beyond the 12-month horizon outside the U.S.

subsume each other. Finally, Gupta, Locke and Scrimgeour (2010) examine an industry momentum strategy based on nearness to the 52-week high (patterned after George and Hwang 2004 for individual stocks), and find that this specification does not perform as well as conventional industry momentum strategies wherein portfolios are formed based on past returns.[2]

The foregoing discussion highlights the importance of examining the momentum effect using pre-1926 U.S. data. To our knowledge only one other study, Geczy and Samonov (2013), attempts to do so, using a proprietary dataset of prices on individual stocks that the authors constructed for the 1800-1925 period. While their study makes an important contribution, their primary focus is on individual stock momentum, not industry momentum, and there are some issues with their data that suggest that an examination of the industry momentum effect using an alternative data source (with comparisons to similarly-constructed modern data) is warranted.[3]

Fortunately, a reasonably good alternative dataset covering the pre-1926 period that marks the beginning of the CRSP database and that permits an examination of industry momentum effects (albeit not individual stock momentum) exists. As discussed in much more detail in Wilson and Jones (1987), the Cowles Commission (1939) published an index of common stocks covering virtually the entire market capitalization of the New York Stock Exchange (NYSE) over the January 1871 – December 1938 period. The Cowles all-stock index,

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[2] Another variant of the 52-week high strategy based on how recently the 52-week high occurred, as developed by Bhootra and Hur (2013), has not yet been extended to industry momentum. Other studies that have examined industry momentum include Du and Demming (2005), which focuses primarily on the relation between industry momentum and the Fama and French risk factors, and Pan, Liao and Huang (2004), which decomposes momentum profits into those arising from autocorrelation of returns and cross-correlations across industries using weekly data. The main themes of these studies are less directly relevant for our work because we cannot replicate them over the 1871-1938 period covered by the Cowles data.

[3] Geczy and Samonov's (2013) stock return data is price-weighted and does not include dividends. Moreover, throughout much of their sample, their data are almost certainly time-averaged because newspaper quotations often used the average of high and low prices during the month. Unlike our study, which compares momentum effects in time-averaged pre-1926 data and similarly constructed time-averaged modern data, Geczy and Samonov do not explore if time-averaging in the pre-1926 data impacts their findings.

which is value-weighted and methodologically closely parallels the S&P 500 index in construction, is considered to be of high quality and has been utilized in numerous studies examining historical stock returns and equity premia in the United States. Less well known is that in the same volume, the Cowles Commission (1939) published stock price and total return indices for 68 industry groupings, meticulously detailing which stocks were included in each industry grouping and for which time periods. It is these industry indices, which are likely to be of similarly high quality but to our knowledge have not been previously used in academic research, that allow us to examine the industry momentum effect in the pre-1926 period.[4] While, as detailed in the data section below, the Cowles data does suffer from time-averaging due to the use of an average of monthly high and low prices in constructing the indices, this property does not preclude an examination of intermediate-horizon momentum effects if appropriate methodological precautions are taken.

It is important to emphasize that throughout the paper, our main focus is to determine if industry momentum effects are present in the Cowles data and to what extent these are similar to those in the modern era; we are less interested in assessing whether investors could reasonably have exploited an industry momentum strategy in this earlier time to earn trading profits. Although Lefevre (1923) provides anecdotal evidence that there were few impediments to the short sales that are necessary to implement classic momentum strategies, and that accomplished investors even back then learned it is best to hold on to winning stocks and sell past losers, we acknowledge that the likely lack of real-time information on industry returns (the Cowles indices

[4] The Cowles Commission (1939) report also contains earnings data grouped by industries. Using these and/or 3-5 year horizon reversals, it would be possible to examine an industry value effect as well. We do not do so, however, because numerous studies, e.g. Novy-Marx (2011), Chou, Ho and Ko (2012) show that in the modern era, value effects prevail only for individual stocks and not entire industries. In other words, unlike momentum which prevails more broadly, the value effect appears to be solely an *intra-industry* effect and cannot fruitfully be examined using only industry-level returns data.

weren't even published until near the end of the era we examine ended), the absence of technological tools such as computers or calculators, and the existence of relatively high bid-ask spreads renders it doubtful that even sophisticated investors would have been able to implement, and profit from, industry momentum strategies in the Cowles era. Nevertheless, we believe that an examination of industry momentum effects in the Cowles data is warranted, because it could provide important insights on the robustness and causes of the entire momentum phenomenon.

The balance of this paper is organized as follows. The data, including selection of industries to include in the study and issues associated with time-averaging, are discussed in section II. We present basic results for industry momentum strategies implemented with the Cowles data, and by comparison, those obtained when identical procedures are applied to modern, post-1962 data, in Section III. Section IV contains additional tests for monthly seasonality and momentum returns by market state. Robustness checks are discussed in Section V, and Section VI concludes the paper.

II. Data and Related Issues

To form our monthly industry return dataset covering the February 1871 to December 1938 period, we begin with the total return indices (Series C: Stock Prices Including Cash Dividends) published by the Cowles Commission (1939, pp. 167-268) for all stocks and for 68 industries. We eliminate 6 of the industries because they are too broad and the stocks included in them duplicate narrower classifications, at least some of which have equally long return histories (e.g. we exclude utilities because that classification includes 5 utility subgroups; we exclude tobacco and tobacco products because it duplicates 2 subgroups). We eliminate a further 7 industries because they are subgroups with relatively short return histories and we chose to include a broader group with a longer history (e.g. we include Coal, which has data from 1871:2-

1938:12, but not Coal-Anthracite and Coal-Bituminous, because the subgroups begin in 1918). Finally, we exclude 4 industries because they are defined as single firms or as all other firms in the industry excluding this one firm (e.g. we chose to include Autos and Trucks instead of the two subgroups Autos and Trucks – GM and Autos and Trucks – excluding GM). Summary statistics on the monthly total returns of the remaining 51 industries, with which we implement momentum strategies, are reported in Table 1. These returns are computed as simple arithmetic percent changes on the Series C total return indices reported by the Cowles Commission.[5] Table 1 also reports summary statistics for monthly returns on the Cowles all-stock index (as corrected by Wilson and Jones, 1987).

< INSERT TABLE 1 HERE>

Two significant issues arise from use of the Cowles industry data. The first, which is clear from Table 1, is that not all of the 51 industries have data for the entire 1871-1925 period that will be our main focus. In fact, only 6 industries go all the way back to 1871, and only 19 have any data prior to 1900. Given this paucity of data, to ensure adequate diversification, when implementing momentum strategies we will define past winner and loser industries more broadly than most studies using modern data, i.e. will define winners as those that rank in the top third (percentile rank ≥ 0.667) of all industries for which we have available data over a particular formation period, and losers as those that rank in the bottom third (percentile rank ≤ 0.333), thereby assuring that winner and loser portfolios contain a minimum of two industries at all

[5] To our knowledge, an electronic version of the industry indices did not exist. Consequently, we entered the Series C total return indices reported by the Cowles Commission (1939) by hand into Excel spreadsheets. We have checked and re-checked our files against the original documents and are confident that our spreadsheets accurately reproduce the data reported in the published volume, which is accessible online at http://cowles.econ.yale.edu/P/cm/m03-2/. For the August-November 1914 period when the NYSE was closed, we assumed the total return index for each industry remained at its July 1914 value; consequently, the return for each industry is zero in the months August-November 1914, and the change in wealth that occurs between July and December, 1914 is entirely reflected in the December 1914 return.

times.[6] Partly for this reason, we will also replicate our procedures over the modern era (1962-2012), and discuss how the Cowles era and modern era results compare. The modern data is from the Kenneth French Data Library at Dartmouth, and consists of returns on 49 industry portfolios (http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html).

A second, more significant issue in using the Cowles data arises from the fact that the indices were constructed using an average of monthly high and low prices for each stock, rather than end-of-month stock prices. It is by now well-known that this procedure induces time-averaging and first-order autocorrelation in the monthly returns; on this, see Working (1960), Cowles (1960) and Schwert (1990). However, Working (1960) shows time averaging does not induce autocorrelation beyond a one-month horizon, and therefore does not preclude testing for intermediate-horizon momentum effects with formation and holding periods 1-12 months in length, *provided* that one skips a month between the end of the formation period and the beginning of the holding period (which is fairly common in momentum studies anyway in order to avoid market microstructure effects). An alternative way of thinking about this issue, which leads to the same conclusion, is to conceptualize how a "time-averaging" investor could implement, say, a 6-month formation period 6-month holding period momentum strategy. By the end of, say, June 1890, the investor could observe the monthly averages of high and low prices on all stocks over the January-June 1890 formation period as reported in the Commercial and Financial Chronicle (the main source for the Cowles data); he/she could then gradually acquire stocks in a winning industry throughout July 1890, hold them for the remainder of the year, and sell them gradually during January 1891. This investor's return experience (excluding

[6] Presumably because coverage is more complete, modern industry momentum studies generally define winner and loser industries more narrowly. For example, Moskowitz and Grinblatt (1999) use 20 industries and define winners and losers as the top/bottom 3 (i.e. top/bottom 15%), and Giannikos and Ji (2007) use the top/bottom 20%. In our later robustness section, we explore how our results are affected if we define winners and losers as top/bottom 20% based on formation period returns.

transactions costs, of course) would be closely approximated by the percentage change in the published Cowles industry total return index from July 1890 to January 1891.

To provide a closer comparison with the Cowles era and its time-averaged data, we construct a time-averaged modern dataset of industry returns, evaluate the same skip-a-month momentum strategies with both the Cowles and modern data and investigate how the results compare across the two eras. In constructing the time-averaged modern data, following the methodology outlined in Schwert (1990), we proceeded as follows: first we downloaded the daily returns on 49 industries and the CRSP value-weighted index from the Kenneth French Data Library for the January 1, 1962 through December 31, 2012 period. From these we constructed daily unit value indices for each series and, finally, monthly unit value indices by taking the average of the maximum and minimum daily unit values for each series in each calendar month. We believe this procedure closely approximates, albeit does not exactly replicate, the methodology used to construct the Cowles indices.[7] When we compare the monthly time-averaged industry return series to those that are constructed from end-of-month unit values, we find (averaged across the 49 industries) that the time-averaged return series have a standard deviation that is approximately 17% lower, and a first-order autocorrelation coefficient that is 0.24 higher than return series constructed from end-of-month unit values. These results are quite close to those in a similar examination of the CRSP equal-weighted index over the 1962-1986 period conducted by Schwert (1990, Table 1), who found that standard deviation was about 19% lower, and the first order autocorrelation coefficient 0.27 higher in the time–averaged data.

[7] Some differences are that we compute unit values from daily industry closing index data whereas Cowles computes these values at the level of individual stocks (including intraday highs and lows) and then aggregates them across stocks in an industry, and that we follow this procedure consistently whereas, post 1918, Cowles computes his monthly unit values from averages of weekly closing price data provided by Standard and Poor's.

One last issue regarding the data is that throughout the study we report alphas, the calculation of which requires a proxy for the risk-free rate of return. Because U.S. Treasury Bills were not issued at all prior to 1920, and not on a regular basis prior to 1929, in both the Cowles and modern eras we instead use monthly rates on 3 month AA commercial paper (obtained from Global Financial Data) as our proxy for the risk-free rate. We recognize, as discussed in Siegel (1992) that these commercial paper rates contain small default risk premia and slightly overestimate the true risk-free rates, but because we use the same rates in both the Cowles and modern eras we do not believe it clouds comparisons between the two eras.

III. Basic Industry Momentum Tests and Results

To form momentum portfolios, each month we rank each industry for which data availability allows calculation of a return over some past k-month formation period relative to all industries for which we have data over the previous k months. We then define approximately the top 1/3 as past winners (in which we presume long positions are taken), and the bottom 1/3 as past losers (which are candidates for short positions if a self-financing strategy is used). No position is taken in the middle 1/3. The specific numbers of industries that are defined to be in the top, middle and bottom third vary depending on the total number of indices for which we have returns data over the previous k months. For example, if the total number is 10, based on the percentrank function in Excel being less than 0.333 or greater than 0.666, we assign 3-4-3 to the top, middle and bottom third, respectively. If the total is 11, we assign 4-3-4; if the total is 48 then we assign 16-16-16, etc. We examine k's of 1, 3, 6, 9 and 12 months; these formation periods closely parallel those used in modern industry momentum studies such as Moskowitz and Grinblatt (1999), Swinkels (2002) and/or Ji and Giannikos (2010).

Upon forming portfolios using the cross-sectional ranking rule described above, we measure returns over subsequent holding periods of 1, 3, 6, 9 and 12 months; again, these holding periods are fairly common in the industry momentum literature. As discussed previously, due to time-averaging in the data, we always skip one month between the end of the formation period and the beginning of the holding period. Following Jegadeesh and Titman (1993) and previous industry momentum studies, we create a single time series of monthly returns even if the holding period is greater than one month, thus eliminating the existence of overlapping observations and the statistical inference issues they entail. For example, assume the formation and holding periods are both 6 months. We form a portfolio at the end of each month, and assume it is held for 6 months; thus, effectively, the holding period return in month t will then be defined to equal the average of the returns, during month t, on the portfolios formed using past 6-month return ranks (with a one-month lag) in months t-1, t-2, t-3, t-4, t-5 and t-6. Given the relatively high transactions costs in stocks that likely existed during the Cowles era, the longer holding periods (say, 6-12 months) are likely to have been more practically relevant to traders actually attempting to implement these strategies, if this were at all feasible given other constraints that prevailed at the time.

Returns to industry momentum strategies as described above, implemented with the Cowles indices over the 1873:3 to 1925:12 period, are presented in Table 2. We begin in 1873:3 because the first month for which we can calculate one-month returns is 1871:2 and we consider formation and holding periods of up to 12 months each, with a one-month lag between them; thus the first month for which we can calculate a return for all of the momentum strategies is 1873:3. We end in 1925:12 because it is the last month before the CRSP returns begin.[8] Because

[8] Du and Demming (2005) and Novy-Marx (2012) have examined industry momentum in the post-1926 period. To our knowledge, these are the only industry momentum studies that have used pre-1962 data.

many previous industry momentum studies indicate that these strategies earn the majority of their profits on the long side, In Panel A of Table 2, following Jensen (1968), we report alphas constructed from strategies that only take long positions in past winning industries. The alphas are the constant terms arising from the following regression:

$$RL_{it} - R_{ft} = \alpha_i + \beta_i\left(R_{Mt} - R_{ft}\right) + e_{it} \qquad (1)$$

Where RL_{it} is the equally-weighted average return on industries in which momentum strategy i with the indicated formation and holding period takes a long position in month t, R_{ft} is the 3-month AA commercial paper rate in month t, and R_{Mt} is the return on the Cowles all-stock index in month t.[9] In Panel B, we report alphas arising from the more traditional self-financing momentum strategies that take equally-weighted long positions in past winning industries and equally-weighted short positions in past relative losers; procedurally, these alphas are calculated using the same approach as in Panel A except that the dependent variable in the regression is now ($RL_{it} - RS_{it}$), where RS_{it} is the equally-weighted average return on industries in which momentum strategy i with the indicated formation and holding period takes a short position in month t. To ensure that residual autocorrelation (due to time-averaging in the data) does not affect our statistical inferences, the t-statistics reported in Table 2, and subsequent tables, are calculated using Newey and West (1987) heteroskedasticity and autocorrelation-consistent standard errors.

< INSERT TABLE 2 HERE >

Although some of the alphas reported in Table 2 are low and not statistically significant, we believe the results, in their totality, support the notion that momentum strategies would have been profitable (at least before transactions costs) during the pre-1925 era. We note, first, that for

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[9] The SMB and HML factors are not available prior to 1926 so we are unable to calculate alphas arising from the Fama and French (1992) three-factor model.

every combination of formation period k and holding period h we examine, for both long-only and long-short momentum strategies, the alpha is positive. For the long-only strategy in Panel A the alpha is significant at the 5% level for k=6/h=9, k=9 and h=3, 6 or 9, and k=12/h=3. For the long-short strategies in Panel B, we find significant outperformance at the 1% level for k=6/h=9, and at the 5% level for k=3 and h=9 or 12, k=6 and h=3 or 12, k=9 and h=6, 9 or 12. The alphas of the best-performing long-short strategies in Panel B are around 0.4% per month; these are somewhat lower than the best skip-a-month winner-loser returns reported for the modern era by Moskowitz and Grinblatt (1999, Table 3) or Ji and Giannikos (2010, Table 1) for the U.S., but necessary methodological differences across these studies render direct comparisons somewhat problematic. Finally, we note that like industry momentum in the modern era, in most cases more than half of the profitability of this strategy comes from the long side, as indicated by a direct comparison of the alphas in Panels A and B holding k and h constant.

< INSERT TABLE 3 HERE >

We report alphas for industry momentum strategies implemented over the entire period of the Cowles data, i.e. through December 1938, in Table 3. This time period is significant because it includes the Great Depression; however, we do reiterate that part of this period (1926-1938) has previously been examined by Du and Demming (2005), albeit with different industry indices. Overall the alphas in Table 3, for comparable formation and holding periods, tend to be somewhat higher, and more statistically significant, than those in Table 2, indicating that the inclusion of the Depression and its aftermath in no way reduces evidence in favor of the profitability of industry momentum in the Cowles era. The best-performing combinations of k and h in Table 3 have alphas in the 0.22-0.29% range for long-only strategies (Panel A), and in the 0.41-0.45% range for long-short strategies (Panel B), and numerous alphas are significant at the 5% level or better. For every combination of k and h, the alpha from a long-only strategy is now more than half as large as the corresponding long-short alpha, indicating that long positions account for the majority of the outperformance. Because the pattern of results for the 1873-1925 and 1873-1938 periods is roughly similar, we will focus henceforth only on the former.

Further evidence regarding the alphas generated by momentum strategies with selected formation periods (i.e. k = 3, 6 and 12 months) is provided in Table 4, wherein we report alphas for individual post-formation months and for various aggregations of post formation months all the way out to 36 months after portfolio formation. Our motivation in Table 4 is to examine whether the intermediate-horizon outperformance of momentum strategies as documented in Table 2 reverses if portfolios are held beyond a 12-month horizon, and to see if there is a Novy-Marx (2012) effect in industry momentum during the pre-1926 Cowles era, whereby profitability of these strategies is greatest 7-12 months after portfolio formation rather than immediately after formation.[10] Again, as previously, we report alphas and associated t-statistics for long positions only in Panel A, and long-short alphas in Panel B. Because we now extend the analysis to 36 months post-formation, the data range for which we report results begins in 1875:3.

< INSERT TABLE 4 HERE >

Purely for the purpose of illustrating the dangers of ignoring time-averaging in the Cowles data, we report alphas for the first post-formation month in Table 4. While these are all very large and significant at the 1% level, they are meaningless because they could not have been captured by an investor. However, as argued earlier, an investor employing time-averaged trading during a month could have effectively captured the gross returns to the industry momentum strategies that accrued after the first post-formation month, and many of these alphas

[10] Among other forms of momentum, Novy-Marx (2012, Table 8) specifically examines industry momentum in the 1926-2010 period and finds that these strategies generate higher returns 7-12 months after portfolio formation than 2-6 months after formation.

are still large and highly significant. For the long-only strategies, post-formation months 9 and 10 are highly significantly positive when k=3. For k=6, post-formation months 6-10 are all significantly positive at 5% or better, while for k=12 the alphas tend to be largest and most significant in post-formation months 2-5, and 9. For the long-short strategies (Panel B), when k=3, alphas are once again highest at 9 and 10 months post-formation; for k=6, alphas are largest and most significant in post-formation months 5-11, and for k=12 alphas peak at 4-6 and 8-10 months post-formation.

Overall, an interesting pattern emerges in Table 4: the shorter the formation period k, the further in the future (after portfolio formation) the outperformance peaks. This pattern is best demonstrated by a comparison of average monthly returns 2-6 versus 7-12 months after portfolio formation, as in Novy-Marx (2012). For k=3, in both Panels A and B alpha is much higher (and only significant) 7-12 months after formation. For k=6, alpha is somewhat higher and more significant in post-formation months 7-12 than 2-6. For the longer k=12 formation period, alphas are larger for post-formation months 2-6, albeit they are still sizable and significant in months 7-12. These results are largely supportive of Novy-Marx's (2012) findings for the post-1925 period.[11] Overall there appears to be a cycle for industry momentum that encompasses both the formation and holding periods, and when k is larger the strategies do not perform well as far out into the future. Another finding that is evident from the results reported in Table 4 is that there is no evidence of continued profitability, or of reversals, for any of the momentum strategies beyond 12 months post-formation. The alphas for post formation months 13-24, and 25-36, are

[11] The Novy-Marx (2012) findings are controversial. Yao (2012) claims that once seasonality in momentum returns is taken into account, short-horizon strategies (formed based on returns 2-6 months prior) perform just as well outside of January as intermediate-horizon strategies (formed based on returns 7-12 months prior). However, Yao does not examine industry momentum, and our later finding that there is no significant January effect in industry momentum returns in the Cowles era virtually ensures that seasonality does not explain the generally superior performance of intermediate-horizon strategies implied by the results reported in Table 4.

generally positive but none are even close to being statistically significant. For the modern era, this issue of potential longer-term reversals in momentum profits has been examined by Ji and Giannikos (2010), who similarly report no significant reversals in industry momentum profits in the U.S. (and most other countries) beyond a 12-month horizon.

To provide as close to a direct comparison of industry momentum effects in the Cowles and modern eras as possible, we replicate our procedures using time-averaged monthly returns to 49 industry portfolios in the modern era in Table 5. The alphas and associated t-statistics are calculated in exactly the same way in Table 5 as in Table 2, except that in the modern era R_{Mt} is defined as the (time-averaged) return on the CRSP value-weighted index in month t. In an attempt to parallel the majority of studies that have examined industry momentum, we use data beginning January 1962; thus, given the maximum 12-month formation and holding periods and the one month gap between them, the results in Table 5 cover the 1964:3 to 2012:12 period.

< INSERT TABLE 5 HERE >

Comparing the alphas arising from the long-only strategies in Panel A of Tables 2 and 5, it appears that strategies with equivalent k and h tend to be more profitable in the modern era, but not by a large margin. For example, a commonly examined k=6/h=6 strategy has an alpha of 0.1905% in Table 2, Panel A and 0.2471% in Table 5, Panel A. While sometimes the differences in alphas between the two eras are larger and sometimes smaller, the difference observed for k=6/h=6 is a typical result. It is noteworthy, however, that the difference in the t-statistics (and their significance) between the two eras tends to be larger; for example, for k=12/h=9 the long-only alphas in the two eras are almost identical, but the t-statistic in the Cowles era is 1.7317 (significant at 10%) and in the modern era it is 2.4171 (significant at 5%). We observe similar results for the long-short strategies in Panel B of Tables 2 and 5. Once again, alphas for corresponding formation/holding periods tend to be higher in the modern era, albeit not by a large margin, while the t-statistics tend to be markedly larger and more significant in Table 5.

While it appears from a comparison of Tables 2 and 5 that industry momentum effects are weaker in the Cowles era, it is entirely possible that the differences in results are being driven by less overall data availability during the earlier period, not by inherent differences in the profitability of the strategies over the two eras. As is clear from Table 1, most of the Cowles industry indices do not begin in 1871; many, in fact, begin well after 1900. In contrast, in the modern era, 43 of the 49 indices have data for the entire 1962-2012 period. Put another way, of the 48 Cowles indices that have any data at all between 1871 and 1925, the average number of available months for each index is approximately 294. For the modern era, the average number of available months across the 49 indices is 608. This is a large difference and could possibly account for the smaller, less significant alphas observed in the Cowles era.

To help determine if poor data availability for many industries in the 1871-1925 period relative to 1962-2012 is influencing our comparisons, we create a modern dataset with induced gaps in the data that closely mimic those in the Cowles data, and then estimate industry momentum effects using the altered data. To do so, we first sort the modern 49 industries by data availability, from most to least, and then by the order they are listed in the Kenneth French Data Library (As Table 1 attests, the Cowles indices, as published, are already sorted by data availability). We then compare the first 48 industries over the 1962-2012 period with the 48 industries in the Cowles database (i.e. all those that have any pre-1926 data), over an equivalent length 1875-1925 period, and if an observation is missing for a given Cowles industry in a given month, we assign a missing value in the corresponding month to the corresponding modern industry. For example, if Cowles industry number 20 has data only from 1900:2 to 1925:12, then we will use data from the modern era for industry number 20 only from 1987:2 to 2012:12. As in the case of the full modern industry dataset, we use time-averaged returns in the altered dataset to more closely match return computation in the Cowles era.

< INSERT TABLE 6 HERE >

Alphas and t-statistics for industry momentum strategies with various formation and holding periods, implemented with the altered modern dataset with induced gaps as described above, are reported in Table 6. Comparing these results first with the unaltered modern results in Table 5, it appears that the effects of inducing gaps in the data on the alphas are mixed. Many of the long-only strategies (in Panel A of both tables) actually exhibit higher alphas in Table 6, particularly for shorter formation periods. In the case of long-short strategies (Panel B), the alphas are generally lower in Table 6, particularly for formation periods of 6 months or more. As might be expected, the abridgement of the data creating less diversification and more “noise” in the portfolios, the t-statistics are generally lower in Table 6 by a noticeable amount, but there is still overwhelming evidence that industry momentum strategies have significantly positive alphas using virtually every combination of k and h, for both long-only and long-short strategies.

When comparing the abridged modern results in Table 6 to the Cowles era results in Table 2, the findings depend on the specific formation and holding periods being compared, and also on whether we are comparing long-only or long-short strategies. For the long-only strategies, the alphas are larger, and more significant, in the modern era for the vast majority of combinations of k and h. For the long-short strategies, the results seem to depend on the length of the formation and holding periods: When k and h are both 6 months or greater in length, the alphas in Table 6 seem very comparable to those in Table 2, albeit they are still more significant in the modern era. However, when either k or h is less than 6 months, the alphas tend to be appreciably higher in the modern era. The best (ex-post) strategy in the Cowles era (k=6/h=9) has a monthly alpha of 0.4147%, while the best strategy in the modern era (k=12/h=1) has an alpha of 0.5832%. Thus, overall, it is fair to conclude that even when we construct a modern industry dataset that mimics the Cowles dataset as closely as is possible, we still find somewhat stronger industry momentum effects in the modern era.[12]

IV. Seasonality and Market States

Several studies have examined the monthly seasonality, i.e. the January effect, in industry momentum returns for the modern era, and results have been mixed. Du and Demming (2005) report lower returns in January than in other months for industry momentum strategies in the U.S., over both the 1927-1963 and 1963-2003 periods. Giannikos and Ji (2007) and Ji and Giannikos (2010), on the other hand, claim that market-adjusted industry momentum returns in the U.S. are slightly higher in January than in other months, and that outside the U.S. January returns are substantially higher than during the rest of the year in the modern era. None of these studies conduct formal statistical tests regarding whether the mean January return differs from the mean return for other months, making reported findings even harder to interpret.

We examine the January effect in industry momentum returns, during both the Cowles and modern eras, in Table 7 via the following regression model:

$$ER_{it} = \beta_1 JAN_t + \beta_2 NONJAN_t + \beta_3 ERM_t + e_t \quad , \qquad (2)$$

Where ER_{it} is the excess return on momentum strategy i in month t, JAN_t and $NONJAN_t$ are 0/1 dummy variables for the month of the year, and ERM_t is the excess return on the market index (the Cowles all-stock index or the CRSP value-weighted index) in month t. In both the Cowles

[12] There is another distinction between the 1871-1925 and 1962-2012 eras that we cannot control for that may also influence our results: because the U.S. economy and stock market are considerably more developed in the modern era, the breadth of coverage of each industry index (in terms of the number of included stocks) is obviously greater in the modern era. Thus, modern industry portfolios are likely to be more diversified with respect to idiosyncratic risk, and this could partially account for the higher t-statistics observed in the modern era.

and modern eras the returns are time-averaged, and the regression standard errors use the Newey and West (1987) correction. In the above model, the estimated alphas are β_1 and β_2 for the January and non-January returns, respectively, and we report a Wald chi-square test statistic for the hypothesis that $\beta_1 = \beta_2$. We do not report the remaining coefficients to conserve space.

< INSERT TABLE 7 HERE >

In Panel A of Table 7, we report means for the market index returns in January and non-January months, estimated using model (2) with only the first two terms. We find a strong January effect in the market indices, with mean January returns being significantly higher than non-January returns in both eras.[13] In Panel B, we report results for long-only industry momentum strategies. For the Cowles era, there is no evidence whatsoever of any significant difference between January and non-January alphas, although January alphas are lower for eight of the nine combinations of k and h. For the modern era, long positions consistently have higher alphas in January, but the differences vs. non-January months are significant only for k=3,h=6 and k=3,h=12. In Panel C, for the long-short momentum strategies, the results for the Cowles era once again indicate no significant evidence of seasonality and no consistent pattern in the results. For the modern era, we find that January alphas are consistently lower than those prevailing in other months, and the differences are significant for eight of the nine combinations of k and h examined; these results correspond more closely with those reported by Du and Demming (2005) and appear to contradict Giannikos and Ji (2007) and Ji and Giannikos (2010). Thus, overall, there appears to be some evidence of seasonal patterns in modern industry momentum returns, but this evidence does not carry over to the earlier Cowles era.

[13] For the Cowles era, our finding that the mean January market return is significantly higher than in other months is consistent with Jones, Pearce and Wilson (1987).

Asem and Tian (2010) find that momentum profits are state dependent: profits are positive when markets continue in the same state, but are negative when markets transition to a different state. Strivers and Sun (2013) confirm this finding using different formation and holding periods and alternative definitions of market states, and show that these findings hold for industry momentum as well. We next examine the market state dependence of momentum profits in the Cowles era and in the modern era using similar time-averaged data. Closely following Asem and Tian (2010), we classify each month t as belonging to one of four market states: UP-UP if the past 12-month return on the market index (either the Cowles All-Stock index or the CRSP value-weighted index) is nonnegative and the month t market index return is also nonnegative; UP-DOWN if the past 12 month market return is nonnegative and the month t market return is negative; DOWN-UP if the past 12 month market return is negative and the month t market return is nonnegative; and DOWN-DOWN if both the past 12 month and month t market returns are negative. Given these definitions, UP-UP and DOWN-DOWN represent continuations of previous market states, while UP-DOWN and DOWN-UP represent reversals. We then estimate the following regression model for various formation and holding periods:

$$ER_t = \beta_1 UPUP_t + \beta_2 UPDOWN_t + \beta_3 DOWNUP_t + \beta_4 DOWNDOWN_t + \beta_5 ERM_t + e_t \qquad (3)$$

where ER_t is the momentum strategy excess return in month t, $UPUP_t$, $UPDOWN_t$, $DOWNUP_t$ and $DOWNDOWN_t$ reflect the market states as described above, and ERM_t is the excess return on the market index. In both the Cowles and modern eras the returns are time-averaged, and the regression standard errors use the Newey and West (1987) correction. In the above model, the estimated alphas in the different market states are $\beta_1 – \beta_4$, and we report a Wald chi-square test statistic for the hypothesis that $\beta_1 = \beta_2 = \beta_3 = \beta_4$. We do not report the remaining coefficients to conserve space.

< INSERT TABLE 8 HERE >

In Panel A, we report results for long-only industry momentum strategies, and in Panel B for long-short self-financing strategies. Even though we use time-averaged data, in the modern era, confirming earlier studies, we find very strong evidence that the profitability of momentum strategies is confined to market states that represent continuations from previous states (UP-UP, DOWN-DOWN), and does not extend to states that represent reversals from previous states (UP-DOWN, DOWN-UP). In these latter transition states long-short momentum profits are consistently negative, whereas in continuation states long-short momentum profits are consistently positive regardless of formation and holding period; the Wald tests uniformly reject the hypothesis that the alphas are equal across states at the 1% level. For the modern era, we observe similar (albeit slightly less strong) results for the long-only strategies in Panel A, indicating that not all of the differences in performance across states is attributable to the short positions. Our most interesting finding is that the market state-dependence of long-short momentum profits appears to be as strong in the Cowles era as in the modern era: once again, alphas in continuation states are uniformly positive and alphas in transition states uniformly negative, and the Wald tests reject the equality of alphas across states, regardless of formation and holding period, at the 1% level. Although the state-dependence results for the long-only momentum portfolios during the Cowles era are not as strong, they still show, for most combinations of formation and holding period, that momentum returns are higher in continuation states. Overall, the market state-dependence results confirm and extend recent empirical findings, and show that these are unlikely to be a product of data-mining.

V. Robustness Tests

We conducted two robustness tests. The results are not reported in order to conserve space. For the 1873:3-1925:12 Cowles period, we evaluated alphas from industry momentum strategies that take long positions only in the top 20% of industries based on past performance, and short positions in the bottom 20% (instead of the top 1/3 and bottom 1/3 as in Table 2, Panel B). With these more exclusionary criteria, the alphas on the best-performing long-short strategies are slightly higher than in Table 2 but this result is not uniform; for some combinations of k and h alphas are actually lower. Moreover, t-statistics tend to be lower (albeit still significant for many combinations of k and h), almost certainly because the more stringent selection criterion leads to less diversified portfolios. Thus, while the basic character of the results does not change if we define winners/losers as top/bottom 20%, the inferences are noticeably weaker.

Given that we also have more conventional returns data for the modern era based on end-of-month stock prices, we re-estimated the alphas and t-statistics reported in Table 5 using end-of-month returns, but holding every other aspect of our methodology (e.g. top/bottom 1/3, skip a month between k and h, Newey-West standard errors) constant. For most combinations of k and h, these results were very similar to what is reported in Table 5: though sometimes larger and sometimes smaller, the alphas were of similar magnitude, and t-statistics remained large, positive and significant for virtually all combinations of k and h.[14] We thus confirm that, as expected, time-averaging in the data does not affect our findings provided we skip a month between the formation and holding periods.

[14] For the most part, our findings were also consistent with Swinkels (2002) and Giannikos and Ji (2010), who examined industry momentum returns in the U.S., using similar formation and holding periods, over 1974-2000 and 1970-2006, respectively.

VI. Conclusion

A voluminous literature has demonstrated that intermediate-horizon momentum strategies appear to be highly profitable when applied to a wide variety of markets and asset classes. One particular subset of these studies has examined industry momentum, and concluded that these strategies also work quite effectively although they probably do not fully explain the profitability of momentum strategies implemented with individual stocks. However, most previous evidence on the efficacy of momentum strategies in general, and industry momentum strategies in particular, arises from the modern (post-1962) era. Moreover, as a recent study by Asness, Moskowitz and Pedersen (2013) shows, returns resulting from momentum (and value) strategies implemented across countries and asset classes are more highly positively correlated than those resulting from passive investments in the same countries/asset classes. Thus, the simultaneous existence of momentum profits in many different markets does not completely rule out data-mining as an explanation of the momentum anomaly, because all of these findings arise from examining the same historical time period.

In this paper, we examine the profitability (before transactions costs) of industry momentum strategies in an earlier time period covered by the Cowles Commission (1939) total return indices, and compare these to the gross profitability that could be obtained in the modern era using similarly-constructed time-averaged data and identical methodological procedures. We find that for formation and holding periods of six months or more, industry momentum strategies would have earned alphas over the 1871-1925 and 1871-1938 periods that are moderately similar, albeit slightly lower and less statistically significant, than those obtained in the modern era. Also, like in the modern era, more than half of the profitability of industry momentum accrues to long positions. We show that recent findings by Novy-Marx (2012) indicating that the profitability of momentum strategies is greatest 7-12 months after portfolio formation largely extend to the 1871-1925 period. Finally, we show that the market state-dependence of momentum strategies first documented by Asem and Tian (2010), whereby momentum profits are positive when the overall stock market continues in the same direction but negative when the market reverses direction, is strongly present in the pre-1926 data. Overall, our findings provide additional evidence that the profitability of industry momentum strategies, and the market state-dependence of these strategies, is pervasive and unlikely to be due solely to data-mining.

The remaining question is what the existence of industry momentum in pre-1926 data tells us about the causes of the momentum phenomenon in general. Given the very different nature of technology, regulations and institutions between the Cowles and modern eras, combined with presumably greater similarity in investor behavior over time, we conjecture that our results are consistent with the notion that momentum arises primarily from behavioral biases such as negative feedback trading patterns implied by prospect theory (see Yao and Li, 2013, for a discussion and theoretical model of these effects). As argued by Asem and Tian (2010), the market state-dependence of momentum strategies that they discovered, and that is clearly present in the pre-1926 period as well, is also consistent with behavioral explanations of momentum as proposed by Daniel, Hirshleifer and Subramanyam (1998). However, we do not have risk factor data for the pre-1926 period and cannot rule out the possibility that momentum profits are a by-product of exposure to risk factors beyond covariance with a market index during this period.

References

Asem, E., Tian, G.Y., 2010. Market dynamics and momentum profits. Journal of Financial and Quantitative Analysis 45 (Dec), 1549-1562.

Asness, C.S., Liew, J.M., Stevens, R.L. 1997. Parallels between the cross-sectional predictability of stock and country returns. Journal of Portfolio Management 23, 79-87.

Asness, C.S., Moskowitz, T.J., Pedersen, L.H., 2013. Value and momentum everywhere. Journal of Finance 68, 929-985.

Bhootra, A., Hur, J. 2013. The timing of 52-week high price and momentum. Journal of Banking and Finance 37, 3773-3782.

Chan, K., Hameed A., Tong W., 2000. Profitability of momentum strategies in the international equity markets. Journal of Financial and Quantitative Analysis 35, 153-172.

Chou, PH., Ho, PH., Ko, KC., 2012. Do Industries matter in explaining stock returns and asset-pricing anomalies? Journal of Banking and Finance 36, 355-370.

Chui, A.C.W., Titman S., Wei, K.C.J. 2010. Individualism and momentum around the world. Journal of Finance 65, 361-392.

Cowles, A. and Associates, Cowles Commission for Research in Economics, 1939. Common Stock Indexes, 2nd ed. Bloomington, IN: Principia Press.

Cowles, A., 1960. A revision of previous conclusions regarding stock price behavior. Econometrica 28, 909-915.

Daniel, K., Hirshleifer, D., Subramanyam, A., 1998. Investor psychology and security market under and overreactions. Journal of Finance 53, 1839-1886.

Du, D., Denning, K., 2005. Industry momentum and common factors. Finance Research Letters 2, 107-124.

Fama, E.F., French, K.R., 1992. The cross-section of expected stock returns. Journal of Finance 47, 427-465.

Geczy, C.C., Samonov, M., 2013. 212 years of price momentum. Working Paper.

George, T.J., Hwang, C.Y., 2004. The 52-week high and momentum investing. Journal of Finance 59, 2145-2176.

Giannikos, C., Ji, X., 2007. Industry momentum at the end of the 20th century. International Journal of Business and Economics 6, 29-46.

Griffin, J.M., Ji, X., Martin, J.S. 2003. Momentum investing and business cycle risk: Evidence from pole to pole. Journal of Finance 58, 2515-2547.

Grundy, B.D., Martin, J.S., 2001. Understanding the nature of the risks and the source of the rewards to momentum investing. Review of Financial Studies 14, 29-78.

Gupta, K., Locke, S., Scrimgeour, F., 2010. International comparison of returns from conventional, industrial and 52-week high momentum Strategies. Journal of International Financial Markets, Institutions & Money 20, 423-435.

Harris, R.D.F., Yilmaz, F., 2009. A momentum trading strategy based on the low frequency component of the exchange rate. Journal of Banking and Finance 33, 1575-1585.

Jegadeesh, N.,Titman, S., 1993. Returns to buying winners and selling losers: implications for stock market efficiency. Journal of Finance 48, 65–91.

Jensen, C.M., 1968. The performance of mutual funds in the period 1945-1964. Journal of Finance 23, 389–415

Ji, S., Giannikos, C.I., 2010. The profitability, seasonality and source of industry momentum. Applied Financial Economics 20, 1337-1349.

Jones, C.P., Pearce, D.K., Wilson, J.W., 1987. Can tax-loss selling explain the January effect? A note. The Journal of Finance 42, 453-461.

Lefevre, E., 1923. Reminiscences of a Stock Operator. New York: G.H. Doran

Miffre, J., Rallis, G., 2007. Momentum strategies in commodity futures markets. Journal of Banking and Finance 31, 1863-1886.

Moskowitz, T.J., Grinblatt, M., 1999. Do industries explain momentum?. The Journal of Finance 54, 1249-1290.

Newey, W.K., West, K.D., 1987. A simple positive definite, heteroscedasticity and autocorrelation consistent covariance matrix. Econometrica 55, 703-708.

Novy-Marx, R., 2011. Operating leverage. Review of Finance 15, 103-134.

Novy-Marx, R., 2012. Is momentum really momentum? Journal of Financial Economics 103, 429-453.

Pan, MS., Liano, K., Huang, GC., 2004. Industry momentum strategies and autocorrelations in stock returns. Journal of Empirical Finance 11, 185-202.

Rouwenhorst, K.G., 1998. International momentum strategies. Journal of Finance 53, 267-284.

Schwert, G.W., 1990. Indexes of U.S. stock prices from 1802 to 1987. Journal of Business 63, 399-426.

Serban, A.F., 2010. Combining mean reversion and momentum trading strategies in foreign exchange markets. Journal of Banking and Finance 34, 2720-2727.

Shen, Q., Szakmary A.C., Sharma, S.C., 2007. An examination of momentum strategies in commodity futures markets. Journal of Futures Markets 27, 227-256.

Siegel, J.J. 1992. The real rate of interest from 1800–1990: a study of the U.S. and the U.K. Journal of Monetary Economics 29, 227-252.

Strivers, C., Sun, L., 2013. Market cycles and the performance of relative strength strategies. Financial Management 42 (Summer), 263-290.

Swinkels, L., 2002. International industry momentum. Journal of Asset Management 3, 124-141.

Wilson, J.W., Jones, C.P., 1987. A comparison of annual common stock returns: 1871-1925 with 1926-1985. Journal of Business 60, 239-258.

Working, H. 1960. Note on the correlation of first differences of averages in a random chain. Econometrica 28, 916-918.

Yao, J., Li, D. 2013. Prospect theory and trading patterns. Journal of Banking and Finance 37, 2793-2805.

Yao, Y. 2012. Momentum, contrarian, and the January seasonality. Journal of Banking and Finance 36, 2757-2769.

Table 1
Summary Statistics of Cowles Industry Returns

Industry	*Description*	*Range of Available Data*	*Mean Monthly Return (%)*	*Standard Deviation of Returns (%)*	*Minimum Return (%)*	*Maximum Return (%)*
1	Railroads	1871:2 - 1938:12	0.5040	5.6908	-28.2243	83.8392
2	Coal	1871:2 - 1938:12	0.5063	8.8943	-28.9057	63.9002
3	Miscellaneous Services	1871:2 - 1937:6	0.9610	5.3342	-29.2760	52.4261
4	Shipping and Shipbuilding	1871:2 - 1938:12	0.4126	9.6166	-29.6834	56.8548
5	Mining and Smelting-Miscellaneous	1871:2 - 1938:12	0.9159	10.2248	-31.3642	112.7746
6	Utilities-Telephone and Telegraph	1871:2 - 1938:12	0.7730	4.3004	-21.9412	42.0782
7	Railroad Equipment	1878:1 - 1938:12	1.0093	6.6108	-25.6538	57.3533
8	Utilities-Electric, Gas, Etc.-Operating Companies	1886:11 - 1938:12	0.6764	5.2439	-28.0693	43.0113
9	Steel and Iron	1887:2 - 1938:12	0.8968	9.7053	-37.8137	72.8879
10	Miscellaneous Manufacturing	1888:2 - 1938:5	0.6573	6.5424	-29.7592	46.3351
11	Sugar Producing and Refining	1889:3 - 1938:12	0.7279	6.7221	-23.7891	39.1579
12	Electrical Equipment	1890:3 - 1938:12	1.0121	7.3806	-34.3583	70.7124
13	Utilities-Electric, Gas, Etc.-Holding Companies	1890:9 - 1938:12	0.6976	9.5887	-43.7363	68.3477
14	Household Products and Supplies	1891:11 - 1938:12	0.8063	11.1307	-52.3316	52.7950
15	Automobiles Tires and Rubber Goods	1892:12 - 1938:12	0.7759	11.7769	-37.5902	75.6661
16	Leather	1895:1 - 1938:12	0.7128	13.8053	-47.3070	94.7977
17	Utilities-Traction, Motor Transportation Etc.	1896:3 - 1938:12	0.1579	6.6985	-41.6107	30.8880
18	Food Products-other than Meats	1898:6 - 1938:12	0.9365	5.3536	-19.6346	35.8917
19	Paper and Paper Products	1898:9 - 1938:12	0.6815	11.8710	-29.9719	91.3514
20	Copper and Brass	1900:2 - 1938:12	1.0026	9.2864	-29.0092	80.2924
21	Machinery and Machine Equipment	1900:7 - 1938:12	0.9881	10.0984	-30.9724	71.3542
22	Wool and Woolen Goods	1901:2 - 1938:12	0.8875	12.5099	-40.8571	88.8235
23	Fertilizer	1901:3 - 1938:12	0.5232	12.6956	-48.8372	122.8571
24	Tobacco-Cigar Manufacturers	1901:4 - 1938:12	1.3650	6.7919	-21.0038	50.5000
25	Chemicals	1901:6 - 1938:12	1.3310	7.1692	-29.7439	49.2576
26	Lead and Zinc	1904:12 - 1938:12	0.8490	12.0278	-51.6216	55.0562
27	Agricultural Machinery	1909:2 - 1938:12	1.2745	9.4025	-27.4556	109.6565
28	Retail Trade-Department Stores	1909:11 - 1938:12	1.1600	9.0292	-30.0619	70.5970
29	Retal Trade-Mail Order Houses	1910:4 - 1938:12	1.2909	9.4071	-34.1445	83.3699
30	Oil Producing and Refining	1910:10 - 1938:12	0.7439	6.4221	-19.4154	31.7583
31	Office and Business Equipment	1911:4 - 1938:12	1.2407	7.7380	-40.0443	52.3880
32	Tobacco-Cigarette Manufacturers	1912:2 - 1938:12	0.9519	5.1813	-15.0932	32.2610
33	Automobiles and Trucks	1912:2 - 1938:12	1.9862	10.8900	-33.6025	71.9219
34	Retail Trade—5¢ TO $1 Chains	1912:7 - 1938:12	1.3647	6.1306	-21.6716	39.5473
35	Apparel	1913:12 - 1938:12	0.5468	7.7689	-18.2660	46.9062
36	Shoes	1915:9 - 1938:12	1.3157	6.4076	-28.9210	34.9642
37	Retail Trade-Tobacco Chains	1915:11 - 1938:12	1.1800	22.3866	-39.0374	233.3333
38	Building Equipment and Supplies	1916:10 - 1938:12	1.0904	9.0408	-25.1087	63.7097
39	Automobile Parts and Accessories	1916:10 - 1938:12	1.3719	11.6556	-35.2185	70.9227
40	Drugs, Medicines and Cosmetics	1916:12 - 1938:12	0.8900	6.2810	-23.3813	41.0014
41	Meat Packing	1917:2 - 1938:12	0.0297	10.2674	-45.1923	61.7021
42	Theatres and Motion Pictures	1919:6 - 1938:12	0.4646	12.9528	-40.6360	112.9870
43	Silk and Silk Goods	1920:4 - 1938:12	-0.1527	12.7872	-36.9863	72.2222
44	Cotton and Cotton Goods	1921:2 - 1938:12	-0.2425	10.8378	-30.7210	66.4234
45	Airplane	1921:7 - 1938:12	2.6185	14.1533	-44.9120	60.9556
46	Retail Trade-Restaurant Chains	1923:1 - 1938:12	0.2066	9.1029	-27.0756	39.1304
47	Radio, Phonograph, and Musical Instruments	1924:11 - 1938:12	1.3929	17.0081	-54.1325	94.7699
48	Retail Trade-Grocery and Meat Chains	1924:12 - 1938:12	0.2949	7.8260	-30.0809	31.1111
49	Advertising	1926:2 - 1938:12	-0.4063	10.5533	-29.6530	57.4359
50	Rayon	1926:2 - 1938:12	0.6057	16.5548	-22.0949	137.2414
51	Retail Trade-Drug Chains	1933:2 - 1938:12	1.6477	8.4706	-12.9389	27.3237
	Cowles All-Stock Index	1871:2-1938:12	0.6381	4.5606	-24.9271	48.3395
	3-month AA Commercial Paper Rate	1871:2 - 1938:12	0.3621	0.2161	0.0525	4.1667

Table 2
Returns to Industry Momentum Strategies, 1873:3 - 1925:12

	Holding Period:				
	1 month	3 months	6 months	9 months	12 months
	Panel A: Long Positions Only				
1 month formation period					
alpha	0.1425	0.1073	0.0362	0.0567	0.0728
t-statistic	(0.9997)	(0.9412)	(0.3551)	(0.5948)	(0.7551)
3 month formation period					
alpha	0.1930	0.1308	0.0727	0.1595	0.1322
t-statistic	(1.4038)	(1.0712)	(0.7099)	(1.6442)	(1.3833)
6 month formation period					
alpha	0.1881	0.1074	0.1905	0.2071	0.1741
t-statistic	(1.3962)	(0.8884)	(1.7655)*	(1.9979)**	(1.6786)*
9 month formation period					
alpha	0.1651	0.2518	0.2452	0.2290	0.2040
t-statistic	(1.3511)	(2.1896)**	(2.2344)**	(2.1233)**	(1.8760)*
12 month formation period					
alpha	0.2084	0.2570	0.2121	0.2008	0.1716
t-statistic	(1.7423)*	(2.2258)**	(1.8577)*	(1.7317)*	(1.4958)
	Panel B: Long-Short Self-Financing				
1 month formation period					
alpha	0.1146	0.1290	0.0631	0.1076	0.1341
t-statistic	(0.5521)	(0.8684)	(0.5450)	(1.2140)	(1.7195)*
3 month formation period					
alpha	0.2990	0.2127	0.1152	0.2822	0.2378
t-statistic	(1.2281)	(1.0386)	(0.7726)	(2.3440)**	(2.1480)**
6 month formation period					
alpha	0.3207	0.2423	0.3820	0.4147	0.3513
t-statistic	(1.3212)	(1.1319)	(2.2009)**	(2.6548)***	(2.4083)**
9 month formation period					
alpha	0.2006	0.3916	0.3985	0.3908	0.3497
t-statistic	(0.8363)	(1.7935)*	(2.1029)**	(2.2108)**	(2.0215)**
12 month formation period					
alpha	0.3082	0.3495	0.3417	0.3679	0.3046
t-statistic	(1.3019)	(1.5528)	(1.7239)*	(1.8868)*	(1.5876)

Notes: All trading strategies skip one month between the formation and holding periods in order to eliminate bias associated with time-averaging in the Cowles data. The alphas are the constant terms from a regression of momentum strategy excess returns on the Cowles all-stock index excess returns. The t-statistics are computed using Newey and West (1987) standard errors. The reported Sharpe ratios are in annual terms.
*, ** and ***, respectively, denote significance at the 10%, 5% and 1% levels.

Table 3
Returns to Industry Momentum Strategies, 1873:3 - 1938:12

	Holding Period:				
	1 month	3 months	6 months	9 months	12 months
	Panel A: Long Positions Only				
1 month formation period					
alpha	0.1779	0.1315	0.0675	0.0840	0.0936
t-statistic	(1.4425)	(1.2904)	(0.7477)	(0.9756)	(1.0708)
3 month formation period					
alpha	0.2250	0.1477	0.1046	0.1808	0.1466
t-statistic	(1.8310)*	(1.3428)	(1.1357)	(2.0067)**	(1.6489)*
6 month formation period					
alpha	0.2054	0.1435	0.2209	0.2249	0.1787
t-statistic	(1.6972)*	(1.3380)	(2.2208)**	(2.2908)**	(1.8481)*
9 month formation period					
alpha	0.2125	0.2942	0.2747	0.2389	0.1916
t-statistic	(1.9105)*	(2.7297)***	(2.6146)**	(2.3153)**	(1.8780)*
12 month formation period					
alpha	0.2530	0.2708	0.2183	0.1852	0.1331
t-statistic	(2.2668)**	(2.4907)**	(2.0447)**	(1.7159)*	(1.2566)
	Panel B: Long-Short Self-Financing				
1 month formation period					
alpha	0.2153	0.1715	0.1015	0.1348	0.1573
t-statistic	(1.2060)	(1.2809)	(0.9582)	(1.6703)*	(2.1849)**
3 month formation period					
alpha	0.3694	0.2447	0.1562	0.3071	0.2517
t-statistic	(1.7307)*	(1.3232)	(1.1518)	(2.8028)***	(2.4665)**
6 month formation period					
alpha	0.3363	0.2738	0.4114	0.4241	0.3331
t-statistic	(1.5470)	(1.4510)	(2.6903)***	(3.0323)***	(2.5492)**
9 month formation period					
alpha	0.2906	0.4531	0.4332	0.3854	0.3012
t-statistic	(1.3996)	(2.3793)**	(2.5653)**	(2.4272)**	(1.9523)*
12 month formation period					
alpha	0.3785	0.3566	0.3240	0.3087	0.2135
t-statistic	(1.8212)*	(1.7956)*	(1.8313)*	(1.7795)*	(1.2568)

Notes: All trading strategies skip one month between the formation and holding periods in order to eliminate bias associated with time-averaging in the Cowles data. The alphas are the constant terms from a regression of momentum strategy excess returns on the Cowles all-stock index excess returns. The t-statistics are computed using Newey and West (1987) standard errors. The reported Sharpe ratios are in annual terms. *, ** and ***, respectively, denote significance at the 10%, 5% and 1% levels.

Table 4

Returns to Momentum Strategies, by Post-Formation Month, 1875:3 - 1925:12

post-formation	3 mo. formation period		6 mo. formation period		12 mo. formation period	
months	alpha	t-statistic	alpha	t-statistic	alpha	t-statistic
Panel A: long positions only						
1	0.7736	5.2433 ***	0.4501	3.1534 ***	0.4978	4.0683 ***
2	0.1969	1.3792	0.1732	1.2617	0.2499	2.0729 **
3	0.1657	1.1649	0.0700	0.5203	0.3096	2.4771 **
4	0.0656	0.4490	0.0701	0.5459	0.3674	2.9355 ***
5	0.0750	0.5392	0.2466	1.8635 *	0.2566	2.0378 **
6	0.0578	0.4465	0.3271	2.6526 ***	0.2494	1.8898 *
7	0.0271	0.2145	0.4230	2.9984 ***	0.2028	1.3205
8	0.2414	1.6290	0.2963	2.0821 **	0.2536	1.8670 *
9	0.4555	2.9556 ***	0.2787	2.1330 **	0.2800	1.9959 **
10	0.4370	2.7218 ***	0.4195	2.7743 ***	0.2219	1.6068 *
11	0.1838	1.2696	0.2802	1.8367 *	0.0917	0.7046
12	0.0693	0.4814	0.1069	0.7302	0.1786	1.1830
2-6	0.1122	1.0250	0.1774	1.6392	0.2866	2.5516 **
7-12	0.2357	2.0663 **	0.3008	2.5019 **	0.2047	1.6480 *
13-24	0.0315	0.2604	0.0471	0.3655	0.1112	0.8347
25-36	0.0881	0.7400	0.1052	0.8323	0.0092	0.0684
Panel B: long - short self-financing						
1	1.3158	5.3685 ***	0.9218	3.9985 ***	0.8779	4.0514 ***
2	0.2662	1.0642	0.2544	1.0392	0.3375	1.4160
3	0.1971	0.8186	0.2280	0.9040	0.3432	1.3722
4	0.1164	0.5078	0.1410	0.6497	0.5047	2.2223 **
5	0.0209	0.0976	0.4211	2.0387 **	0.5016	2.2374 **
6	0.0329	0.1673	0.6535	3.1033 ***	0.4343	2.0645 **
7	0.0595	0.3195	0.7503	3.2981 ***	0.3612	1.5905
8	0.4007	1.9120 *	0.5624	2.3685 **	0.5154	2.3759 **
9	0.9456	3.8692 ***	0.6169	2.9414 ***	0.5710	2.4062 **
10	0.7330	3.0728 ***	0.7076	3.0282 ***	0.4594	1.9670 **
11	0.2893	1.2240	0.4709	2.0005 **	0.1804	0.7929
12	0.1716	0.8438	0.2473	1.2005	0.2513	1.0792
2-6	0.1228	0.7105	0.3570	1.9913 **	0.4035	1.9337 *
7-12	0.4333	2.9517 **	0.5592	3.1623 ***	0.3898	1.9439 *
13-24	-0.0541	-0.3598	0.0285	0.1592	0.0549	0.2626
25-36	0.0495	0.3630	0.1573	0.9365	0.0720	0.3680

Notes: Returns in the first post-formation month are distorted due to time-averaging in the Cowles data. The alphas are the constant terms from a regression of momentum strategy excess returns on the Cowles all stock index excess returns. The reported alphas, even for multiple month aggregations, are in mean monthly terms in %. The t-statistics are based on Newey and West (1987) standard errors. *, ** and ***, respectively, denote significance at the 10%, 5% and 1% levels.

Table 5
Returns to Industry Momentum Strategies, 1964:3 - 2012:12, Implemented with Time-Averaged Returns

	Holding Period:				
	1 month	3 months	6 months	9 months	12 months
	Panel A: Long Positions Only				
1 month formation period					
alpha	0.1533	0.1511	0.1278	0.1386	0.1536
t-statistic	(1.6803)*	(1.8095)*	(1.5412)	(1.7993)*	(2.0939)**
3 month formation period					
alpha	0.1555	0.1392	0.1617	0.2039	0.1895
t-statistic	(1.6417)	(1.4309)	(1.8133)*	(2.5060)**	(2.4928)**
6 month formation period					
alpha	0.2292	0.2205	0.2471	0.2502	0.2134
t-statistic	(2.2165)**	(2.2304)**	(2.7195)***	(2.9755)***	(2.6788)***
9 month formation period					
alpha	0.2987	0.2799	0.2662	0.2367	0.1855
t-statistic	(3.1163)***	(2.9785)***	(3.0122)***	(2.8418)***	(2.3392)**
12 month formation period					
alpha	0.3535	0.2797	0.2404	0.2030	0.1526
t-statistic	(3.7869)***	(3.0232)***	(2.7304)***	(2.4171)**	(1.9175)*
	Panel B: Long-Short Self-Financing				
1 month formation period					
alpha	0.1956	0.2030	0.1684	0.1882	0.2178
t-statistic	(1.7495)*	(2.5378)**	(2.6286)***	(3.3780)***	(4.2301)***
3 month formation period					
alpha	0.2325	0.2276	0.2601	0.3235	0.2963
t-statistic	(2.0120)**	(2.1482)**	(3.0436)***	(4.1703)***	(4.2433)***
6 month formation period					
alpha	0.4119	0.3906	0.4368	0.4437	0.3598
t-statistic	(3.2926)***	(3.3079)***	(3.8949)***	(4.1626)***	(3.6311)***
9 month formation period					
alpha	0.5222	0.4957	0.4764	0.4048	0.2995
t-statistic	(3.9863)***	(3.7291)***	(3.7011)***	(3.3086)***	(2.6630)***
12 month formation period					
alpha	0.6145	0.4925	0.4207	0.3299	0.2301
t-statistic	(4.3268)***	(3.5507)***	(3.1506)***	(2.6031)***	(1.9762)**

Notes: All trading strategies skip one month between the formation and holding periods in order to eliminate effects associated with induced time-averaging in the data. The alphas are the constant terms from a regression of momentum strategy excess returns on the CRSP value-weighted index excess returns. The t-statistics are computed using Newey and West (1987) standard errors. The reported Sharpe ratios are in annual terms.
*, ** and ***, respectively, denote significance at the 10%, 5% and 1% levels.

Table 6
Returns to Industry Momentum Strategies, 1964:3 - 2012:12, Implemented with Time-Averaged Returns and Induced Gaps

	Holding Period:				
	1 month	3 months	6 months	9 months	12 months
	Panel A: Long Positions Only				
1 month formation period					
alpha	0.2549	0.1703	0.2088	0.1908	0.2131
t-statistic	(2.3525)**	(1.7395)*	(2.2004)**	(2.1712)**	(2.5048)**
3 month formation period					
alpha	0.1879	0.2276	0.2282	0.2465	0.2325
t-statistic	(1.5815)	(1.9429)*	(2.2015)**	(2.5736)**	(2.5139)**
6 month formation period					
alpha	0.2697	0.2418	0.2932	0.2835	0.2379
t-statistic	(2.2697)**	(2.1001)**	(2.8038)***	(2.8493)***	(2.4534)**
9 month formation period					
alpha	0.2842	0.3038	0.3118	0.2551	0.1864
t-statistic	(2.5071)**	(2.7168)***	(2.9086)***	(2.4709)**	(1.9185)*
12 month formation period					
alpha	0.3655	0.2842	0.2327	0.1920	0.1323
t-statistic	(3.2226)***	(2.5237)**	(2.1726)**	(1.8844)*	(1.3384)
	Panel B: Long-Short Self-Financing				
1 month formation period					
alpha	0.2568	0.1750	0.1956	0.1600	0.2191
t-statistic	(2.0296)**	(1.8869)*	(2.7340)***	(2.5541)**	(3.6287)***
3 month formation period					
alpha	0.2553	0.2971	0.2832	0.3054	0.2846
t-statistic	(1.8551)*	(2.4314)**	(2.9355)***	(3.2962)***	(3.3935)***
6 month formation period					
alpha	0.3394	0.2866	0.3512	0.3626	0.2824
t-statistic	(2.5322)**	(2.2760)**	(2.8865)***	(3.0462)***	(2.5000)***
9 month formation period					
alpha	0.3717	0.3955	0.4211	0.3424	0.2217
t-statistic	(2.4854)**	(2.7160)***	(2.9654)***	(2.4736)**	(1.7554)*
12 month formation period					
alpha	0.5832	0.4589	0.3359	0.2394	0.1274
t-statistic	(3.8275)***	(3.1656)***	(2.3571)**	(1.7111)*	(0.9721)

Notes: All trading strategies skip one month between the formation and holding periods in order to eliminate effects associated with induced time-averaging in the data. The alphas are the constant terms from a regression of momentum strategy excess returns on the CRSP value-weighted index excess returns. The t-statistics are computed using Newey and West (1987) standard errors. The above results are for a modern dataset with induced gaps in some of the industry indices to mimic those found in the Cowles data over the 1875-1925 period. *, ** and ***, respectively, denote significance at the 10%, 5% and 1% levels.

Table 7
Returns in January vs. Other Months

Panel A: Market Returns

	Cowles Era, 1873:3 - 1925:12 (Cowles All-Stock Index)	Modern Era, 1964:3 - 2012:12 (CRSP Value-Weighted Index)
mean return, January	1.5418	1.4600
mean return, other months	0.1156	0.2548
Chi-Square	12.7257***	6.2428**

Panel B: Long Positions Only

	Cowles Era, 1873:3 - 1925:12 Holding Period:			Modern Era, 1964:3 - 2012:12 Holding Period:		
	3 months	6 months	12 months	3 months	6 months	12 months
3 month formation period						
alpha, January	-0.0107	-0.0114	-0.1190	0.4583	0.4708	0.4920
alpha, other months	0.1431	0.0800	0.1539	0.1117	0.1350	0.1633
Chi-Square	0.1494	0.0811	0.7984	2.2498	2.8507*	3.3531*
6 month formation period						
alpha, January	0.1342	0.0122	-0.0198	0.4043	0.4724	0.4290
alpha, other months	0.1051	0.2060	0.1909	0.2046	0.2276	0.1947
Chi-Square	0.0078	0.3243	0.4551	0.7603	1.2772	1.3256
12 month formation period						
alpha, January	0.2422	0.1350	0.1313	0.4209	0.4034	0.2705
alpha, other months	0.2583	0.2187	0.1751	0.2675	0.2263	0.1423
Chi-Square	0.0013	0.0508	0.0173	0.3650	0.5345	0.3217

Panel C: Long-Short Self-Financing

	Cowles Era, 1873:3 - 1925:12 Holding Period:			Modern Era, 1964:3 - 2012:12 Holding Period:		
	3 months	6 months	12 months	3 months	6 months	12 months
3 month formation period						
alpha, January	0.5133	0.4405	0.2016	-0.2201	-0.1967	-0.1094
alpha, other months	0.1866	0.0870	0.2410	0.2663	0.2997	0.3314
Chi-Square	0.2758	0.4615	0.0092	2.0625	2.9257*	3.9282**
6 month formation period						
alpha, January	0.5856	0.3442	0.2229	-0.3049	-0.1169	-0.2568
alpha, other months	0.2126	0.3853	0.3625	0.4508	0.4848	0.4132
Chi-Square	0.3303	0.0042	0.0750	4.1747**	3.3056*	5.6471**
12 month formation period						
alpha, January	0.3752	0.2331	0.4642	-0.3231	-0.3956	-0.6290
alpha, other months	0.3473	0.3511	0.2907	0.5631	0.4914	0.3045
Chi-Square	0.0013	0.0317	0.0865	4.9095**	5.6673**	7.4843***

Notes: all strategies skip one month between the formation and holding periods. All reported alphas are in monthly terms in %, and are calculated as the coefficients β_1 and β_2 from the model $ER_{it} = \beta_1 JAN_t + \beta_2 NONJAN_t + \beta_3 ERM_t + e_t$, where ER_t is the momentum strategy excess return in month t, JAN_t= 1 if January and 0 otherwise, $NONJAN_t$ = 0 if January and 1 otherwise, and ERM_t is the excess return on the market index (the Cowles all-stock index from 1873:3-1925:12, and the CRSP value-weighted index from 1964:3-2012:12) in month t. The regression standard errors (not reported) are adjusted using the Newey and West (1987) correction, and the reported chi-square test statistics take these corrections into account. The modern era returns are time-averaged in order to more closely match the methodology used to construct the Cowles returns. *, ** and ***, respectively, represent significance at the 10%, 5% and 1% levels.

Table 8
Momentum Returns by Market State

Panel A: Long Positions Only

	Cowles Era, 1873:3 - 1925:12			Modern Era, 1964:3 - 2012:12		
	Holding Period:			Holding Period:		
	3 months	6 months	12 months	3 months	6 months	12 months
3 month formation period						
alpha, up-up	0.2850	0.1031	0.1132	0.3692	0.3796	0.3473
alpha, up-down	-0.0158	-0.0661	-0.0114	-0.3974	-0.3091	-0.2761
alpha, down-up	-0.2683	-0.1465	0.1259	0.0085	-0.0472	0.1902
alpha, down-down	0.4504	0.4700	0.4201	0.5437	0.5501	1.0411
Chi-Square, all alphas equal	5.5874	4.6792	1.8854	15.4760***	14.7087***	13.6712***
6 month formation period						
alpha, up-up	0.1628	0.2580	0.1911	0.4891	0.4870	0.3974
alpha, up-down	-0.1452	-0.0861	-0.0387	-0.3354	-0.3271	-0.3241
alpha, down-up	-0.3409	-0.1728	0.0822	-0.2412	-0.0963	0.0991
alpha, down-down	0.8842	0.8867	0.5862	0.8624	0.9236	0.7944
Chi-Square, all alphas equal	12.8847***	12.2579***	3.3306	23.2800***	22.7527***	18.9367***
12 month formation period						
alpha, up-up	0.7129	0.4890	0.3125	0.5710	0.5018	0.3661
alpha, up-down	-0.2935	-0.2131	-0.0693	-0.4356	-0.3885	-0.3443
alpha, down-up	-0.1254	0.0657	0.2244	-0.0720	-0.0634	0.0153
alpha, down-down	0.5276	0.4328	0.1863	1.0724	0.9097	0.5420
Chi-Square, all alphas equal	11.2331**	4.4289	1.0376	29.0404***	22.9270***	14.2173***

Panel B: Long-Short Self-Financing

	Cowles Era, 1873:3 - 1925:12			Modern Era, 1964:3 - 2012:12		
	Holding Period:			Holding Period:		
	3 months	6 months	12 months	3 months	6 months	12 months
3 month formation period						
alpha, up-up	0.9881	0.6849	0.7474	0.6487	0.6494	0.5842
alpha, up-down	-0.4613	-0.4445	-0.3113	-0.5351	-0.3521	-0.3091
alpha, down-up	-1.1710	-1.0102	-0.6216	-0.8503	-0.9918	-0.5587
alpha, down-down	1.0370	0.9459	0.9008	1.3626	1.3706	1.3906
Chi-Square, all alphas equal	20.4101***	22.5680***	28.1775***	35.8982***	57.6811***	65.1809***
6 month formation period						
alpha, up-up	0.8870	0.9877	0.8563	0.9197	0.9017	0.7073
alpha, up-down	-0.3761	-0.1654	-0.1449	-0.4478	-0.3963	-0.3953
alpha, down-up	-1.5226	-1.2488	-0.7802	-1.2990	-1.0646	-0.6919
alpha, down-down	1.6919	1.6585	1.2335	1.9017	2.0036	1.7577
Chi-Square, all alphas equal	26.8959***	27.5958***	24.5377***	60.7465***	67.8831***	53.3110***
12 month formation period						
alpha, up-up	1.4624	1.1488	0.8798	1.0398	0.8934	0.6326
alpha, up-down	-0.7960	-0.4902	-0.1697	-0.5469	-0.4924	-0.4747
alpha, down-up	-1.0795	-0.8179	-0.6167	-1.1474	-1.0294	-0.8469
alpha, down-down	1.2215	1.1100	0.7591	2.3337	2.0821	1.3099
Chi-Square, all alphas equal	28.7311***	21.7592***	12.2847***	56.2744***	47.2623***	28.1356***

Notes: all strategies skip one month between the formation and holding periods. All reported alphas are in monthly terms in %, and are calculated as the coefficients β_1 - β_4 from the model $ER_t = \beta_1 UPUP_t + \beta_2 UPDOWN_t + \beta_3 DOWNUP_t + \beta_4 DOWNDOWN_t + \beta_5 ERM_t + e_t$, where ER_t is the momentum strategy excess return in month t, $UPUP_t$, $UPDOWN_t$, $DOWNUP_t$ and $DOWNDOWN_t$ reflect market states based on cumulative market returns over the previous 12 months versus the current month t, and ERM_t is the excess return on the market index (the Cowles all-stock index from 1873:3-1925:12, and the CRSP value-weighted index from 1964:3-2012:12) in month t. The regression standard errors (not reported) are adjusted using the Newey and West (1987) correction, and the reported chi-square test statistics take these corrections into account. The modern era returns are time-averaged in order to more closely match the methodology used to construct the Cowles returns. *, ** and ***, respectively, represent significance at the 10%, 5% and 1% levels.